DISIS-2016-002

Definitive Interconnection System Impact Study Report

Published August 20, 2018

By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION	COMMENTS
04/19/2018	SPP	Initial report issued.	Results for Cluster Groups 1, 2, 4, 10, 12, and 14.
5/22/2018	SPP	Report re-issued.	Results for Cluster Group 8. LOIS amounts updated for Cluster Group 4. One-line diagram for ASGI-2016-010 updated.
6/4/2018	SPP	Report re-issued.	1. Corrected total cluster upgrade costs in Sec. 5 and 10. 2. Changes affecting Group 8 a. Corrected the Contingency ID for VIOLA 7 345.00 - WICHITA 345KV CKT 1 in Table 8-8. b. Added 3 missing constraints in Table 8-9 for SILOAM CITY - SILOAM SPRINGS, SILOAM CITY – SILOAM SPRINGS TAP, and SILOAM SPRINGS TAP TRANSFORMER, updated costs in Appendix E and F, and constraints in Appendix G-T. c. Updated total cost for GRDA-GREC Tap in Appendix E and F.
6/17/2018	SPP	Report re-issued	Draft results for Cluster Group 6
7/16/2018	SPP	Report re-issued	Results for Cluster Groups 6, 7, 13, and 17. Model development description updated.
8/10/2018	SPP	Report re-issued	Preliminary results for Cluster Groups 9, 15, and 16. Identification of Group 8 and 13 requests requiring an Affected System Impact Study from AECI.

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION	COMMENTS
8/20/2018	SPP	Report re-issued	Results for Cluster Groups 9, 15, and 16. Cost allocation for Groups 8,13, and GEN-2016-177

CONTENTS

1 INTRODUCTION

Pursuant to the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT), SPP has conducted this Definitive Interconnection System Impact Study (DISIS) for generation interconnection requests received during the DISIS Queue Cluster Window which closed on November 30, 2016. The customers will be referred to in this study as the DISIS Interconnection Customers. This DISIS analyzes the impact of interconnecting new generation totaling 15,938.10 MW to the SPP Transmission System. The interconnecting SPP Transmission Owners include:

- American Electric Power West (AEPW)
- Basin Electric Power Cooperative (BPEC)
- Grand River Dam Authority (GRDA)
- Kansas City Power and Light\KCP&L Greater Missouri Operations (KCPL)
- Midwest Energy (MIDW)
- Nebraska Public Power District (NPPD)
- Oklahoma Gas and Electric (OKGE)
- Omaha Public Power District (OPPD)
- Southwestern Public Service (SPS)
- Southwestern Power Administration (SWPA)*
- Western Area Power Administration (WAPA)
- Westar Energy, Inc. (WERE)
- Western Farmers Electric Cooperative (WFEC)

*SWPA is a SPP Contract Participant

The generation interconnection requests included in this System Impact Study are listed in 11.1 by queue number, amount, requested interconnection service type, area, requested interconnection point, proposed interconnection point, and the requested in-service date[1].

The primary objective of this DISIS is to identify the system constraints, transient instabilities, and over-dutied equipment associated with connecting the generation to the area transmission system. The Impact Study and other subsequent Interconnection Studies are designed to identify required Transmission Owner Interconnection Facilities, Network Upgrades and other Direct Assignment Facilities needed to inject power into the grid at each specific point of interconnection.

[1] The generation interconnection requests in-service dates may need to be deferred based on the required lead time for the Network Upgrades necessary. The Interconnection Customers that proceed to the Facility Study will be provided a new in-service date based on the completion of the Facility Study or as otherwise provided for in the GIP.

2 MODEL DEVELOPMENT (STUDY ASSUMPTIONS)

2.1 INTERCONNECTION REQUESTS INCLUDED IN THE CLUSTER

This DISIS includes all interconnection requests that were submitted during the DISIS Queue Cluster Window that met all of the requirements of the Generator Interconnection Procedures (GIP) that were in effect at the time this study commenced. Appendix A lists the interconnection requests that are included in this study.

2.2 AFFECTED SYSTEM INTERCONNECTION REQUEST

Affected System Interconnection Requests included in this study are listed in Appendix A with the "ASGI" prefix. Affected System Interconnection Requests were only studied in "cluster" scenarios.

2.3 PREVIOUSLY QUEUED INTERCONNECTION REQUESTS

The previous-queued requests included in this study are listed in Appendix B. In addition to the Base Case Upgrades, the previous-queued requests and associated upgrades were assumed to be in-service and added to the Base Case models. These requests were dispatched as Energy Resource Interconnection Service (ERIS) resources with equal distribution across the SPP footprint. Prior-queued requests that requested Network Resource Interconnection Service (NRIS) were also dispatched in separate NRIS scenarios sinking into the area of the interconnecting transmission owner.

2.4 DEVELOPMENT OF BASE CASES

POWER FLOW

The power flow models used for this study are based on the 2016-series Integrated Transmission Planning models used for the 2017 ITP-Near Term analysis. These models include:

- Year 1 2017 winter peak (17WP)
- Year 2 2018 spring (18G)
- Year 2 2018 summer peak (18SP)
- Year 5 2021 light (21L)
- Year 5 2021 summer (21SP)
- Year 5 2021 winter peak (21WP)
- Year 10 2026 summer peak (26SP)

DYNAMIC STABILITY

The dynamic stability models used for this study are based on the 2016-series SPP Model Development Working Group (MDWG) Models. These models include:

- Year 1 2017 winter peak (17WP)
- Year 2 2018 summer peak (18SP)
- Year 10 2026 summer peak (26SP)

SHORT CIRCUIT

The Year 2 and Year 10 dynamic stability summer peak models were used for short-circuit analysis.

BASE CASE UPGRADES

The facilities listed in the table below are part of the current SPP Transmission Expansion Plan, the Balanced Portfolio, or recently approved Priority Projects. These facilities have an approved Notification to Construct (NTC) or are in construction stages and were assumed to be in-service at the time of dispatch and added to the base case models. The DISIS Interconnection Customers have not been assigned advancement costs for the projects listed below.

<u>The DISIS Interconnection Customers' Generation Facilities in-service dates may need to be delayed until the completion of the following upgrades. In some cases, the in-service date is beyond the allowable time a customer can delay. In this case, the Interconnection Customer may move forward with Limited Operation or remain in the DISIS Queue for additional study cycles.</u> If, for some reason, construction on these projects is discontinued, additional restudies will be needed to determine the interconnection needs of the DISIS Interconnection Customers.

SPP Notification to Construct (NTC) ID	UID	Project Owner	Upgrade Name	Estimated Date of Upgrade Completion (EOC)
200223		OGE	Tatonga - Woodward District EHV 345 kV Ckt 2	3/1/2018
200223		OGE	Matthewson - Tatonga 345 kV Ckt 2	3/1/2018
200240		OGE	Chisholm - Gracemont 345 kV Ckt 1 (OGE)	3/1/2018
200255		AEP	Chisholm - Gracemont 345kV Ckt 1 (AEP)	3/1/2018
200255		AEP	Chisholm 345/230 kV Substation	3/1/2018
200255		AEP	Chisholm 230 kV	3/1/2018
200360		SPS	IMC #1 Tap - Livingston Ridge 115 kV Ckt 1 Rebuild	11/16/2018
200360		SPS	Intrepid West - Potash Junction 115 kV Ckt 1 Rebuild	11/16/2018
200360		SPS	IMC #1 Tap - Intrepid West 115 kV Ckt 1 Rebuild	11/16/2018
200360		SPS	Cardinal - Targa 115 kV Ckt 1 Rebuild	5/31/2018
200360	51250	SPS	National Enrichment Plant - Targa 115 kV Ckt 1	12/15/2018
200391	51528	OGE	DeGrasse 345 kV Substation	6/1/2019
200391	51529	OGE	DeGrasse 345/138 kV Transformer	6/1/2019
200391	51530	OGE	DeGrasse - Knob Hill 138 kV New Line	6/1/2019
200391	51569	OGE	DeGrasse 138 kV Substation (OGE)	6/1/2019
200220		NPPD	Cherry Co. (Thedford) - Gentleman 345 kV Ckt 1	10/1/2019
200220		NPPD	Cherry Co. (Thedford) Substation 345 kV	10/1/2019
200220		NPPD	Cherry Co. (Thedford) - Holt Co. 345 kV Ckt 1	10/1/2019
200220		NPPD	Holt Co. Substation 345 kV	10/1/2019
200253	50441	NPPD	Neligh 345/115 kV Substation	4/1/2018
200309		SPS	Hobbs 345/230 kV Ckt 1 Transformer	6/1/2018
200309		SPS	Hobbs - Yoakum 345 kV Ckt 1	6/1/2020
200395		SPS	Tuco - Yoakum 345 kV Ckt 1	6/1/2020
200395		SPS	Yoakum 345/230 kV Ckt 1 Transformer	6/1/2020
200256	50722	SPS	Chaves - Price 115 kV Ckt 1 Rebuild	1/30/2018

SPP Notification to Construct (NTC) ID	UID	Project Owner	Upgrade Name	Estimated Date of Upgrade Completion (EOC)
200256	50723	SPS	CV Pines - Price 115 kV Ckt 1 Rebuild	1/30/2018
200256	50724	SPS	Capitan - CV Pines 115 kV Ckt 1 Rebuild	1/30/2018
200282		SPS	China Draw - Yeso Hills 115 kV Ckt 1	6/1/2018
200282		SPS	Dollarhide - Toboso Flats 115 kV Ckt 1	6/1/2018
200309		SPS	Hobbs - Kiowa 345 kV Ckt 1	6/1/2018
200309		SPS	Kiowa 345 kV Substation	6/1/2018
200309		SPS	Kiowa - North Loving 345 kV Ckt 1	6/1/2018
200309		SPS	North Loving 345 kV Terminal Upgrades	6/1/2018
200309		SPS	China Draw - North Loving 345 kV Ckt 1	6/1/2018
200309		SPS	China Draw 345 kV Ckt 1 Terminal Upgrades	6/1/2018
200309		SPS	China Draw 345/115 kV Ckt 1 Transformer	6/1/2018
200309		SPS	North Loving 345/115 kV Ckt 1 Transformer	6/1/2018
200309		SPS	Kiowa 345/115 kV Ckt 1 Transformer	6/1/2018
200395	50924	SPS	Livingston Ridge 115 kV Substation Conversion	11/30/2017
200411		SPS	Livingston Ridge - Sage Brush 115 kV Ckt 1	6/1/2018
200309	50925	SPS	Sage Brush 115 kV Substation	12/16/2016
200309	50928	SPS	Largarto - Sage Brush 115 kV Ckt 1	12/15/2016
200309	50927	SPS	Lagarto 115 kV Substation	6/1/2018
200309	50951	SPS	Cardinal - Lagarto 115 kV Ckt 1	12/15/2016
200309	50967	SPS	Cardinal 115 kV Substation	12/15/2016
200411	50923	SPS	Ponderosa - Ponderosa Tap 115 kV Ckt 1	6/1/2017
200395		SPS	Canyon West – Dawn – Panda – Deaf Smith 115kV Ckt 1	12/15/2018
200369		SPS	Canyon East Sub – Randall County Interchange 115kV Ckt 1	12/31/2020
200359	11509	SPS	Carlisle 230/115kV transformer replacement	3/27/2018
200309		SPS	Hobbs – Yoakum – TUCO 345kV project	6/1/2018
200395		SPS	Terry County – Wolfforth 115kV Ckt 1 terminal equipment replacement	6/1/2018
200391		OGE	DeGrasse 345/138kV project	6/1/2019
200396		WFEC	DeGrasse 345/138kV project	12/31/2019
200395		SPS	Harrington East – Potter 230kV Ckt 1 terminal equipment replacement	6/1/2019
200228		WERE	Viola 345/138kV project	6/1/2018
200228		MKEC	Viola 345/138kV project	6/1/2018
200395		SPS	Seminole 230/115kV transformer Ckt 1 & 2 replacement	5/15/2018
200262		SPS	Yoakum County Interchange 230/115kV transformer Ckt 1 & 2 replacement	6/1/2019

CONTINGENT UPGRADES

The following facilities do not yet have approval. These facilities have been assigned to higher-queued interconnection customers. These facilities have been included in the models for this study and are assumed to be in service. This list may not be all-inclusive. <u>The DISIS Interconnection Customers, at this time, do not have cost responsibility for these facilities but may later be assigned cost if higher-queued customers terminate their Generation Interconnection Agreement or withdraw from the interconnection queue. The DISIS Interconnection Customer Generation Facilities in-service dates may need to be delayed until the completion of the following upgrades.</u>

Assigned Study	Upgrade Name	Estimated Date of Upgrade Completion (EOC)
DISIS-2010-002	Twin Church - Dixon County 230kV Line Upgrade	11/1/2018
DISIS-2010-002	Buckner - Spearville 345 kV Ckt 1 Terminal Upgrades	Complete 7/20/2017
DISIS-2011-001	Hoskins - Dixon County 230kV Line Upgrade	11/1/2018
DISIS-2014-002	Plant X - Tolk 230kV rebuild circuit #1	5/31/2018
DISIS-2014-002	Plant X - Tolk 230kV rebuild circuit #2	5/31/2018
DISIS-2014-002	TUCO Interchange 345/230kV CKT 1 Replacement	6/1/2018
DISIS-2015-001	(NRIS Only) Renfrow – Renfrow 138kV circuit #1 rebuild.	9/25/2017
DISIS-2015-001	Oklaunion 345kV Reactive Power	TBD
DISIS-2015-002	Beaver County 345kV Reactive Power Support Install +100Mvar SVC at Beaver County Substation.	TBD
DISIS-2015-002	Border - Chisholm 345kV CKT 1 & 2	TBD
DISIS-2015-002	Bushland - Potter County 230kV CKT 1	TBD
DISIS-2015-002	Carlisle 115/69/13kV Transformer CKT 1	TBD
DISIS-2015-002	Chisholm Substation Upgrade 345kV	TBD
DISIS-2015-002	Cleo Corner - Cleo Plant Tap 138kV CKT 1	TBD
DISIS-2015-002	Cleveland - Silver City 138kV CKT 1	TBD
DISIS-2015-002	Cornville Tap - Naples Tap 138kV CKT 1	TBD
DISIS-2015-002	Crawfish Draw 345/230kV Substation Upgrade Taps TUCO – Border 345kV, TUCO – Oklaunion 345kV, and TUCO – Swisher 230kV Build 345/230/13kV transformer	TBD
DISIS-2015-002	Crawfish Draw - Border 345kV CKT 2	TBD
DISIS-2015-002	Daglum - Dickinson 230kV CKT 1	TBD
DISIS-2015-002	Dickinson 230/115/13.8kV CKT 2	TBD
DISIS-2015-002	Gavins Point - Yankton Junction 115kV CKT 1	TBD
DISIS-2015-002	GEN-2015-063 Tap - Mathewson 345kV CKT 1	TBD
DISIS-2015-002	Grapevine - Wheeler 230kV CKT 1	TBD
DISIS-2015-002	Naples Tap - Payne 138kV CKT 1	TBD
DISIS-2015-002	Norge - Southwest Station 138kV CKT 1	TBD
DISIS-2015-002	Potter County Interchange 345/230/13kV Transformer circuit #2, build.	TBD
DISIS-2015-002	Albion - Petersburg - North Petersburg 115kV CKT 1	TBD
DISIS-2015-002	Wheeler - Sweetwater 230kV CKT 1	TBD
DISIS-2015-002	Woodward 345/138/13kV Transformer CKT 3	TBD
DISIS-2016-001	Andrews 345/115/13kV Transformer CKT 1 Replace 230/115kV transformer CKT 1 with 345/115kV transformer	TBD
DISIS-2016-001	Andrews 345/115/13kV Transformer CKT 2 Replace 230/115kV transformer CKT 2 with 345/115kV transformer	TBD
DISIS-2016-001	Andrews Substation Voltage Conversion Convert Andrews 230kV to 345kV	TBD
DISIS-2016-001	Atwood Capacitive Reactive Power Support Install 10 Mvars of Capicator Bank(s)	TBD
DISIS-2016-001	Banner County - Keystone 345kV CKT 1 Build approximately 140 of new 345kV from Banner County to Keystone. Banner County and Keystone Substation Work.	TBD
DISIS-2016-001	Beaver County - Clark County 345kV CKT 1 Build approximately 125 miles of new 345kV from Grapevine - Chisholm	TBD
DISIS-2016-001	BEPC Laramie Stability Limit Potential mitigation for BEPC Laramie Stability Limit	TBD
DISIS-2016-001	Border 345kV Reactive Power Support Install (6)Steps of 50Mvar Capacitor Bank(s) and +300Mvar SVC at Border Substation	TBD

Assigned Study	Upgrade Name	Estimated Date of Upgrade Completion (EOC)
DISIS-2016-001	Cleveland - Cleveland 138kV CKT Z1 NRIS only required upgrade: Replace bus tie breaker with a three breaker ring	TBD
DISIS-2016-001	Cleveland 345/138/13kV Transformer CKT 2 NRIS only required upgrade: Install second 345/138kV Transformer	TBD
DISIS-2016-001	Crawfish Draw 230/115/13kV Transformer CKT 1 NRIS only required upgrade: Build 115kV yard, re-terminate Hale County - TUCO 115kV, build 230/115/13kV transformer 1	TBD
DISIS-2016-001	Drinkard - Drinkard Tap 115kV CKT 1 Rebuild approximately 2 miles from Drinkard to Drinkard Tap	TBD
DISIS-2016-001	Drinkard Tap - West Hobbs 115kV CKT 1 Rebuild approximately 12.5 miles from Drinkard Tap to West Hobbs	TBD
DISIS-2016-001	Fairfax Tap - Shidler 138kV CKT 1 NRIS only required upgrade: Rebuild approximately 2.4 miles of 138kV	TBD
DISIS-2016-001	Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	TBD
DISIS-2016-001	GEN-2015-063 Tap - Woodring 345kV CKT 1	TBD
DISIS-2016-001	Glenham - Mound City 230kV CKT 1 Uprate CT	TBD
DISIS-2016-001	Hitchland 345/230/13kV Transformer CKT 3 NRIS only required upgrade: Build third 345/230/13kV Transformer	TBD
DISIS-2016-001	Jamestown - Center 345kV CKT 1 MPC mitigation for Jamestown - Center 345kV	TBD
DISIS-2016-001	Keystone - Gentleman 345kV CKT 2 Build approximately 30 miles of new 345kV. Gentleman and Keystone Substation Work.	TBD
DISIS-2016-001	Kildare - White Eagle 138kV CKT 1 Rebuild approximately 11 miles of 138kV from Kildare to White Eagle	TBD
DISIS-2016-001	Kinsley - Pawnee 115kV CKT 1 Increase conductor clearance	TBD
DISIS-2016-001	Kinze - McElroy 138kV CKT 1 Rebuild approximately 2 miles of 138kV from Kinze to McElroy	TBD
DISIS-2016-001	Lubbock Holly 230/69/13kV CKT 2 NRIS only required upgrade: Install second Lubbock Holly 230/69/13kV Transformer	TBD
DISIS-2016-001	Middleton Tap - Chilocco 138kV CKT 1 Rebuild approximately 3.45 miles of 138kV from Middleton to Chilocco	TBD
DISIS-2016-001	National Enrichment Plant - Drinkard 115kV CKT 1 Rebuild approximately 7.5 miles from NEF Plant to Drinkard	TBD
DISIS-2016-001	Neosho - Riverton 161kV CKT 1 Rebuild approximately 28 miles of 161kV	TBD
DISIS-2016-001	Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	TBD
DISIS-2016-001	Oklaunion 345kV Reactive Power Support Incremental Upgrade Install 250Mvar capacitor banks and +/-100Mvar SVC at Oklaunion	TBD
DISIS-2016-001	Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	TBD
DISIS-2016-001	Osage - White Eagle 138kV CKT 1 Rebuild approximately 3 miles of 138kV from Osage to White Eagle	TBD
DISIS-2016-001	Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County – Chisholm	TBD
DISIS-2016-001	Shamrock 115kV Capacitor Bank	TBD

Assigned Study	Upgrade Name	Estimated Date of Upgrade Completion (EOC)
	Add 20Mvar of Capacitor Bank(s) at Shamrock 115kV	
DISIS-2016-001	Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	TBD
DISIS-2016-001	Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	TBD
DISIS-2016-001	Tolk 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Tolk	TBD
DISIS-2016-001	Webb City Tap - Fairfax Tap 138kV CKT 1 NRIS only required upgrade: Rebuild approximately 0.3 miles of 138kV. Costs included in Fairfax Tap - Shidler Upgrade	TBD

POTENTIAL UPGRADES NOT IN THE BASE CASE

Any potential upgrades that do not have a Notification to Construct (NTC) and are not explicitly listed within this report have not been included in the base case. These upgrades include any identified in the SPP Extra-High Voltage (EHV) overlay plan, or any other SPP planning study other than the upgrades listed above in the previous section.

REGIONAL GROUPINGS

The interconnection requests listed in Appendix A are grouped into fifteen (15) active regional groups based on geographical and electrical impacts. These groupings are shown in Appendix C.

To determine interconnection impacts, fifteen (15) different generation dispatch scenarios of the spring, summer, and winter base case models are developed to accommodate the regional groupings.

2.5 DEVELOPMENT OF ANALYSIS CASES

POWER FLOW

For Variable Energy Resources (VER) (solar/wind) in each power flow case, ERIS, is evaluated for the generating plants within a geographical area of the interconnection request(s) for the VERs dispatched at 100% nameplate of maximum generation. The VERs in the remote areas are dispatched at 20% nameplate of maximum generation in the spring, summer peak, and winter peak models. The VERs in the remote areas are dispatched at 10% nameplate of maximum generation in the light load models These projects are dispatched across the SPP footprint using load factor ratios.

Peaking units are not dispatched in the spring case, or in the “High VER” summer and winter peak cases. To study peaking units’ impacts, the Year 1 winter peak and Year 2 summer peak, Year 5 summer and winter peaks, and Year 10 summer peak models are developed with peaking units dispatched at 100% of the nameplate rating and VERs dispatched at 20% of the nameplate rating. Each interconnection request is also modeled separately at 100% nameplate for certain analyses.

All generators (VER and peaking) that requested NRIS are dispatched in an additional analysis into the interconnecting Transmission Owner's (T.O.) area at 100% nameplate with ERIS only requests at 80% nameplate. This method allows for identification of network constraints that are common between regional groupings to have affecting requests share the mitigating upgrade costs throughout the cluster.

Each interconnection request is included in the power flow analysis models as an equivalent generator(s) dispatched at the applicable percentage of the requested service amount with 0.95 power factor capability. The facility modeling includes explicit representation of equivalent Generator Step-Up (GSU) and main project transformer(s) with impedance data provided in the interconnection request. Equivalent collector system(s) as well as transmission lead line(s) shorter than 20 miles are added to the power flow analysis models with zero impedance branches.

DYNAMIC STABILITY

For each group, all interconnection requests are dispatched at 100% nameplate output while the other groups are dispatched at 20% output for VERs and 100% output for thermal requests.

- Each study group includes system adjustments of dispatching, to maximum output, generation interconnected at the same or adjacent substations to a current study request within that group.
- Study Group 9 included an additional dispatch scenario to evaluate the Gerald Gentleman Station registered NERC flowgate #6006.
- Study Group 16 included system adjustments for the Miles City DC Tie, North Dakota – Canadian border – The phase shifting transformer to Saskatchewan Power (also known as B-10T), and reduction of WAPA (area 652) load and generation:
    - 2017 Winter Peak –
        - Miles City DC Tie– 200MW East to West transfer
        - B-10T – 65MW South to North transfer
    - 2018 Summer Peak –
        - Miles City DC Tie – 200MW East to West transfer
        - B-10T – 200MW North to South transfer
        - 1,100 MW reduction to load and generation (proxy for summer shoulder)
    - 2026 Summer Peak –
        - Miles City DC Tie – 200MW East to West transfer

Each interconnection request is included in the dynamic stability analysis models as an equivalent generator(s) dispatched at the applicable percentage of the aggregate generator nameplate capabilities provided in the interconnection request. The facility modeling includes explicit representation of equivalent Generator Step-up (GSU) transformer(s), equivalent collector system(s), main project transformer(s), and transmission lead line(s) with impedance data provided in the interconnection request.

SHORT CIRCUIT

The Year 2 and Year 10 dynamic stability Summer Peak models were used for this analysis.

3 IDENTIFICATION OF NETWORK CONSTRAINTS (SYSTEM PERFORMANCE)

3.1 THERMAL OVERLOADS

Network constraints are found by using PSS/E AC Contingency Calculation (ACCC) analysis with PSS/E MUST First Contingency Incremental Transfer Capability (FCITC) analysis on the entire cluster grouping dispatched at the various levels previously described.

For ERIS, thermal overloads are determined for system intact (n-0) greater than 100% of Rate A - normal and for contingency (n-n) greater than 100% of Rate B – emergency conditions.

The overloads are then screened to determine which interconnection requests have at least

- 3% Distribution Factor (DF) for system intact conditions (n-0),
- 20% DF upon outage-based conditions (n-n),
- or 3% DF on contingent elements that resulted in a non-converged solution.

Appropriate transmission reinforcements are identified to mitigate the constraints.

Interconnection Requests that requested NRIS are also studied in a separate NRIS analysis to determine if any constraint measured greater than or equal to a 3% DF. If so, these constraints are also assigned transmission reinforcements to mitigate the impacts.

3.2 VOLTAGE

For non-converged power flow solutions that are determined to be caused by lack of voltage support, appropriate transmission support will be identified to mitigate the constraint.

After all thermal overload and voltage support mitigations are determined; a full ACCC analysis is then performed to determine voltage constraints. The following voltage performance guidelines are used in accordance with the Transmission Owner local planning criteria.

SPP voltage criteria is applicable to all SPP facilities 69 kV and greater in the absence of more stringent criteria:

System Intact	Contingency
0.95 – 1.05 per unit	0.90 – 1.05 per unit

Areas and specific buses having more-stringent voltage criteria:

Areas/Facilities	System Intact	Contingency
AEPW – all buses EMDE High Voltage	0.95 – 1.05 per unit	0.92 – 1.05 per unit
WERE Low Voltage	0.95 – 1.05 per unit	0.93 – 1.05 per unit
WERE High Voltage	0.95 – 1.05 per unit	0.95 – 1.05 per unit
TUCO 230 kV Bus #525830	0.925 – 1.05 per unit	0.925 – 1.05 per unit
Wolf Creek 345 kV Bus #532797	0.985 – 1.03 per unit	0.985 – 1.03 per unit
FCS Bus #646251	1.001 – 1.047 per unit	1.001 – 1.047 per unit

First-Tier External Areas facilities 115 kV and greater.

Area	System Intact	Contingency
EES-EAI LAGN EES AMMO CLEC LAFA LEPA XEL MP SMMPA GRE OTP ALTW MEC MDU DPC ALTE	0.95 – 1.05 per unit	0.90 – 1.05 per unit
OTP-H (115kV+)	0.97 – 1.05 per unit	0.92 – 1.10 per unit
SPC	0.95 – 1.05 per unit	0.95 – 1.05 per unit

The constraints identified through the voltage scan are screened for the following for each interconnection request. 1) 3% DF on the contingent element and 2) 2% change in pu voltage. In certain conditions, engineering judgement was used to determine whether or not a generator had impacts to voltage constraints.

3.3 DYNAMIC STABILITY

Stability issues are considered for transmission reinforcement under ERIS. Generators that fail to meet low voltage ride-through requirements (FERC Order #661-A) or SPP's stability requirements for damping or dynamic voltage recovery are assigned upgrades such that these requirements can be met.

3.4 UPGRADES ASSIGNED

Thermal overloads that require transmission support to mitigate are discussed in Section 8 and listed in Appendix G-T (Cluster Analysis). Voltage constraints that may require transmission support are discussed in Section 8 and listed in Appendix G-V (Cluster Analysis). Constraints that are identified solely through the stability analysis are discussed in Section 9 and the appropriate appendix for the detailed stability study of that Interconnection Request. All of these upgrades are cost assigned in Appendix E and Appendix F.

Other network constraints not requiring transmission reinforcements are shown in Appendix H-T (Cluster Analysis). With a defined source and sink in a Transmission Service Request, this list of network constraints can be refined and expanded to account for all Network Upgrade requirements for firm transmission service. Additional constraints identified by multi-element contingencies are listed in Appendix I.

In no way does the list of constraints in Appendix G-T (Cluster Analysis) identify all potential constraints that guarantee operation for all periods of time. It should be noted that although this study analyzed many of the most probable contingencies, it is not an all-inclusive list and cannot account for every operational situation. Because of this, it is likely that the Customer(s) may be required to reduce their generation output to 0 MW, also known as curtailment, under certain system conditions to allow system operators to maintain the reliability of the transmission network.

4 DETERMINATION OF COST ALLOCATED NETWORK UPGRADES

Cost Allocated Network Upgrades of Variable Energy Resources (VER) (solar/wind) generation interconnection requests are determined using the Year 2 spring model. Cost Allocated Network Upgrades of peaking units are determined using the Year 5 summer peak model. A PSS/E and MUST sensitivity analysis is performed to determine the DF with no contingency that each generation interconnection request has on each new upgrade. The impact each generation interconnection request has on each upgrade project is weighted by the size of each request. Finally, the costs due by each request for a particular project are then determined by allocating the portion of each request's impact over the impact of all affecting requests.

For example, assume that there are three Generation Interconnection requests, X, Y, and Z that are responsible for the costs of Upgrade Project '1'. Given that their respective PTDF for the project have been determined, the cost allocation for Generation Interconnection request 'X' for Upgrade Project 1 is found by the following set of steps and formulas:

Determine an impact factor for a given project for all responsible GI requests:

$$Request\ X\ Impact\ Factor\ on\ Upgrade\ Project\ 1 = PTDF(\%)(X) \times MW(X) = X1$$

$$Request\ Y\ Impact\ Factor\ on\ Upgrade\ Project\ 1 = PTDF(\%)(Y) \times MW(Y) = Y1$$

$$Request\ Z\ Impact\ Factor\ on\ Upgrade\ Project\ 1 = PTDF(\%)(Z) \times MW(Z) = Z1$$

Determine each request's Allocation of Cost for that particular project:

$$Request\ X's\ Project\ 1\ Cost\ Allocation\ (\$) = \frac{Network\ Upgrade\ Project\ 1\ Cost\ (\$) \times X1}{X1 + Y1 + Z1}$$

Repeat previous for each responsible GI request for each Project.

The cost allocation of each needed Network Upgrade is determined by the size of each request and its impact on the given project. This allows for the most efficient and reasonable mechanism for sharing the costs of upgrades.

4.1 CREDITS/COMPENSATION FOR AMOUNTS ADVANCED FOR NETWORK UPGRADES

Interconnection Customer shall be entitled to either credits or potentially incremental Long Term Congestion Rights (iLTCR), otherwise known as compensation, in accordance with Attachment Z2 of the SPP Tariff for any Network Upgrades, including any tax gross-up or any other tax-related payments associated with the Network Upgrades, and not refunded to the Interconnection Customer.

5 REQUIRED INTERCONNECTION FACILITIES

The requirement to interconnect the requested generation into the existing and proposed transmission systems in the affected areas of the SPP transmission footprint consist of the necessary cost allocated shared facilities listed in Appendix F by upgrade. The interconnection requirements for the cluster total an estimated **$6.212 billion**, not including the following costs.

- **Costs Not Included** – Group 9 & 15 evaluation of the registered NERC flowgates #5221, #6006, #6007, & #6008 identified transmission reinforcement upgrades.
- **Costs Not Included** – POI adjustment for interconnection requests GEN-2016-077 and GEN-2016-094, and associated changes to identified transmission reinforcement upgrades.
- **Costs Not Included** – Substantiated cost estimates for 765 kV Network Upgrades.
- **Costs Not Included** – Costs on Affected Systems for Associated Electric Cooperative Inc. (AECI), East River Electric Power Cooperative, Inc (EREC), Mid-Continent Independent System Operator (MISO), and Minnkota Power Cooperative, Inc (MPC).
- **Costs Not Included** –Particular Interconnection Facilities observing instability in the transient stability analysis due to Interconnection Facilities configuration or Interconnection Customer provided dynamic model settings and parameters. Please refer to Appendix E for requests that are identified as requiring further review or costs for Interconnection Facilities.

Interconnection Facilities specific to each interconnection request are listed in Appendix E. A preliminary one-line diagram for each request is listed in Appendix D.

For an explanation of how required Network Upgrades and Interconnection Facilities were determined, refer to the section on "Identification of Network Constraints."

5.1 FACILITIES ANALYSIS

The interconnecting Transmission Owner for each Interconnection Request has provided its preliminary analysis of required Transmission Owner Interconnection Facilities and the associated Network Upgrades, shown in Appendix D. This analysis was limited only to the expected facilities to be constructed by the Transmission Owner at the Point of Interconnection. These costs are included in the one-line diagrams in Appendix D and also listed in Appendix E and F as combined "Interconnection Costs". If the one-lines and costs in Appendix D have been updated by the Transmission Owner's Interconnection Facilities Study, those costs will be noted in the appendix. These costs will be further refined by the Transmission Owner as part of the Interconnection Facilities Study. Any additional Network Upgrades identified by this DISIS beyond the Point of Interconnection are defined and estimated by either the Transmission Owner or by SPP. These additional Network Upgrade costs will also be refined further by the Transmission Owner within the Interconnection Facilities Study.

5.2 ENVIRONMENTAL REVIEW

For Interconnection Requests that result in an interconnection to, or modification to, the transmission facilities of the Western-UGP, a National Environmental Policy Act (NEPA) Environmental Review will be required. The Interconnection Customer will be required to execute an Environmental Review Agreement per Section 8.6.1 of the GIP.

6 AFFECTED SYSTEMS COORDINATION

The following procedures are in place to coordinate with Affected Systems.

- Impacts on Associated Electric Cooperative Inc. (AECI) – For any observed violations of thermal overloads on AECI facilities, AECI has been notified by SPP to evaluate the violations for impacts on its transmission system.
- Impacts on Midcontinent Independent System Operator (MISO) – Per SPP's agreement with MISO, MISO will be contacted and provided a list of interconnection requests that proceed to move forward into the Interconnection Facilities Study Queue. MISO will then evaluate the Interconnection Requests for impacts and will be in contact with affected Interconnection Customers. For potential impacts see Appendix H-T – Affected System and Appendix H-V – Affected System
- Impacts on Minnkota Power Cooperative, Inc (MPC) – MPC will be contacted and provided a list of interconnection requests that proceed to move forward into the Interconnection Facilities Study Queue. MPC will then evaluate the Interconnection Requests for impacts. For potential impacts see Appendix H-T – Affected System and Appendix H-V – Affected System
- Impacts to other affected systems – For any observed violations of thermal overloads or voltage constraints, SPP will contact the owner of the facility for further information.

7 POWER FLOW ANALYSIS

7.1 POWER FLOW ANALYSIS METHODOLOGY

The ACCC function of PSS/E is used to simulate single element and special (i.e., breaker-to-breaker, multi-element, etc.) contingencies in portions or all of the modeled control areas of SPP, as well as, other control areas external to SPP and the resulting scenarios analyzed. Single element and multi-element contingencies are evaluated.

7.2 POWER FLOW ANALYSIS

A power flow analysis is conducted for each Interconnection Customer's facility using modified versions of the Year 1 winter peak season, the Year 2 spring, Year 2 summer peak season, Year 5 summer and winter peak seasons, and Year 10 summer peak seasonal models. The output of the Interconnection Customer's facility is offset in each model by a reduction in output of existing online SPP generation. This method allows the request to be studied as an ERIS request. Certain requests that are also pursuing NRIS have an additional analysis conducted for displacing resources in the interconnecting Transmission Owner's balancing area.

8 POWER FLOW RESULTS

8.1 CLUSTER SCENARIO

The Cluster Scenario considers the Base Case as well as all Interconnection Requests in the DISIS Study Queue and all generating facilities (and with respect to (3) below, any identified Network Upgrades associated with such higher-queued interconnection) that, on the date the DISIS is commenced:

1. are directly connected to the Transmission System;
2. are interconnection to Affected Systems and may have an impact on the Interconnection Request;
3. have a pending higher-queued Interconnection Request to interconnect to the Transmission System; and
4. have no Interconnection Queue Position but have executed a GIA or requested that an unexecuted GIA be filed with FERC.

Constraints and associated mitigations for each Interconnection Request are summarized below. Details are contained in Appendix G-T and Appendix G-V. Cost allocation for the Cluster Scenario is found in Appendix E.

CLUSTER GROUP 1 (WOODWARD AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

Several ERIS and NRIS thermal constraints were observed for single-contingency (N-1) and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations.

Table 8-1 Group 1 Cluster ERIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
DOVER SW - HENESSEY 138KV CKT 1	191	105.28	CRESENT - TWIN LAKES 138KV CKT 1	Terminal equipment

In addition to the ERIS constraint mitigations, several NRIS thermal and voltage constraints were observed for system-intact and single-contingency (N-1) conditions. The table below summarizes constraints and associated mitigations assignable to those requests that elect NRIS.

Table 8-2 Group 1 Cluster NRIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
BETHEL - BROKEN BOW 138KV CKT 1	98	104.62	P23:345:AEPW:PITTSBURG CB 3429A NBTB	Rebuild finished per 2015 ITP10, Bethel - Broken Bow 138kV
CIMARRON (CIMARON1) 345/138/13.8KV TRANSFORMER CKT 1	382	149.12	P42:345:OKGE:SB_CION7382	Build a 3rd xfmr at Cimarron 345kV
CIMARRON (CIMARON2) 345/138/13.8KV TRANSFORMER CKT 1	382	122.47	CIMARRON (CIMARON1) 345/138/13.8KV TRANSFORMER CKT 1	
DOVER SW - HENESSEY 138KV CKT 1	191	102.48	CRESENT - TWIN LAKES 138KV CKT 1	Terminal equipment
TUPELO - TUPELO TAP 138KV CKT 1	143	103.8	P23:345:AEPW:PITTSBURG CB 3429A NBTB	Rebuild Tupelo - Tupelo Tap 138kV (NRIS)

CLUSTER GROUP 2 (HITCHLAND AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

Several ERIS thermal constraints were observed for system-intact, single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations.

Table 8-3 Group 2 Cluster ERIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
Hansford County Switch Station - SPEARMAN INTERCHANGE 115KV CKT 1	158.95	100.38	System Intact	Upgrade terminal equipment
MAJESTIC WIND - MARTIN SUB 115KV CKT 1	163.13	99.6	System Intact	Interconnection Customer facility. Interconnection Customer would need to review for mitigation.
MARTIN SUB - PANTEX NORTH SUB 115KV CKT 1	159.34	106.31	HUTCHINSON COUNTY INTERCHANGE S. - MARTIN SUB 115KV CKT 1	Previously assigned per SPP NTC-200444 to replace terminal equipment.
HIGHLAND PARK TAP - PANTEX SOUTH SUB 115KV CKT 1	153.97	106.1	HUTCHINSON COUNTY INTERCHANGE S. - MARTIN SUB 115KV CKT 1	
CAPROCK REC-PEMBROOK () 115/69/13.2KV TRANSFORMER CKT 1	48.6	184.93	CAPROCK REC-PEMBROOK - POWELL CNR 3115.00 115KV CKT 1	Affected System Facilities for TCEC. TCEC could require a review and mitigation
ELKHART TAP - EVA REGULATOR 69KV CKT 1	20	142.05	CAPROCK REC-PEMBROOK - POWELL CNR 3115.00 115KV CKT 1	

CLUSTER GROUP 3 (SPEARVILLE AREA)

No additional generation was studied for this group.

CLUSTER GROUP 4 (NORTHWEST KANSAS AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C

Several ERIS thermal constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations. The table below summarizes constraints and associated mitigations.

Table 8-4 Group 4 Cluster ERIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
HOYT - JEFFREY ENERGY CENTER 345KV CKT 1	1076	103.44	P23:345:WERE:RENO_345-140::G16111TAP	Advance Geary 345/115kV Substation and Geary-Chapman 115kV Ckt1 and rebuild Hoyt – Jeffrey Energy Center
SUMMIT (SUMM TX-1) 345/230/14.4KV TRANSFORMER CKT 1	598	103.29	G16-111-TAP 345.00 - RENO COUNTY 345KV CKT 1	
RENO COUNTY (RENO TX-1) 345/115/14.4KV TRANSFORMER CKT 1	308	124.18	P23:345:WERE:RENO_345-160::	Add 3rd 345/115/14.4kV Transformer
RENO COUNTY (RENO TX-2) 345/115/14.4KV TRANSFORMER CKT 1	308	124.42	P23:345:WERE:RENO_345-150::	

In addition to the ERIS constraint mitigations, several NRIS thermal and voltage constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations assignable to those requests that elect NRIS.

Table 8-5 Group 4 Cluster NRIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
RENO COUNTY (RENO TX-1) 345/115/14.4KV TRANSFORMER CKT 1	308	121.34	P23:345:WERE:RENO_345-160::	Add 3rd 345/115/14.4kV Transformer
RENO COUNTY (RENO TX-2) 345/115/14.4KV TRANSFORMER CKT 1	308	122.17	P23:345:WERE:RENO_345-150::	
SUMMIT (SUMM TX-1) 345/230/14.4KV TRANSFORMER CKT 1	598	102.76	G16-111-TAP 345.00 - RENO COUNTY 345KV CKT 1	Advance Geary 345/115kV Substation and Geary-Chapman 115kV Ckt1
BUCKEYE_230 230.00 (BUCK_E_MPT) 230/34.5/13.8KV TRANSFORMER CKT 2	110	108.4	System Intact	IC Facility – Not for Current Study Mitigation

CLUSTER GROUP 6 (SOUTH TEXAS PANHANDLE/NEW MEXICO AREA)

The requested POI for GEN-2016-077 is not viable, additional analysis will be required to identify if additional mitigation is required with a viable POI on the requested circuit. The interconnection cost estimate is for a valid POI on the requested circuit.

New requests for this study group as well as prior-queued requests are listed in Appendix C

ERIS thermal constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations.

Below is a list of the upgrades assigned, and the corresponding scenarios in which these upgrades were assigned. Scenario numbers are denoted as "S#".

Table 8-6 Group 6 Cluster Upgrade Scenarios

Scenario	Incremental Mitigation
0	Add temporary study SVCs at various locations to achieve a solved dispatch
2	Add Crawfish Draw – Seminole 765kV Ckt 1
	Remove temporary SVCs at various locations
3	Add Crawfish Draw – Seminole 765kV Ckt 2
4	Add Crossroads – Crawfish Draw 765kV Ckt 1
5	Add 3rd Tolk 345/230kV transformer
	Add 2nd Crawfish Draw 345/230kV transformer
6	Mitigate Crossroads - Tolk 345kV CKT 1 clearance and terminal ratings issues
	Reconductor Pittsburg – Seminole 345kV CKT 1
	Reconductor Cochran – Lost Draw 115kV CKT 1
	Add +600MVAR SVC at Crawfish Draw 765kV substation
	Add Midpoint 765kV substation tying both Crawfish Draw – Seminole 765kV circuits together
	Remove in-line reactors on Crawfish Draw – Crossroads 765kV CKT 1
	Remove in-line reactors on Crawfish Draw – Midpoint – Seminole 765kV CKT 1 &2
	Add 700MVAR switched shunt reactors at Crawfish Draw 765kV substation
	Add 1,600MVAR switched shunt reactors at Midpoint 765kV substation
	Add 300MVAR switched shunt reactors at Seminole 765kV substation
7	Replace terminal equipment on Elk City 230/138/13.8KV Transformer CKT 1

Several steady state voltage constraints for mitigation were identified with the inclusion of thermal and stability constraint mitigations. The results identified a need to include significant switchable reactive compensation for the 765kV transmission line charging current that will be refined in the facility study. SPP determined the 765 kV Network Upgrade cost estimates using conceptual amounts which require a facility study to substantiate.

Table 8-7 Group 6 Cluster Non-Convergence ERIS Constraints

Monitored Elements	Mitigation
System Intact	Scenario 0 Model was solved using temporary study SVC's in various locations throughout the South Texas panhandle/New Mexico area; see appendix G-T for various non-converging scenario 0 results.
CRAWFISH765 765.00 - SEMINOLE765 765.00 765KV CKT 1	In addition to higher queued assigned upgrades the following new upgrades are required for group 6 potential voltage collapse:
BORDER 7345.00 - G16-120-TAP 345.00 345KV CKT 1	

BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1	1. Add Crawfish Draw - Seminole 765KV CKT 1 2. Add Crawfish Draw - Seminole 765KV CKT 2 3. Add Crossroads - Crawfish Draw 765kv CKT 1
CRAWFISH_DR 345.00 - OKLAUNION 345KV CKT 1	
ELM CREEK - MRWYP16 230KV CKT 1	
GEN520947 1-HUGO1	
Hitchland Interchange - POTTER COUNTY INTERCHANGE 345KV CKT 1	
HUGO - VALLIANT 345KV CKT 1	
POTTER COUNTY INTERCHANGE - TOLK STATION 345KV CKT 1	
TUCO INTERCHANGE - YOAKUM_345 345.00 345KV CKT 1	
CHAVES COUNTY INTERCHANGE - SAN JUAN MESA TAP 230KV CKT 1	
CROSSROADS 7345.00 - TOLK STATION 345KV CKT 1	
G16-063-TAP 345.00 - SUNNYSIDE 345KV CKT 1	
LAWTON EASTSIDE - TERRYRD7 345.00 345KV CKT 1	
LYDIA - WELSH 345KV CKT 1	
NORTHWEST TEXARKANA - VALLIANT 345KV CKT 1	
OASIS INTERCHANGE - SAN JUAN MESA TAP 230KV CKT 1	
PITTSBURG - VALLIANT 345KV CKT 1	
PITTSBURG - SEMINOLE 345KV CKT 1	

Table 8-8 Group 6 Cluster Non-Convergence NRIS Constraints

All non-converged constraints are mitigated by ERIS assigned upgrades.

Table 8-9: Group 6 Cluster ERIS Thermal Constraints

Monitored Elements	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
CASTRO COUNTY INTERCHANGE - DEAF SMITH REC-#21 115KV CKT 1	159.0	117.8086	System Intact	Add Crawfish Draw – Seminole 765kV CKT 1 and CKT 2
CHISHOLM6 230.00 - ELK CITY 230KV 230KV CKT 1	353.0	134.728	System Intact	
CIMARRON - MINCO 345KV CKT 1	956.0	118.654	SUNNYSIDE - TERRYRD7 345.00 345KV CKT 1	
CRAWFISH_DR 345.00 - OKLAUNION 345KV CKT 1	1022.0	116.1433	System Intact	
GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1	318.69	100.4122	System Intact	
Hitchland Interchange - POTTER COUNTY INTERCHANGE 345KV CKT 1	956.09	121.8916	System Intact	
LAWTON EASTSIDE - OKLAUNION 345KV CKT 1	1011.0	110.0991	System Intact	
MOORE COUNTY INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1	318.69	111.655	System Intact	
NEWHART 230 - POTTER COUNTY INTERCHANGE 230KV CKT 1	375.26	104.4846	System Intact	

Monitored Elements	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
ALLRED TAP - SHELL C3 TAP 115KV CKT 1	232.64	99.8	INK_BASIN 6230.00 - YOAKUM COUNTY INTERCHANGE 230KV CKT 1	Add Crossroads - Crawfish Draw 765kv CKT 1
AMOCO SWITCHING STATION - SUNDOWN INTERCHANGE 230KV CKT 1	318.69	102.2611	NEEDMORE 230.00 - TOLK STATION WEST 230KV CKT 1	
AMOCO SWITCHING STATION - YOAKUM COUNTY INTERCHANGE 230KV CKT 1	414.3	105.3258	NEEDMORE 230.00 - TOLK STATION WEST 230KV CKT 1	
ANDREWS 3115.00 - National Enrichment Plant Sub 115KV CKT 1	525.0	111.4875	HOBBS (UPDATE DATA) 345/230/13.2KV TRANSFORMER CKT 1	
CRAWFISH_DR 345.00 - TUCO INTERCHANGE 345KV CKT 1	1793.0	100.2604	CRAWFISH_DR 345.00 - TUCO INTERCHANGE 345KV CKT 2	
CROSSROADS 7345.00 - TOLK STATION 345KV CKT 1	717.06	134.4355	HOBBS - YOAKUM_345 345.00 345KV CKT 1	
CUNNIGHM_S 6230.00 - HOBBS INTERCHANGE 230KV CKT 1	502	120.2338	'G15079_T 230.00 - YOAKUM COUNTY INTERCHANGE 230KV CKT 1'	
DENVER CITY INTERCHANGE S. - SHELL C2 SUB 115KV CKT 1	159.34	137.035	INK_BASIN 6230.00 - YOAKUM COUNTY INTERCHANGE 230KV CKT 1	
ELK CITY 230KV (ELKCTY-6) 230/138/13.8KV TRANSFORMER CKT 1	287.0	164.7449	System Intact	
G15079_T 230.00 - YOAKUM COUNTY INTERCHANGE 230KV CKT 1	377.65	161.0263	CUNNIGHM_S 6230.00 - CUNNINGHAM STATION 230KV CKT *1	
INK_BASIN 6230.00 - YOAKUM COUNTY INTERCHANGE 230KV CKT 1	377.65	137.3157	HOBBS - YOAKUM_345 345.00 345KV CKT 1	
LYNTEGAR REC-CLAUENE - TERRY COUNTY INTERCHANGE 115KV CKT 1	79.67	103.2663	COCHRAN INTERCHANGE - NEWTAP3 115.00 115KV CKT 1	
SUNDOWN INTERCHANGE - WOLFFORTH INTERCHANGE 230KV CKT 1	318.69	105.5874	CRAWFISH_DR 345.00 - TOLK STATION 345KV CKT 1	
TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1	644.0	99.9	CRAWFISH_DR 345.00 - TOLK STATION 345KV CKT 1	
TOLK STATION (TOLK2) 345/230/13.2KV TRANSFORMER CKT 1	560	146.6726	''P44:69:SPS:ARTESIA _4740''	Add Tolk XFMR 345/230/13.2kV Transformer CKT 3
CRAWFISH_DR 345.00 (CRAWFISHXFMR) 345/230/13.2KV TRANSFORMER CKT 1	560.0	113.1884	TUCO INTERCHANGE (SIEM 8743066) 345/230/13.2KV TRANSFORMER CKT 2	Add Crawfish Draw 345/230kv Transformer CKT 2

Monitored Elements	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
COCHRAN INTERCHANGE - NEWTAP3 115.00 115KV CKT 1	120.9	127.75	System Intact	Reconductor Cochran - Lost Draw 115kV CKT 1
CROSSROADS 7345.00 - TOLK STATION 345KV CKT 1	717.06	134.43	HOBBS - YOAKUM_345 345.00 345KV CKT 1	Crossroads - Tolk 345kV CKT 1 terminal equipment
PITTSBURG - SEMINOLE 345KV CKT 1	717	110.59	System Intact	Reconductor Pittsburg-Seminole 345 kV Ckt 1
ELK CITY 230KV (ELKCTY-6) 230/138/13.8KV TRANSFORMER CKT 1	272	100.72	System Intact	Replace transformer terminal equipment
'National Enrichment Plant Sub - TARGA 3115.00 115KV CKT 1'	139.03	102.1341	'CUNNIGHM_S 6230.00 - CUNNINGHAM STATION 230KV CKT *1'	Rebuild 3 miles of 115 kV from Cardinal – Targa per NTC 200360

Table 8-10: Group 6 Cluster NRIS Thermal Constraints

All constraints are mitigated by ERIS assigned upgrades.

The table below summarizes constraints and associated mitigations assignable to incremental ERIS steady state voltage. The steady state voltage constraints for mitigation are identified incremental to the thermal constraint mitigations.

Table 8-11 Group 6 Cluster ERIS Voltage Constraints

Monitored Element	TC Voltage (PU)	VMIN (PU)	VMAX (PU)	Contingency	Mitigation
'BORDER 7345.00 345KV'	1.057966	0.9	1.05	'CHISHOLM7 345.00 - GRAPEVINE 345.00 345KV CKT 1'	Border Switched Shunt Adjustment
'BORDER 7345.00 345KV'	1.058209	0.9	1.05	'GRAPEVINE 345.00 - POTTER COUNTY INTERCHANGE 345KV CKT 1'	
'BORDER 7345.00 345KV'	1.058851	0.9	1.05	'BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1'	
'BORDER 7345.00 345KV'	1.063357	0.9	1.05	'BORDER 7345.00 - G16-120-TAP 345.00 345KV CKT 1'	
'COLE 2 69.000 69KV'	1.053588	0.9	1.05	'MINGO - RED WILLOW 345KV CKT 1'	Cole transformer tap adjustment

The table below summarizes constraints and associated mitigations assignable to incremental NRIS steady state voltage. The steady state voltage constraints for mitigation are identified incremental to the thermal constraint mitigations.

Table 8-12 Group 6 Cluster NRIS Voltage Constraints

Monitored Element	TC Voltage (PU)	VMIN (PU)	VMAX (PU)	Contingency	Mitigation
'ANDREWS 6230.00 230KV'	1.091213	0.9	1.05	'HOBBS (UPDATE DATA) 345/230/13.2KV TRANSFORMER CKT 1'	Andrews transformer tap adjustment
'CHAVES COUNTY INTERCHANGE 230KV'	1.073083	0.9	1.05	'OASIS INTERCHANGE - SAN JUAN MESA TAP 230KV CKT 1'	
'CHAVES COUNTY INTERCHANGE 230KV'	1.096556	0.9	1.05	'CHAVES COUNTY INTERCHANGE - EDDY_NORTH 6230.00 230KV CKT 1'	
'GEN-2016-062230.00 230KV'	1.091213	0.9	1.05	'HOBBS (UPDATE DATA) 345/230/13.2KV TRANSFORMER CKT 1'	
'CHAVES COUNTY INTERCHANGE 230KV'	1.073083	0.9	1.05	'OASIS INTERCHANGE - SAN JUAN MESA TAP 230KV CKT 1'	San Juan Mesa Windfarm Switched Shunt Adjustment
'CHAVES COUNTY INTERCHANGE 230KV'	1.096556	0.9	1.05	'CHAVES COUNTY INTERCHANGE - EDDY_NORTH 6230.00 230KV CKT 1'	
'OASIS INTERCHANGE 230KV'	1.058381	0.9	1.05	'CHAVES COUNTY INTERCHANGE - EDDY_NORTH 6230.00 230KV CKT 1'	
'OASIS INTERCHANGE 230KV'	1.05899	0.9	1.05	'CHAVES COUNTY INTERCHANGE - SAN JUAN MESA TAP 230KV CKT 1'	
'PLEASANT HILL 230KV'	1.054475	0.9	1.05	'CHAVES COUNTY INTERCHANGE - EDDY_NORTH 6230.00 230KV CKT 1'	
'PLEASANT HILL 230KV'	1.055154	0.9	1.05	'CHAVES COUNTY INTERCHANGE - SAN JUAN MESA TAP 230KV CKT 1'	
'SAN JUAN MESA TAP 230KV'	1.100952	0.9	1.05	'CHAVES COUNTY INTERCHANGE - EDDY_NORTH 6230.00 230KV CKT 1'	
'SAN JUAN MESA TAP 230KV'	1.102297	0.9	1.05	'CHAVES COUNTY INTERCHANGE - SAN JUAN MESA TAP 230KV CKT 1'	
'SAN JUAN MESA TAP 230KV'	1.123706	0.9	1.05	'OASIS INTERCHANGE - SAN JUAN MESA TAP 230KV CKT 1'	

Results for GEN-2016-177 are preliminary. Final results will be posted in a later update.

CLUSTER GROUP 7 (SOUTHWESTERN OKLAHOMA AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C

The table below summarizes constraint and associated mitigation.

Table 8-13: Group 7 Cluster NRIS Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
CORNVILLE - NORGE ROAD 138KV CKT 1	136	102.04	System Intact	Rebuild Cornville – Norge Road 138kV CKT 1

CLUSTER GROUP 8 (NORTH OKLAHOMA/SOUTH CENTRAL KANSAS AREA)

Several ERIS non-converged constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations.

Table 8-14 Group 8 Cluster Non-Convergence ERIS Constraints

<table>
<tr><th>Monitored Elements</th><th>Mitigation</th></tr>
<tr><td>AXTELL - G16-050-TAP 345.00 345KV CKT 1</td><td rowspan="33">In addition to higher queued assigned upgrades the following new upgrades are required for group 8 potential voltage collapse:

1. Advance Geary Project NTC-200242
2. Install +300/-150 Mvar Static Var Compensator (SVC) at North Tulsa 345kV
3. Install +300/-100 Mvar SVC at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.</td></tr>
<tr><td>CANEYRV7 345.00 - NEOSHO 345KV CKT 1</td></tr>
<tr><td>DELAWARE - NORTHEAST STATION 345KV CKT 1</td></tr>
<tr><td>EMPORIA ENERGY CENTER - G14_001T 345.00 345KV CKT 1</td></tr>
<tr><td>EMPORIA ENERGY CENTER - SWISSVALE 345KV CKT 1</td></tr>
<tr><td>FT SMITH - MUSKOGEE 345KV CKT 1</td></tr>
<tr><td>G14_001T 345.00 - WICHITA 345KV CKT 1</td></tr>
<tr><td>G15052_T 345.00 - OPENSKY7 345.00 345KV CKT 1</td></tr>
<tr><td>G15052_T 345.00 - ROSE HILL 345KV CKT 1</td></tr>
<tr><td>G15063_T 345.00 - MATHWSN7 345.00 345KV CKT 1</td></tr>
<tr><td>G15063_T 345.00 - WOODRING 345KV CKT 1</td></tr>
<tr><td>G16-050-TAP 345.00 - POST ROCK 345KV CKT 1</td></tr>
<tr><td>G16-100-TAP 345.00 - SPRING CREEK 345KV CKT 1</td></tr>
<tr><td>G16-111-TAP 345.00 - G16-122-TAP 345.00 345KV CKT 1</td></tr>
<tr><td>G16-111-TAP 345.00 - RENO COUNTY 345KV CKT 1</td></tr>
<tr><td>G16-122-TAP 345.00 - SUMMIT 345KV CKT 1</td></tr>
<tr><td>G16133_345CS345.00 345KV SWITCHED SHUNT</td></tr>
<tr><td>GEN300003 1-THOMAS HILL UNIT 3</td></tr>
<tr><td>GEN300006 1-NEW MADRID UNIT 1</td></tr>
<tr><td>GEN300007 1-NEW MADRID UNIT 2</td></tr>
<tr><td>GEN509394 1-FLINT CREEK</td></tr>
<tr><td>GEN511839 1-NORTHEASTERN STATION #2</td></tr>
<tr><td>GEN512688 2-GRDA1 GSU2 22</td></tr>
<tr><td>GEN542951 5-HAWTHORN UNIT #5</td></tr>
<tr><td>GEN542955 1-LACYGNE UNIT #1</td></tr>
<tr><td>GEN542956 2-LACYGNE UNIT #2</td></tr>
<tr><td>GEN542957 1-IATAN UNIT #1</td></tr>
<tr><td>GEN542962 2-IATAN UNIT #2</td></tr>
<tr><td>GEN549893 2-SOUTHWEST 2</td></tr>
<tr><td>GRDA1 - GREC TAP5 345.00 345KV CKT 1</td></tr>
<tr><td>HOYT - JEFFREY ENERGY CENTER 345KV CKT 1</td></tr>
<tr><td>HOYT - STRANGER CREEK 345KV CKT 1</td></tr>
</table>

LACYGNE - STILWELL 345KV CKT 1	
LACYGNE - WAVERLY7 345.00 345KV CKT 1	
MINGO - RED WILLOW 345KV CKT 1	
NORTHEAST STATION - ONETA 345KV CKT 1	
NORTHEAST STATION - TULSA NORTH 345KV CKT 1	
NORTHWEST - SPRING CREEK 345KV CKT 1	
RANCHRD7 345.00 - SOONER 345KV CKT 1	
RENO COUNTY - WICHITA 345KV CKT 1	
RIVERSIDE STATION - SAPULPA ROAD 345KV CKT 1	
SAPULPA ROAD - WEKIWA 345KV CKT 1	
SWISSVALE - WEST GARDNER 345KV CKT 1	
T.NO.2-4 138.00 - TULSA NORTH 138KV CKT 1	
TULSA NORTH - WEKIWA 345KV CKT 1	
TULSA NORTH (TULSA N) 345/138/34.5KV TRANSFORMER CKT 1	
VIOLA 7 345.00 - WICHITA 345KV CKT 1	
WAVERLY7 345.00 - WOLF CREEK 345KV CKT 1	
G16133_765CS765.00 765/345KV TRANSFORMER CKT 1	In addition to higher queued assigned upgrades the following new upgrades are required for group 8 potential voltage collapse: 1. Advance Geary Project NTC-200242 2. Install +300/-150 Mvar Static Var Compensator (SVC) at North Tulsa 345kV 3. Install +300/-100 Mvar SVC at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146. 4. Power reduction for IC N-1 or third transformer for collector system and main substation transformer will be required. Proposed IC solution for these voltage related contingencies would be required to be review for SPP to mitigation of DISIS constraint.
G16133_765CS765.00 765/345KV TRANSFORMER CKT 2	
G16133_765TN765.00 765/345KV TRANSFORMER CKT 1	
G16133_765TN765.00 765/345KV TRANSFORMER CKT 2	

Several NRIS non-converged constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations.

Table 8-15 Group 8 Cluster Non-Convergence NRIS Constraints

Monitored Elements	Mitigation
7JASPER 345.00 - BLACKBERRY 345KV CKT 1	In addition to ERIS higher queued assigned upgrades the following new current study ERIS upgrades are required for group 8 potential voltage collapse: 1. Advance Geary Project NTC-200242 2. Install +300/-150 Mvar Static Var Compensator (SVC) at North Tulsa 345kV 3. Install +300/-100 Mvar SVC at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.
7JASPER 345.00 - MORGAN 345KV CKT 1	
7SPORTSMAN - BLACKBERRY 345KV CKT 1	
ARCADIA - NORTHWEST 345KV CKT 1	
BARTLESVILLE COMANCHE - MOUND ROAD 138KV CKT 1	
BARTLESVILLE SOUTHEAST - NORTH BARTLESVILLE 138KV CKT 1	
BLACKBERRY - NEOSHO 345KV CKT 1	
CANEYRV7 345.00 - LATHAMS7 345.00 345KV CKT 1	
CANEYRV7 345.00 - NEOSHO 345KV CKT 1	
CHEROKEE DATA CENTER EAST TAP - OWAS88 138KV CKT 1	
CIMARRON - DRAPER LAKE 345KV CKT 1	
CLARKSVILLE - ONETA 345KV CKT 1	
CLEVELAND - G15066_T 345.00 345KV CKT 1	
COFFEYVILLE TAP - NORTH BARTLESVILLE 138KV CKT 1	
DOMES - MOUND ROAD 138KV CKT 1	
DOMES - PAWHUSKA TAP 138KV CKT 1	
EMPORIA ENERGY CENTER - G14_001T 345.00 345KV CKT 1	
EMPORIA ENERGY CENTER - SWISSVALE 345KV CKT 1	
G14_001T 345.00 - WICHITA 345KV CKT 1	
G15052_T 345.00 - OPENSKY7 345.00 345KV CKT 1	
G15052_T 345.00 - ROSE HILL 345KV CKT 1	
G15063_T 345.00 - MATHWSN7 345.00 345KV CKT 1	
G15063_T 345.00 - WOODRING 345KV CKT 1	
G16-063-TAP 345.00 - HUGO 345KV CKT 1	
G16-063-TAP 345.00 - SUNNYSIDE 345KV CKT 1	
G16-100-TAP 345.00 - SPRING CREEK 345KV CKT 1	
G16-122-TAP 345.00 - SUMMIT 345KV CKT 1	
GEARY 7 345.00 - SUMMIT 345KV CKT 1	
GEN336821 1-GRAND GULF UNIT	
GEN509394 1-FLINT CREEK	
GEN509403 1-PIRKEY GENERATION	
GEN511839 1-NORTHEASTERN STATION #2	
GEN511840 1-NORTHEASTERN STATION #3	
GEN512688 2-GRDA1 GSU2 22	
GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1	
GRDA1 - GREC TAP5 345.00 345KV CKT 1	
GREC TAP5 345.00 - TULSA NORTH 345KV CKT 1	
LATHAMS7 345.00 - ROSE HILL 345KV CKT 1	
LAWTON EASTSIDE - TERRYRD7 345.00 345KV CKT 1	
LYDIA - VALLIANT 345KV CKT 1	
LYDIA - WELSH 345KV CKT 1	
MORISNT4 138.00 - STILLWATER 138KV CKT 1	
NORTHEAST STATION - ONETA 345KV CKT 1	
NORTHEAST STATION - OWASSO 109TH STREET 138KV CKT 1	
NORTHEAST STATION - TULSA NORTH 138KV CKT 1	
NORTHEAST STATION - TULSA NORTH 345KV CKT 1	
NORTHWEST - SPRING CREEK 345KV CKT 1	
OPENSKY7 345.00 - RANCHRD7 345.00 345KV CKT 1	
OSAGE - WEBB CITY TAP 138KV CKT 1	
OWASSO 109TH STREET - OWASSO NORTH TAP 138KV CKT 1	
OWASSO NORTH TAP - TULSA NORTH 138KV CKT 1	

Monitored Elements	Mitigation
PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1	
PECAN CREEK - RIVERSIDE STATION 345KV CKT 1	
PITTSBURG - SEMINOLE 345KV CKT 1	
PITTSBURG - VALLIANT 345KV CKT 1	
RIVERSIDE STATION - SAPULPA ROAD 345KV CKT 1	
SAPULPA ROAD - WEKIWA 345KV CKT 1	
SHIDLER - WEST PAWHUSKA 138KV CKT 1	
SPVALLY4 138.00 - STILLWATER 138KV CKT 1	
SUNNYSIDE - TERRYRD7 345.00 345KV CKT 1	
SWISSVALE - WEST GARDNER 345KV CKT 1	
T.NO.2-4 138.00 - TULSA NORTH 138KV CKT 1	
TULSA NORTH - WEKIWA 345KV CKT 1	
TULSA NORTH (TULSA N) 345/138/34.5KV TRANSFORMER CKT 1	
G16133_765CS765.00 765/345KV TRANSFORMER CKT 1	In addition to higher queued assigned upgrades the following new Current Study ERIS upgrades are required for group 8 potential voltage collapse: 1. Advance Geary Project NTC-200242 2. Install +300/-150 Mvar Static Var Compensator (SVC) at North Tulsa 345kV 3. Install +300/-100 Mvar SVC at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146. 4. Power reduction for IC N-1 or third transformer for collector system and main substation transformer will be required. Proposed IC solution for these voltage related contingencies would be required to be review for SPP to mitigation of DISIS constraint.
G16133_765CS765.00 765/345KV TRANSFORMER CKT 2	
G16133_765TN765.00 765/345KV TRANSFORMER CKT 1	
G16133_765TN765.00 765/345KV TRANSFORMER CKT 2	

Several ERIS thermal constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations. The table below summarizes constraints and associated mitigations.

Table 8-16 Group 8 Cluster ERIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
4REMNGTON 138.00 - ASGI1708TP 138.00 138KV CKT 1	213.0	120.2206	SHIDLER - WEST PAWHUSKA 138KV CKT 1	Upgrade Remington-Shidler 138 kV line to 1192.5 ACSR at 100 C
4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	217.0	133.0496	System Intact	Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C
4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	217.0	190.0555	SHIDLER - WEST PAWHUSKA 138KV CKT 1	
BARTLESVILLE COMANCHE - BARTLESVILLE SOUTHEAST 138KV CKT 1	153	127.9684	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	Rebuild approximately 5 miles of 138kV assigned to higher queued AECI project (GIA-59)
FAIRFAX 138/69KV TRANSFORMER CKT 1	56.0	153.5289	System Intact	Upgrade the Fairfax 138/69 kV 56 MVA transformer to two 84 MVA units
BARTLESVILLE COMANCHE - MOUND ROAD 138KV CKT 1	131.0	173.601	System Intact	Rebuild approximately 45 miles of 138kV assigned to higher queued AECI project (GIA-59)
BARTLESVILLE COMANCHE - MOUND ROAD 138KV CKT 1	131.0	226.0955	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	
DOMES - MOUND ROAD 138KV CKT 1	189.0	130.1181	System Intact	
DOMES - MOUND ROAD 138KV CKT 1	189.0	185.1161	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	
DOMES - PAWHUSKA TAP 138KV CKT 1	189.0	135.0301	System Intact	
DOMES - PAWHUSKA TAP 138KV CKT 1	189.0	190.2539	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	
DOMES - PAWHUSKA TAP 138KV CKT 1	357.0	106.5016	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	
PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1	189.0	139.3717	System Intact	
PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1	189.0	194.8696	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	
SHIDLER - WEST PAWHUSKA 138KV CKT 1	181.0	147.1323	System Intact	
SHIDLER - WEST PAWHUSKA 138KV CKT 1	189.0	196.5191	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	
BENTON - WICHITA 345KV CKT 1	956.0	114.2609	LACYGNE - WAVERLY7 345.00 345KV CKT 1	Replace terminal equipment
ELPASOE4 138.00 - FARBER 138KV CKT 1	287.0	105.8275	P23:345:WERE:WICH_345-116::-BUFFALOFLATS	Replace terminal equipment
FARBER - SUMNER COUNTY NO. 10 BELLE PLAIN 138KV CKT 1	314.0	102.3217	P23:345:WERE:WICH_345-116::-BUFFALOFLATS	Rebuild assigned to higher queued DISIS-2016-001

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
				Interconnection Customer(s)
G15063_T 345.00 - MATHWSN7 345.00 345KV CKT 1	1192.0	122.5143	System Intact	In addition to higher queued group 8 assigned upgrades the following are required for mitigation: 1. Build Woodring – G15-063Tap (Redington) 345kV CKT 2 2. Build Redington – Spring Creek 345kV CKT 1 3. Northwest – Spring Creek 345kV CKT 2 4. Replace terminal equipment for Northwest – Spring Creek 345kV CKT 1 per DISIS-2016-001-1 assignment
G15063_T 345.00 - MATHWSN7 345.00 345KV CKT 1	1192.0	165.5665	G16-100-TAP 345.00 - SPRING CREEK 345KV CKT 1	
G15063_T 345.00 - MATHWSN7 345.00 345KV CKT 1	1541.0	146.4519	NORTHWEST - SPRING CREEK 345KV CKT 1	
G15063_T 345.00 - WOODRING 345KV CKT 1	1195.0	140.5221	G16-100-TAP 345.00 - SPRING CREEK 345KV CKT 1	
G16-100-TAP 345.00 - SPRING CREEK 345KV CKT 1	1039.0	122.4951	System Intact	
G16-100-TAP 345.00 - SPRING CREEK 345KV CKT 1	1195.0	148.4997	G15063_T 345.00 - MATHWSN7 345.00 345KV CKT 1	
NORTHWEST - SPRING CREEK 345KV CKT 1	1342.0	112.973	System Intact	
NORTHWEST - SPRING CREEK 345KV CKT 1	1540.0	153.3887	G15063_T 345.00 - MATHWSN7 345.00 345KV CKT 1	
HUNTERS7 345.00 - WOODRING 345KV CKT 1	1195.0	116.2688	VIOLA 7 345.00 - WICHITA 345KV CKT 1	Build Hunter – Woodring 345kV CKT 2
VIOLA 7 345.00 - WICHITA 345KV CKT 1	1076.0	104.1027	System Intact	1. Viola Project 345/138kV per NTC-200228, 200296, 200362. 2. Build Viola – Buffalo Flats 345kV CKT 1
VIOLA 7 345.00 - WICHITA 345KV CKT 1	1076	139.3553	HUNTERS7 345.00 - WOODRING 345KV CKT 1	
VIOLA 7 345.00 (VIOLA TX-1) 345/138/13.8KV TRANSFORMER CKT 1	440.0	166.5387	P23:345:WERE:WICH_345-116::-BUFFALOFLATS	
G16133_765CS765.00 - G16133_765R3765.00 765KV CKT 1	2000.0	123.1937	System Intact	Interconnection Customer(s) facilities. IC will have to provide mitigation (equipment upgrade, ratings verifications) for constraints.
G16133_765CS765.00 - G16133_765R3765.00 765KV CKT 1	2000.0	125.9727	G15063_T 345.00 - WOODRING 345KV CKT 1	
G16133_765R1765.00 - G16133_765TN765.00 765KV CKT 1	2000.0	122.6919	System Intact	
G16133_765R1765.00 - G16133_765TN765.00 765KV CKT 1	2000.0	124.5485	CANEYRV7 345.00 - NEOSHO 345KV CKT 1	
G16133G16146345.00 - TULSA NORTH 345KV CKT 1	2000.0	120.0423	System Intact	
G16133G16146345.00 - TULSA NORTH 345KV CKT 1	2000.0	122.4122	LACYGNE - WAVERLY7 345.00 345KV CKT 1	
GRDA1 - GREC TAP5 345.00 345KV CKT 1	901.0	141.9681	System Intact	Replace terminal equipment
GRDA1 - GREC TAP5 345.00 345KV CKT 1	1055.0	123.9508	TULSA NORTH - WEKIWA 345KV CKT 1	

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
HARDY 4 138.00 - WEBBCTY4 138.00 138KV CKT 1	138.0	106.211	System Intact	Rebuild/Re-conductor approximately 2 miles of 138kV
SHIDWFC4 138.00 - WEBB CITY TAP 138KV CKT 1	117.0	114.1108	System Intact	Rebuild/Re-conductor approximately 2.5 miles of 138kV
SHIDWFC4 138.00 - WEBBCTY4 138.00 138KV CKT 1	117.0	120.4404	System Intact	Rebuild/Re-conductor approximately 13 miles of 138kV
OSAGE - WEBB CITY TAP 138KV CKT 1	287.0	105.8274	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	Rebuild assigned to DISIS-2016-001 Interconnection Customer(s)
KELLY - KING HILL N.M. COOP (NEMAHA MARSHALL R.E.C. 115KV CKT 1	92.0	103.5361	CLIFTON - CONCORDIA 115KV CKT 1	1. Iatan – Stranger Creek 161kV Voltage Conversion to 345 NTC-200328 and 200337. 2. Geary Project. NTC-200242
LACYGNE - WAVERLY7 345.00 345KV CKT 1	1141.0	116.0886	System Intact	Replace terminal equipment to achieve conductor element
LACYGNE - WAVERLY7 345.00 345KV CKT 1	1254.0	111.4018	BENTON - WICHITA 345KV CKT 1	
RENFROW4 138.00 - RENFROW4 138.00 138KV CKT 1	183.0	118.1338	System Intact	Rebuild/Re-conductor approximately 2 miles of 138kV
RENFROW4 138.00 - WAKITA_138 138.00 138KV CKT 1	183.0	114.5556	System Intact	Rebuild/Re-conductor approximately 17 miles of 138kV
SPVALLY4 138.00 - STILLWATER 138KV CKT 1	194.0	102.5738	System Intact	1. Build Woodring – G15-063Tap (Redington) 345kV CKT 2 2. Build Redington – Spring Creek 345kV CKT 1
TULSA NORTH - WEKIWA 345KV CKT 1	1182.0	102.1011	GRDA1 - GREC TAP5 345.00 345KV CKT 1	Rebuild/Re-conductor approximately 17.5 miles of 345kV
TULSA NORTH (TULSA N) 345/138/34.5KV TRANSFORMER CKT 1	675.0	113.8817	System Intact	Install second 345/138kV transformer
TULSA NORTH (TULSA N) 345/138/34.5KV TRANSFORMER CKT 1	742.0	125.5404	TULSA NORTH - WEKIWA 345KV CKT 1	
WAVERLY7 345.00 - WOLF CREEK 345KV CKT 1	1141.0	99.5	System Intact	1. Iatan – Stranger Creek 161kV Voltage Conversion to 345 NTC-200328 and 200337. 2. Geary Project. NTC-200242 3. Viola – Buffalo Flats 345kV CKT 1
WAVERLY7 345.00 - WOLF CREEK 345KV CKT 1	1195.0	101.1065	BENTON - WICHITA 345KV CKT 1	

Several NRIS thermal constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations. The table below summarizes constraints and associated mitigations.

Table 8-17 Group 8 Cluster NRIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
4REMNGTON 138.00 - ASGI1708TP 138.00 138KV CKT 1	174.0	147.0969	SHIDLER - WEST PAWHUSKA 138KV CKT 1	Mitigated by ERIS Upgrade: Remington-Shidler 138 kV line to 1192.5 ACSR at 100 C
4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	212.0	120.1947	System Intact	Mitigated by ERIS Upgrade: Remington-Fairfax 138 kV line to 1590 ACSR at 100 C
4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	212.0	170.253	SHIDLER - WEST PAWHUSKA 138KV CKT 1	
BARTLESVILLE COMANCHE - BARTLESVILLE SOUTHEAST 138KV CKT 1	153.0	116.107	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	Mitigated by ERIS Upgrade: Rebuild approximately 5 miles of 138kV assigned to higher queued AECI project (GIA-59)
BARTLESVILLE COMANCHE - MOUND ROAD 138KV CKT 1	131.0	122.7703	System Intact	Rebuild approximately 45 miles of 138kV assigned to higher queued AECI project (GIA-59)
BARTLESVILLE COMANCHE - MOUND ROAD 138KV CKT 1	131.0	191.8509	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	
DOMES - MOUND ROAD 138KV CKT 1	189.0	111.8173	System Intact	
DOMES - MOUND ROAD 138KV CKT 1	189.0	161.4663	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	
DOMES - PAWHUSKA TAP 138KV CKT 1	189.0	114.5698	System Intact	
DOMES - PAWHUSKA TAP 138KV CKT 1	189.0	164.2834	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	
PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1	189.0	118.803	System Intact	
PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1	189.0	168.6955	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	
SHIDLER - WEST PAWHUSKA 138KV CKT 1	181.0	124.9734	System Intact	
SHIDLER - WEST PAWHUSKA 138KV CKT 1	189.0	102.0788	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	
FAIRFAX 138/69KV TRANSFORMER CKT 1	56.0	135.5407	System Intact	Mitigated by ERIS Upgrade: Upgrade the Fairfax 138/69 kV 56 MVA transformer to two 84 MVA units
FAIRFAX 138/69KV TRANSFORMER CKT 1	56.0	186.4159	FAIRFAX - PAWNSW4 138.00 138KV CKT 1	
ALTOONA - BUTLER 138KV CKT 1	101.0	113.4864	LACYGNE - WAVERLY7 345.00 345KV CKT 1	Build approximately 95 miles of Wolf Creek – Neosho 345kV CKT 1
MIDIAN (MIDI TX-1) 138/69/13.2KV TRANSFORMER CKT 1	110.0	106.6399	BUTLER - MIDIAN 138KV CKT 1	
CANEYRV7 345.00 - NEOSHO 345KV CKT 1	923.0	101.5129	LACYGNE - WAVERLY7 345.00 345KV CKT 1	
WAVERLY7 345.00 - WOLF CREEK 345KV CKT 1	1195.0	103.9609	CANEYRV7 345.00 - NEOSHO 345KV CKT 1	

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
LACYGNE - WAVERLY7 345.00 345KV CKT 1	1254.0	111.4434	CANEYRV7 345.00 - NEOSHO 345KV CKT 1	
BUTLER - MIDIAN 138KV CKT 1	143.0	108.1228	MIDIAN (MIDI TX-1) 138/69/13.2KV TRANSFORMER CKT 1	Build approximately 95 miles of Wolf Creek – Neosho 345kV CKT 1 and replace terminal equipment
ANADARKO - GRACMNT4 138.00 138KV CKT 1	200.0	104.2448	System Intact	Rebuild/Re-conductor approximately 5 miles of 138kV
ANADARKO - GRACMNT4 138.00 138KV CKT 1	234.0	115.5412	ANADARKO - SOUTHWESTERN STATION 138KV CKT 1	
BARTLESVILLE COMANCHE - BLUESTEM 138KV CKT 1	131.0	103.6094	BARTLESVILLE COMANCHE - BARTLESVILLE SOUTHEAST 138KV CKT 1	Build second Bartlesville – Bartlesville SE 138kV circuit #2
BENTON (BENT TX-1) 345/138/13.8KV TRANSFORMER CKT 1	440.0	106.6478	BENTON (BENT TX-2) 345/138/13.8KV TRANSFORMER CKT 1	Install Benton 345/138/13kV Transformer CKT 3
BENTON (BENT TX-2) 345/138/13.8KV TRANSFORMER CKT 1	440.0	103.989	BENTON (BENT TX-1) 345/138/13.8KV TRANSFORMER CKT 1	
CATOOSA - OWAS88 138KV CKT 1	210.0	101.4125	GRDA1 - GREC TAP5 345.00 345KV CKT 1	Rebuild/re-conductor 10 miles of 138kV
CHEROKEE DATA CENTER EAST TAP - OWAS88 138KV CKT 1	211.0	106.6425	GRDA1 - GREC TAP5 345.00 345KV CKT 1	Rebuild/re-conductor 2.5 miles of 138kV
CHEROKEE DATA CENTER EAST TAP - TULSA NORTH 138KV CKT 1	168.0	108.2759	System Intact	Rebuild/re-conductor 4 miles of 138kV
CHEROKEE DATA CENTER EAST TAP - TULSA NORTH 138KV CKT 1	209.0	120.5498	GRDA1 - GREC TAP5 345.00 345KV CKT 1	
CIMARRON (CIMARON1) 345/138/13.8KV TRANSFORMER CKT 1	382.0	116.151	CIMARRON (CIMARON2) 345/138/13.8KV TRANSFORMER CKT 1	Install 3rd transformer
CIMARRON (CIMARON2) 345/138/13.8KV TRANSFORMER CKT 1	382.0	119.9686	CIMARRON (CIMARON1) 345/138/13.8KV TRANSFORMER CKT 1	
CITY OF WINFIELD - RAINBOW 69KV CKT 1	43	119.2238	OAK - STROTHER FIELD (CITY OF WINFIELD) 69KV CKT 1	Rebuild/Re-conductor approximately 5 miles 69kV
OAK - RAINBOW 69KV CKT 1	43.0	122.1591	OAK - STROTHER FIELD (CITY OF WINFIELD) 69KV CKT 1	
G15063_T 345.00 - MATHWSN7 345.00 345KV CKT 1	1192.0	126.4527	G16-100-TAP 345.00 - SPRING CREEK 345KV CKT 1	Mitigated by the following ERIS upgrades: 1. Build Woodring – G15-063Tap (Redington) 345kV CKT 2 2. Build Redington – Spring Creek 345kV CKT 1 3. Hunter – Woodring 345kV CKT 2
G15063_T 345.00 - WOODRING 345KV CKT 1	1195.0	106.5606	G16-100-TAP 345.00 - SPRING CREEK 345KV CKT 1	
G16-100-TAP 345.00 - SPRING CREEK 345KV CKT 1	1039.0	102.6238	System Intact	
G16-100-TAP 345.00 - SPRING CREEK 345KV CKT 1	1195.0	121.3972	G15063_T 345.00 - MATHWSN7 345.00 345KV CKT 1	
VIOLA 7 345.00 - WICHITA 345KV CKT 1	1076.0	113.5549	G15052_T 345.00 - ROSE HILL 345KV CKT 1	
CRESWELL - MIDLTNT4 138.00 138KV CKT 1	222.0	103.0441	P23:345:WERE:WICH_345-116::-BUFFALOFLATS'	

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
VIOLA 7 345.00 (VIOLA TX-1) 345/138/13.8KV TRANSFORMER CKT 1	440.0	117.9047	P23:345:WERE:WICH_345-116::-BUFFALOFLATS	4. Viola – Buffalo Flats 345kV CKT 1 5. Northwest – Spring Creek 345kV CKT 2 6. Replace terminal equipment for Northwest – Spring Creek 345kV CKT 1 per DISIS-2016-001-1 assignment
EVANS ENERGY CENTER NORTH - SEDGWICK COUNTY NO. 12 COLWICH 138KV CKT 1	191.0	105.1446	RENO COUNTY - WICHITA 345KV CKT 1	Updated rating for Evan - Sedgwick
G16-032-TAP 345.00 345/138KV TRANSFORMER CKT 1	194.0	123.6013	System Intact	Interconnection Customer facility
G16-032-TAP 345.00 345/138KV TRANSFORMER CKT 1	222.0	139.6542	G15063_T 345.00 - MATHWSN7 345.00 345KV CKT 1	
G16133_765CS765.00 - G16133_765R3765.00 765KV CKT 1	2000.0	121.4655	System Intact	Interconnection Customer(s) facilities. IC will have to provide mitigation (equipment upgrade, ratings verifications) for constraints.
G16133_765CS765.00 - G16133_765R3765.00 765KV CKT 1	2000.0	125.687	G16133_765CS765.00 765/345KV TRANSFORMER CKT 1	
G16133_765R1765.00 - G16133_765TN765.00 765KV CKT 1	2000.0	122.5592	System Intact	
G16133_765R1765.00 - G16133_765TN765.00 765KV CKT 1	2000.0	124.2527	GRDA1 - GREC TAP5 345.00 345KV CKT 1	
G16133G16146345.00 - TULSA NORTH 345KV CKT 1	2000.0	119.4968	System Intact	
G16133G16146345.00 - TULSA NORTH 345KV CKT 1	2000.0	121.3382	GRDA1 - GREC TAP5 345.00 345KV CKT 1	
GRDA1 - GREC TAP5 345.00 345KV CKT 1	901.0	137.0632	System Intact	Replace terminal equipment
GRDA1 - GREC TAP5 345.00 345KV CKT 1	1055.0	131.8392	CHAMBER SPRINGS - CLARKSVILLE 345KV CKT 1	
BRISTOW - SILVER CITY 138KV CKT 1	114.0	104.203	OSAGE - WEBB CITY TAP 138KV CKT 1	Change out relays
OSAGE - WEBB CITY TAP 138KV CKT 1	287.0	102.6976	4REMNGTON 138.00 - FAIRFAX 138KV CKT 1	DISIS-2016-001-1 assigned upgrade
PITTSBURG - SEMINOLE 345KV CKT 1	717	99.6	CANADIAN RIVER - MUSKOGEE 345KV CKT 1	Updated rating is sufficient for this study's mitigation
RENO COUNTY (RENO TX-2) 345/115/14.4KV TRANSFORMER CKT 1	308.0	117.9397	P23:345:WERE:RENO_345-140::G16111TAP	Build 3rd transformer
SAND SPRINGS - SHEFFIELD 138KV CKT 1	156.0	106.0481	System Intact	Rebuild/Re-conductor approximately 1 mile of 138kV
SAND SPRINGS - SHEFFIELD 138KV CKT 1	202.0	133.7775	SAPULPA ROAD - WEKIWA 345KV CKT 1	

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
SHEFFIELD - WEKIWA 138KV CKT 1	156	106.363	System Intact	Rebuild/Re-conductor approximately 7.5 miles of 138kV
SHEFFIELD - WEKIWA 138KV CKT 1	173	153.734	SAPULPA ROAD - WEKIWA 345KV CKT 1	
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	317.0	158.4859	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1	Rebuild/re-conductor 2 miles of 161kV
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	286.0	135.5888	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1	Upgrade terminal equipment
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350.0	117.6236	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1	Build second Siloam Springs Tap (Tonnece) transformer
HARDY 4 138.00 - WEBBCTY4 138.00 138KV CKT 1	138.0	105.8156	System Intact	Rebuild/Re-conductor approximately 2 miles of 138kV
SHIDWFC4 138.00 - WEBB CITY TAP 138KV CKT 1	117.0	113.9112	System Intact	Mitigated by ERIS Upgrade: Rebuild/Re-conductor approximately 2.5 miles of 138kV
SHIDWFC4 138.00 - WEBBCTY4 138.00 138KV CKT 1	117.0	120.126	System Intact	Mitigated by ERIS Upgrade: Rebuild/Re-conductor approximately 13 miles of 138kV
TULSA NORTH (TULSA N) 345/138/34.5KV TRANSFORMER CKT 1	675.0	108.6503	System Intact	Mitigated by ERIS Upgrade: Install second 345/138kV transformer
TULSA NORTH (TULSA N) 345/138/34.5KV TRANSFORMER CKT 1	742.0	129.6571	GRDA1 - GREC TAP5 345.00 345KV CKT 1	

The following requests will require an Affected System review from AECI:

GEN-2016_091	GEN-2016_128	GEN-2016_143
GEN-2016_100	GEN-2016_133	GEN-2016_144
GEN-2016_101	GEN-2016_134	GEN-2016_145
GEN-2016_118	GEN-2016_137	GEN-2016_146
GEN-2016_119	GEN-2016_138	GEN-2016_148
GEN-2016_120	GEN-2016_141	GEN-2016_162
GEN-2016_127	GEN-2016_142	GEN-2016_163

The table below summarizes constraints and associated mitigations assignable to incremental ERIS steady state voltage. The steady state voltage constraints for mitigation are identified incremental to the thermal constraint mitigations.

Table 8-18 Group 8 Cluster ERIS Voltage Constraints

Monitored Element	TC Voltage (PU)	VMIN (PU)	VMAX (PU)	Contingency	Mitigation
7JASPER 345.00 345KV	0.876186	0.95	1.05	LACYGNE - WAVERLY7 345.00 345KV CKT 1	Existing Benton capacitor bank switched on, current study thermal upgrades, and install Neosho 200 Mvar Capacitor Bank
87th STREET 345KV	0.944269	0.95	1.05	P55:345:KCPL:STILWELL_BUS_22	
BENTON 345KV	0.93601	0.95	1.05	LACYGNE - WAVERLY7 345.00 345KV CKT 1	
CANEYRV7 345.00 345KV	0.883056	0.95	1.05	LACYGNE - WAVERLY7 345.00 345KV CKT 1	
NEOSHO 345KV	0.861014	0.95	1.05	LACYGNE - WAVERLY7 345.00 345KV CKT 1	
WICHITA 345KV	0.942535	0.95	1.05	LACYGNE - WAVERLY7 345.00 345KV CKT 1	
G16-153-TAP 345.00 345KV	0.930411	0.90	1.05	LACYGNE - WAVERLY7 345.00 345KV CKT 1	Viola project, current study thermal upgrades, and reactive power requirement (Order 827)
GEN-2016-153345.00 345KV	0.949951	0.90	1.05	LACYGNE - WAVERLY7 345.00 345KV CKT 1	IC facility mitigation
GEN-2016-162345.00 345KV	0.947625	0.90	1.05	LACYGNE - WAVERLY7 345.00 345KV CKT 1	
GEN-2016-163345.00 345KV	0.949158	0.90	1.05	LACYGNE - WAVERLY7 345.00 345KV CKT 1	
GEN-2016-057345.00 345KV	1.091346	0.90	1.05	MATHWSN7 345.00 - NORTHWEST 345KV CKT 1	
ZONE-1 SUB 345.00 345KV	1.052324	0.90	1.05	G16133_765CS765.00 765/345KV TRANSFORMER CKT 1	
ZONE-2 SUB 345.00 345KV	1.052314	0.90	1.05	G16133_765CS765.00 765/345KV TRANSFORMER CKT 1	
ZONE-4 SUB 345.00 345KV	1.052633	0.90	1.05	G16133_765CS765.00 765/345KV TRANSFORMER CKT 1	
ZONE-5 SUB 345.00 345KV	1.051285	0.90	1.05	G16133_765CS765.00 765/345KV TRANSFORMER CKT 1	
ZONE-6 SUB 345.00 345KV	1.051789	0.90	1.05	G16133_765CS765.00 765/345KV TRANSFORMER CKT 1	

The table below summarizes constraints and associated mitigations assignable to incremental NRIS steady state voltage. The steady state voltage constraints for mitigation are identified incremental to the thermal constraint mitigations.

Table 8-19 Group 8 Cluster NRIS Voltage Constraints

Monitored Element	TC Voltage (PU)	VMIN (PU)	VMAX (PU)	Contingency	Mitigation
G16-045-SUB2345.00 345KV	1.088014	0.9	1.05	GEN588097 1-G7 0.69 0.6900	GEN-2016-133 through GEN-2016-146 IC facility reactive power mitigation
G16133_345CS345.00 345KV	1.121134	0.9	1.05	GEN588057 1-G9 0.69 0.6900	
G16133_765CS765.00 765KV	1.125528	0.9	1.05	GEN588097 1-G7 0.69 0.6900	

G16133_765R2765.00 765KV	1.113902	0.9	1.05	GEN588097 1-G7 0.69 0.6900	
G16133_765R3765.00 765KV	1.125528	0.9	1.05	GEN588097 1-G7 0.69 0.6900	
G16-045-SUB2345.00 345KV	1.122185	0.9	1.05	GEN588097 1-G7 0.69 0.6900	
ZONE-1 SUB 345.00 345KV	1.122181	0.9	1.05	GEN588097 1-G7 0.69 0.6900	
ZONE-2 SUB 345.00 345KV	1.121142	0.9	1.05	GEN588097 1-G7 0.69 0.6900	
ZONE-3 SUB 345.00 345KV	1.121207	0.9	1.05	GEN588097 1-G7 0.69 0.6900	
ZONE-4 SUB 345.00 345KV	1.122203	0.9	1.05	GEN588097 1-G7 0.69 0.6900	
ZONE-5 SUB 345.00 345KV	1.121841	0.9	1.05	GEN588097 1-G7 0.69 0.6900	
ZONE-6 SUB 345.00 345KV	1.122185	0.9	1.05	GEN588097 1-G7 0.69 0.6900	

CLUSTER GROUP 9 (NEBRASKA AREA)

Generation in this area may require additional upgrades to relieve system reliability constraints related to NERC registered flowgates #5221, #6006, #6007, & #6008. These flowgates require additional review and updates resultant from the inclusion of the assigned network upgrades.

New requests for this study group as well as prior-queued requests are listed in Appendix C

Below is a list of the upgrades assigned, and the corresponding scenarios in which these upgrades were assigned. Scenario numbers are denoted as "S#".

Table 8-20 Group 9 Cluster Upgrade Scenarios

Scenario	Incremental Mitigation
0	None
2	Addition of Keystone to Red Willow 345kV circuit #1
	Addition of Post Rock to Red Willow 345kV circuit #1
	Reroute Laramie River Station (GEN-2016-110-Tap) to Stegall 345kV circuit #1 through the GEN-2016-023-Tap substation
3	Build GEN-2016-023-Tap substation to Stegall 345kV circuit #2
4	Addition of Antelope to Grand Prairie 345kV circuit #1
	Install +100 MVAR SVC at Keystone 345kV
	Install 20.0MVAR Atwood Switch 115kV switched shunt capacitor
	Install 10.0MVAR Heizer 69kV switched shunt capacitor
	Install 50.0MVAR Mingo 115kV switched shunt capacitor
	Install 30.0MVAR PH Run 115kV switched shunt capacitor

ERIS and NRIS non-converged constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The tables below summarize constraints and associated mitigations.

Table 8-21 Group 9 Cluster Non-Convergence ERIS Constraints

Contingent Elements	Mitigation
'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	1. Build Keystone – Red Willow 345kV Ckt 1 2. Build Red Willow – Caprock 345kV Ckt1 3. Reroute Laramie River Station (GEN-2016-110-Tap) to Stegall 345kV circuit #1 through the GEN-2016-023-Tap substation
'AXTELL - PAULINE 345KV CKT 1'	
'AXTELL - SWEETWATER 345KV CKT 1'	
'BANNER_CO 345.00 - G1623&1629-T345.00 345KV CKT 1'	
'BANNER_CO 345.00 - KEYSTONE 345KV CKT 1'	
'BANNER_CO 345.00 - SIDNEY2-LNX3345.00 345KV CKT 1'	
'CROOKED CREEK - NORTH PLATTE 230KV CKT 1'	
'FT THOMPSON - FTTHOM2-LNX3345.00 345KV CKT Z'	
'FTTHOM2-LNX3345.00 - GRPRAR2-LNX3345.00 345KV CKT 1'	
'FTTHOMPSON-GRANDPRAIRIE-TLINE-REACTOR-CKT1'	
'G15088_T 345.00 - G16-096-TAP 345.00 345KV CKT 1'	
'G15088_T 345.00 - MOORE 345KV CKT 1'	
'G16-050-TAP 345.00 - POST ROCK 345KV CKT 1'	
'G16-110-TAP 345.00 - LARAMIE RIVER 345KV CKT 1'	
'G16-110-TAP 345.00 - STEGALL 345KV CKT 1'	
'GEN344225 1-1CAL G1 25.000'	
'GERALD GENTLEMAN STATION - RED WILLOW 345KV CKT 1'	
'GERALD GENTLEMAN STATION - SWEETWATER 345KV CKT 1'	
'GERALD GENTLEMAN STATION - SWEETWATER 345KV CKT 2'	
'GR ISLD3 345.00 - MCCOOL 345KV CKT 1'	
'GR ISLD3 345.00 - SWEETWATER 345KV CKT 1'	
'GR ISLD-LNX3345.00 - GR ISLD3 345.00 345KV CKT Z'	
'GR ISLD-LNX3345.00 - HOLT.CO3 345.00 345KV CKT 1'	
'GRANDPRAIRIE-FTTHOMPSON-TLINE-REACTORS-CKT1'	
'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
'HOLCOMB - SETAB 345KV CKT 1'	
'HOLT 7 345.00 - MULLNCR7 345.00 345KV CKT 1'	
'HOLT 7 345.00 - SUB 3458 NEB CTY 345KV CKT 1'	
'KETCHEM7 345.00 - MULLNCR7 345.00 345KV CKT 1'	
'KETCHEM7 345.00 - SIBLEY 345KV CKT 1'	
'KEYSTONE - SIDNEY1-LNX3345.00 345KV CKT 1'	
'MCCOOL - MOORE 345KV CKT 1'	
'MINGO - RED WILLOW 345KV CKT 1'	
'MINGO - SETAB 345KV CKT 1'	
'NUNDRWD - WAYSIDE 230KV CKT 1'	
'SIDNEY-KEYSTONE-TLINE-REACTORS-CKT1'	
'STEGALL - STEGALL-LNX3230.00 230KV CKT Z'	
'STEGALL-LNX3230.00 - WAYSIDE 230KV CKT 1'	
'STEGALL-WAYSIDE-TLINE-REACTOR-CKT1'	

Table 8-22 Group 9 Cluster Non-Convergence NRIS Constraints

All non-converged constraints are mitigated by ERIS assigned upgrades.

Several ERIS thermal constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations.

Table 8-223 Group 9 Cluster ERIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
'BAILEYVILLE N.M. STATION (NEMAHA MARSHALL R - SMITTYVILLE N.M. COOP (NEMAHA MARSHALL R.E. 115KV CKT 1'	92	139.3618	'CLIFTON - CONCORDIA 115KV CKT 1'	1. Add Keystone – Red Willow 345kV 2. Add Red Willow – Post Rock 345kV
'BAILEYVILLE N.M. STATION (NEMAHA MARSHALL R - SOUTH SENECA 115KV CKT 1'	92	141.4832	'CLIFTON - CONCORDIA 115KV CKT 1'	
'BANNER_CO 345.00 - G1623&1629-T345.00 345KV CKT 1'	765	114.0115	'G16-110-TAP 345.00 - STEGALL 345KV CKT 1'	
'FT THOMPSON (FT2 KU1A) 345/230/13.8KV TRANSFORMER CKT 1'	313	107.4712	''P23:345:UMZW:# 705 #: FT2 IN SD. BREAKER FAULT (3396)''	
'FT THOMPSON (FT2 KU1B) 345/230/13.8KV TRANSFORMER CKT 1'	313	103.6825	''P43:345:UMZW:# 2419 #: FT2 IN SD. FT2 KU1B TRANSFORMER FAULT & FT2 2996 STUCK BKR''	
'GR ISLD-LNX3345.00 - GR ISLD3 345.00 345KV CKT Z'	720	124.1393	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
'HOSKINS (HOSKINS T2) 345/230/13.8KV TRANSFORMER CKT 1'	336	109.0027	''P42:345:NPPD:BKR-HOS-3312''	
'HOSKINS (HOSKN T4) 345/115/13.8KV TRANSFORMER CKT 1'	336	112.3116	''P42:345:NPPD:BKR-HOS-3310''	
'KELLY - KING HILL N.M. COOP (NEMAHA MARSHALL R.E.C. 115KV CKT 1'	92	135.9272	'CONCORDIA - ELM CREEK 230KV CKT 1'	
'KELLY - TECUMSEH HILL 161KV CKT 1'	112	122.9665	'CONCORDIA (CONCORD6) 230/115/13.8KV TRANSFORMER CKT 1'	
'MARSHAL3 115.00 - SMITTYVILLE N.M. COOP (NEMAHA MARSHALL R.E. 115KV CKT 1'	92	142.4537	'CLIFTON - CONCORDIA 115KV CKT 1'	
'MINGO - SETAB 345KV CKT 1'	762.5	108.8512	''P42:345:NPPD:BKR-AXT-3302''	

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
'KNOLL 230 - POSTROCK6 230.00 230KV CKT 1'	398	101.4931	System Intact	Advance Knoll - Post Rock 230kV ckt2.
'GERALD GENTLEMAN STATION - RED WILLOW 345KV CKT 1'	956	103.4719	'KEYSTONE - RED WILLOW 345KV CKT 1'	Rebuild GGS – Red Willow 345kV
'MINGO - RED WILLOW 345KV CKT 1'	785	117.5157	'POST ROCK - RED WILLOW 345KV CKT 1'	Rebuild Mingo – Red Willow 345kV

Additional NRIS thermal constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations.

Table 8-234 Group 9 Cluster NRIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
'COLUMEAST (COL.EAST T3) 230/115/13.8KV TRANSFORMER CKT 1'	187	117.8539	'COLUMEAST - SHELL CREEK 345KV CKT 1'	1. Add Grand Island – Seward county 345kV CKT 1 2. Add Grand Prairie – Hoskins 345kV CKT 1 3. Add Hoskins – Ft. Calhoun 345kV CKT 1
'DIXONCO 230.00 - TWIN CHURCH 230KV CKT 1'	320	115.6511	''P42:345:NPPD:BKR-HOS-3312''	
'FT RANDAL - FT THOMPSON 230KV CKT 1'	320	104.2082	'GRPRAR1-LNX3345.00 - HOLT.CO3 345.00 345KV CKT 1'	
FT RANDAL - LAKE PLATT 230KV CKT 1'	318.7	100.0769	'GRPRAR1-LNX3345.00 - HOLT.CO3 345.00 345KV CKT 1'	
'GR ISLD-LNX3345.00 - GR ISLD3 345.00 345KV CKT Z'	720	144.1995	'HOLT.CO3 345.00 - THEDFORD3 345.00 345KV CKT 1'	
'GR ISLD-LNX3345.00 - HOLT.CO3 345.00 345KV CKT 1'	720	143.1848	'HOLT.CO3 345.00 - THEDFORD3 345.00 345KV CKT 1'	
'GRAND ISLAND (GRAND.ISD T2) 230/115/13.8KV TRANSFORMER CKT 1'	316	100.8563	'GRAND ISLAND (GRAND.ISD T5) 230/115/13.8KV TRANSFORMER CKT 2'	
'GRAND ISLAND (GRAND.ISD T5) 230/115/13.8KV TRANSFORMER CKT 2'	316	100.7532	'GRAND ISLAND (GRAND.ISD T2) 230/115/13.8KV TRANSFORMER CKT 1'	

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
'GRPRAR1-LNX3345.00 - YANKTON 345KV CKT Z'	720	117.0697	''P45:345:UMZW:# 1327 #: FT2 IN SD.''	
'SIOUX CITY - TWIN CHURCH 230KV CKT 1'	320	108.4544	'HOSKINS - RAUN 345KV CKT 1'	
'MONOLITH 7 115.00 - SHELDON 115KV CKT 1'	400	108.6878	'MONOLITH 3 345.00 - MOORE 345KV CKT 1'	Assume incremental upgrade of Monolith – Sheldon 345kV (NTC #200477; UID #71967)
'MULLERGREN - SOUTH HAYS 230KV CKT 1'	297	112.6202	'G13-010T 345.00 - SPEARVILLE 345KV CKT 1'	Rebuild Great Bend – South Hays 230kV CKT 1
'POST ROCK (POSTROCK T1) 345/230/13.8KV TRANSFORMER CKT 1'	600	108.6255	'G13-010T 345.00 - SPEARVILLE 345KV CKT 1'	Add Post Rock 345/230/13kV Transformer CKT 2

The tables below summarize constraints and associated mitigations assignable to incremental ERIS & NRIS steady state voltage. The steady state voltage constraints for mitigation are identified incremental to the thermal constraint mitigations.

Table 8-245 Group 9 Cluster ERIS Voltage Constraints

Monitored Element	TC Voltage (PU)	VMIN (PU)	VMAX (PU)	Contingency	Mitigation
'103RD & ROKEBY 345KV'	0.94893	0.95	1.05	'G16-050-TAP 345.00 - POST ROCK 345KV CKT 1'	1. Add Grand Prairie - Antelope 345kV 2. Install +100 MVAR SVC at Keystone 345kV 3. Install 20.0MVAR Atwood Switch 115kV switched shunt capacitor 4. Install 10.0MVAR Heizer 69kV switched shunt capacitor 5. Install 50.0MVAR Mingo 115kV switched shunt capacitor 6. Install 30.0MVAR PH Run 115kV switched shunt capacitor
'ARNOLD 115KV'	0.895451	0.9	1.05	'COOPER - ST JOE 345KV CKT 1'	
'ATWOOD 115KV'	0.884642	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'ATWOOD SWITCH 115KV'	0.88895	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'AXTELL 345KV'	0.938944	0.95	1.05	'BASE CASE'	
'BEACH STATION 115KV'	0.89056	0.9	1.05	'COOPER - ST JOE 345KV CKT 1'	
'BEELER 115KV'	0.896827	0.9	1.05	'HOLCOMB - SETAB 345KV CKT 1'	
'BIRD CITY 115KV'	0.888941	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'BREWSTER 115KV'	0.897528	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'BUCKEYE_230 230.00 230KV'	0.898382	0.9	1.05	'G13-010T 345.00 - POST ROCK 345KV CKT 1'	
'BVERVLLY 115.00 115KV'	0.885973	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'CHASE 115KV'	0.897852	0.9	1.05	'G13-010T 345.00 - SPEARVILLE 345KV CKT 1'	
'CITY OF GOODLAND 115KV'	0.892007	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	

'CITY OF ST.FRANCIS 115KV'	0.891477	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'COLBY 115KV'	0.89721	0.9	1.05	'AXTELL - SWEETWATER 345KV CKT 1'	
'COLBY2 69KV'	0.896886	0.9	1.05	'BUCKNER7 345.00 - SPEARVILLE 345KV CKT 1'	
'COLUMWEST 230KV'	0.944429	0.95	1.05	'BASE CASE'	
'ELLIS 69KV'	0.893575	0.9	1.05	'AXTELL - SWEETWATER 345KV CKT 1'	
'FINNEY SWITCHING STATION 345KV'	0.947865	0.95	1.05	'BASE CASE'	
'FREMONT SUB F 69KV'	0.949353	0.95	1.05	'GEN647418 8-FREMONT 8'	
'G13_010_1 345.00 345KV'	0.888009	0.9	1.05	'G13-010T 345.00 - SPEARVILLE 345KV CKT 1'	
'G13-010T 345.00 345KV'	0.938241	0.95	1.05	'BASE CASE'	
'G15064_1 115.00 115KV'	0.89997	0.9	1.05	'COOPER - ST JOE 345KV CKT 1'	
'G15065_1 345.00 345KV'	0.898953	0.9	1.05	'COOPER - ST JOE 345KV CKT 1'	
'G16-050-TAP 345.00 345KV'	0.933068	0.95	1.05	'BASE CASE'	
'G16-096-TAP 345.00 345KV'	0.897054	0.9	1.05	'G15088_T 345.00 - MOORE 345KV CKT 1'	
'GEN-2016-050345.00 345KV'	0.866789	0.9	1.05	'G15088_T 345.00 - MOORE 345KV CKT 1'	
'GEN-2016-067345.00 345KV'	0.898953	0.9	1.05	'COOPER - ST JOE 345KV CKT 1'	
'GEN-2016-096345.00 345KV'	0.897054	0.9	1.05	'G15088_T 345.00 - MOORE 345KV CKT 1'	
'GOODLAND 115KV'	0.896535	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'GOODLAND TAP 115KV'	0.896585	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'GOVE 115KV'	0.89411	0.9	1.05	'AXTELL - SWEETWATER 345KV CKT 1'	
'GR ISLD3 345.00 345KV'	0.942015	0.95	1.05	'BASE CASE'	
'GR ISLD-LNX3345.00 345KV'	0.942015	0.95	1.05	'BASE CASE'	
'GRAHAM SUBSTATION 115KV'	0.887733	0.9	1.05	'COOPER - ST JOE 345KV CKT 1'	
'GRAND ISLAND 230KV'	0.937704	0.95	1.05	'BASE CASE'	
'GRINNELL 115KV'	0.892374	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'HERNDON 115KV'	0.89154	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'HOLCOMB 345KV'	0.948219	0.95	1.05	'BASE CASE'	

'HOXIE 115KV'	0.892391	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'HUMBOLDT 161KV'	0.940848	0.95	1.05	'COOPER - ST JOE 345KV CKT 1'	
'JOHNSON 115KV'	0.89526	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'KANARADO 115KV'	0.899327	0.9	1.05	'AXTELL - SWEETWATER 345KV CKT 1'	
'KNOLL 230 230KV'	0.895243	0.9	1.05	'G13-010T 345.00 - POST ROCK 345KV CKT 1'	
'LAWN RIDGE 115KV'	0.896575	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'LOCUST CREEK 161KV'	0.886932	0.9	1.05	'COOPER - ST JOE 345KV CKT 1'	
'LUDELL 3 115.00 115KV'	0.889367	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'LUDELLT3 115.00 115KV'	0.889373	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'MAGELLAN 69KV'	0.944064	0.95	1.05	'COOPER - ST JOE 345KV CKT 1'	
'MAGELLAN TAP 69KV'	0.944459	0.95	1.05	'COOPER - ST JOE 345KV CKT 1'	
'MCCOOL 345KV'	0.944056	0.95	1.05	'BASE CASE'	
'MCDONLD3 115.00 115KV'	0.886219	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'MINGO 115KV'	0.89997	0.9	1.05	'COOPER - ST JOE 345KV CKT 1'	
'MINGO 345KV'	0.923815	0.95	1.05	'BASE CASE'	
'MULLERGREN 230KV'	0.93294	0.95	1.05	'BASE CASE'	
'NATIONAL SUNFLOWER INDUSTRY TAP 115KV'	0.898166	0.9	1.05	'AXTELL - SWEETWATER 345KV CKT 1'	
'NESS CITY 115KV'	0.899604	0.9	1.05	'G15088_T 345.00 - MOORE 345KV CKT 1'	
'NORCATUR 115KV'	0.896434	0.9	1.05	'AXTELL - SWEETWATER 345KV CKT 1'	
'NORTH ATWOOD 115KV'	0.888808	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'NSI 115KV'	0.897575	0.9	1.05	'AXTELL - SWEETWATER 345KV CKT 1'	
'NW68TH & HOLDREGE 345KV'	0.943928	0.95	1.05	'G16-050-TAP 345.00 - POST ROCK 345KV CKT 1'	
'OBERLIN 115KV'	0.896254	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'OBERLIN TAP 115KV'	0.896468	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'ONEOK 3 115.00 115KV'	0.885813	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'PAULINE 345KV'	0.881442	0.9	1.05	'G15088_T 345.00 - MOORE 345KV CKT 1'	
'PHEASANT RUN 115KV'	0.89135	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'POST ROCK 345KV'	0.926569	0.95	1.05	'BASE CASE'	
'POSTROCK6 230.00 230KV'	0.935327	0.95	1.05	'BASE CASE'	

'PSCO LAMAR DC TIE 345KV'	0.884288	0.9	1.05	'BUCKNER7 345.00 - HOLCOMB 345KV CKT 1'	
'RANSOM 115KV'	0.897826	0.9	1.05	'COOPER - ST JOE 345KV CKT 1'	
'RANSOM 69KV'	0.898841	0.9	1.05	'BUCKNER7 345.00 - SPEARVILLE 345KV CKT 1'	
'RED WILLOW 345KV'	0.930555	0.95	1.05	'BASE CASE'	
'RHOADES 115KV'	0.887268	0.9	1.05	'COOPER - ST JOE 345KV CKT 1'	
'RIVERDALE 230KV'	0.935564	0.95	1.05	'BASE CASE'	
'RULETON 115KV'	0.897518	0.9	1.05	'AXTELL - SWEETWATER 345KV CKT 1'	
'S1398 5 161.00 161KV'	0.936027	0.95	1.05	'COOPER - ST JOE 345KV CKT 1'	
'S1399 5 161KV'	0.934626	0.95	1.05	'COOPER - ST JOE 345KV CKT 1'	
'SEGNTP 3 115.00 115KV'	0.895358	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'SEGUIN 3 115.00 115KV'	0.894148	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'SETAB 345KV'	0.936878	0.95	1.05	'BASE CASE'	
'SHARON SPRINGS 115KV'	0.897915	0.9	1.05	'G13-010T 345.00 - SPEARVILLE 345KV CKT 1'	
'SHELL CREEK 230KV'	0.947834	0.95	1.05	'BASE CASE'	
'SOUTH HAYS 230KV'	0.934464	0.95	1.05	'BASE CASE'	
'ST.FRANCIS 115KV'	0.890802	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'ST.FRANCIS TAP 115KV'	0.891605	0.9	1.05	'AXTELL - G16-050-TAP 345.00 345KV CKT 1'	
'SUB 1251 161KV'	0.992032	1.00186	1.0472	'ATCHSN 3 345.00 - COOPER 345KV CKT 1'	
'SUB 964 69KV'	0.948838	0.95	1.05	'G16-050-TAP 345.00 - POST ROCK 345KV CKT 1'	
'SUB 992 69KV'	0.94653	0.95	1.05	'GEN647418 8-FREMONT 8'	
'SUB 993 69KV'	0.937534	0.95	1.05	'COOPER - ST JOE 345KV CKT 1'	
'WALKEMEYER 7345.00 345KV'	0.94957	0.95	1.05	'BASE CASE'	
'WTCLF 3 115.00 115KV'	0.895026	0.9	1.05	'COOPER - ST JOE 345KV CKT 1'	
'WTCLFTP3 115.00 115KV'	0.89553	0.9	1.05	'COOPER - ST JOE 345KV CKT 1'	

Table 8-26 Group 9 Cluster NRIS Voltage Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
All NRIS voltage constraints are mitigated by ERIS assigned upgrades.				

CLUSTER GROUP 10 (SOUTHEAST OKLAHOMA/NORTHEAST TEXAS AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

No thermal or voltage constraints were observed in this group.

CLUSTER GROUP 12 (NORTHWEST ARKANSAS AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

No thermal or voltage constraints were observed in this group.

CLUSTER GROUP 13 (NORTHEAST KANSAS/NORTHWEST MISSOURI AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

One NRIS thermal constraint was observed for system-intact and single-contingency (N-1) conditions. The table below summarizes the constraint and associated mitigation.

Table 8-257 Group 13 Cluster NRIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
166TH STREET - JARBALO JUNCTION SWITCHING STATION 115KV CKT 1	239	112.40	P23:345:WERE:STRA_345-99::	Replace terminal equipment at Jarbalo Junction

The following requests will require an Affected System review from AECI:

GEN-2016_149
GEN-2016_150
GEN-2016_157
GEN-2016_158
GEN-2016_174
GEN-2016_176

CLUSTER GROUP 14 (SOUTH CENTRAL OKLAHOMA AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

Several ERIS thermal and voltage constraints were observed for system-intact and single-contingency (N-1) conditions. The table below summarizes constraints and associated mitigations.

Table 8-268 Group 14 Cluster ERIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
ARBUCKLE - G16-126-TAP 138.00 138KV CKT 1	191	165.53	BLUERIVER - PARK LANE 138KV CKT 1	Double Circuit from G16-126 Tap - Arbuckle 138kV
BLUERIVER - PARK LANE 138KV CKT 1	191	165.48	ARBUCKLE - G16-126-TAP 138.00 138KV CKT 1	

In addition to the ERIS constraint mitigations, several NRIS thermal and voltage constraints were observed for system-intact and single-contingency (N-1) conditions. The table below summarizes constraints and associated mitigations assignable to those requests that elect NRIS.

Table 8-279 Group 14 Cluster NRIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
ARBUCKLE - G16-126-TAP 138.00 138KV CKT 1	191	165.6	BLUERIVER - PARK LANE 138KV CKT 1	Double Circuit from G16-126 Tap - Arbuckle 138kV
BLUERIVER - PARK LANE 138KV CKT 1	191	165.42	ARBUCKLE - G16-126-TAP 138.00 138KV CKT 1	

CLUSTER GROUP 15 (EASTERN SOUTH DAKOTA)

In the event that the requested POI for GEN-2016-094 is not viable, this request may be incorporated into Group 15.

Generation in this area may require additional upgrades to relieve system reliability constraints related to NERC registered flowgate #6008. This flowgate requires additional review and updates resultant from the inclusion of the assigned network upgrades.

New requests for this study group as well as prior-queued requests are listed in Appendix C

Below is a list of the upgrades assigned, and the corresponding scenarios in which these upgrades were assigned. Scenario numbers are denoted as "S#".

Table 8-30 Group 15 Cluster Upgrade Scenarios

Scenario	Incremental Mitigation
0	None
2	Advance (R-Plan) Gerald Gentleman to Thedford to Holt 345kV circuit #1
	Addition of Antelope to Grand Prairie 345kV circuit #1
	Addition of GEN-2016-017 Tap to Ft. Thompson 345kV circuit #2
3	Rebuild GEN-2016-017 Tap to Ft. Thompson 345kV circuit #1
	Rebuild Ft. Thompson to Grand Prairie 345kV circuit #1
	Replace both Ft. Thompson 345/230kV transformers

Several ERIS non-converged constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations.

Table 8-31 Group 15 Cluster Non-Convergence ERIS Constraints

Monitored Elements	Mitigation
'ANTELOP-LNX3345.00 - GI1408_ABN 345.00 345KV CKT 1'	1. Build 2nd Circuit GEN-2016-017 Tap – Ft. Thompson 345kV 2. Build Grand Prairie – Antelope 345kV 3. Advance GGS - Thedford - Holt County 345 kV
'BRDLAND-LNX3345.00 - GI1408_ABN 345.00 345KV CKT 1'	
'BRDLAND-LNX3345.00 - HURON 345KV CKT Z'	
'BROADLAND - HURON 230KV CKT 1'	
'FT THOMPSON - FTTHOM1-LNX3345.00 345KV CKT Z'	

'FT THOMPSON - FTTHOM1-LNX3345.00 345KV CKT Z'	
'FTTHOM1-LNX3345.00 - G16-017-TAP 345.00 345KV CKT 1'	
'FTTHOM1-LNX3345.00 - G16-017-TAP 345.00 345KV CKT 1'	
'G16-017-TAP 345.00 - LELAND2-LNX3345.00 345KV CKT 1'	
'G1617TAP-LELANDOLDS-TLINE-REACTORS-CKT1'	
'GEN-2016-017TAP-FTTHOMPSONREACTOR-FTTHOMPSON-CKT1'	
'GEN-2016-017TAP-FTTHOMPSONREACTOR-FTTHOMPSON-CKT1'	
'GR ISLD-LNX3345.00 - GR ISLD3 345.00 345KV CKT Z'	
'GR ISLD-LNX3345.00 - GR ISLD3 345.00 345KV CKT Z'	
'GR ISLD-LNX3345.00 - HOLT.CO3 345.00 345KV CKT 1'	
'GR ISLD-LNX3345.00 - HOLT.CO3 345.00 345KV CKT 1'	
'GRANDPRAIRIE-HOLT-TLINE-REACTOR-CKT1'	
'GROTON - GROTON-LNX3 345.00 345KV CKT Z'	
'GROTON-LNX3 345.00 - LELAND1-LNX3345.00 345KV CKT 1'	
'GRPRAR1-LNX3345.00 - HOLT.CO3 345.00 345KV CKT 1'	
'GRPRAR1-LNX3345.00 - YANKTON 345KV CKT Z'	
'HURON (BD KU2A) 345/230/13.8KV TRANSFORMER CKT 1'	
'JUDSON 3345.00 - TANDE-LNX 345.00 345KV CKT 1'	
'JUDSON 3345.00 - TANDE-LNX 3345.00 345KV CKT 1'	
'LELAND OLDS - LELAND1-LNX3345.00 345KV CKT Z'	
'LELANDOLDS-GROTON-TLINE-REACTORS-345kV-CKT1'	

Table 8-32 Group 15 Cluster Non-Convergence NRIS Constraints

All non-converged constraints are mitigated by ERIS assigned upgrades.

Several ERIS thermal constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations.

Table 8-33 Group 15 Cluster ERIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
'DKSN_CO5 161.00 - LAKEFIELD 5 NO1 + NO 2 161KV CKT 1'	184	101.8885	''P13:115:UMZB:# 2729 #: WEL IN ND. WHEELOCK KV2A''	1. Rebuild GEN-2016-017 Tap – Ft. Thompson 345kV ckt1 2. Build GEN-2016-017 Tap – Ft. Thompson 345kV ckt2 3. Build Grand Prairie – Antelope 345kV ckt1 4. Advance GGS - Thedford - Holt County 345 kV 5. Rebuild Ft. Thompson – Grand Prairie 345kV
'FT THOMPSON - FTTHOM1-LNX3345.00 345KV CKT Z'	717	126.4141	'BRDLAND-LNX3345.00 - GI1408_ABN 345.00 345KV CKT 1'	
'FT THOMPSON - G16-094-TAP 230.00 230KV CKT 1'	352	113.1063	'FT THOMPSON - G16-094-TAP 230.00 230KV CKT 2'	
'FT THOMPSON - G16-094-TAP 230.00 230KV CKT 2'	352	113.1063	'FT THOMPSON - G16-094-TAP 230.00 230KV CKT 1'	
'FTTHOM1-LNX3345.00 - G16-017-TAP 345.00 345KV CKT 1'	717	126.2684	'BRDLAND-LNX3345.00 - GI1408_ABN 345.00 345KV CKT 1'	
'GR ISLD-LNX3345.00 - GR ISLD3 345.00 345KV CKT Z'	720	118.0381	'KELLY - MEADOWGROVE4230.00 230KV CKT 1'	
'GR ISLD-LNX3345.00 - HOLT.CO3 345.00 345KV CKT 1'	720	117.6454	'KELLY - MEADOWGROVE4230.00 230KV CKT 1'	
'FT THOMPSON (FT2 KU1A) 345/230/13.8KV TRANSFORMER CKT 1'	229.7682	720	''P23:345:UMZW:# 2423 #: GI IN NE. GI 1596 BKR FAULT''	Replace both Ft. Thompson 345/230kV transformers
'FT THOMPSON (FT2 KU1B) 345/230/13.8KV TRANSFORMER CKT 1'	229.794	720	''P23:345:UMZW:# 2422 #: GI IN NE. GI 1796 BKR FAULT''	
'GRPRAR1-LNX3345.00 - HOLT.CO3 345.00 345KV CKT 1'	720	103.8019	'ANTELOPE 3345.00 - YANKTON 345KV CKT 1'	Rating correction to 844 MVA
'GRPRAR1-LNX3345.00 - YANKTON 345KV CKT Z'	720	104.064	'ANTELOPE 3345.00 - YANKTON 345KV CKT 1'	

Table 8-284 Group 15 Cluster NRIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
'ABERDEEN SIEBRECHT - GROTON 115KV CKT 1'	129	118.9376	'G09_001IST 345.00 - WATERTOWN 345KV CKT 1'	1. Build 2nd circuit Aberdeen Siebrecht-Groton 115 kV 2. Build 2nd circuit BRISTOL - GROTON 115KV 3. Build 2nd circuit 'BRISTOL - SUMMIT 115KV 4. Build 2nd circuit G13_001IST 115.00 - SUMMIT 115KV 5. Build 2nd circuit G13_001IST 115.00 - WATERTOWN 115KV
'BRISTOL - GROTON 115KV CKT 1'	111	119.0426	'G09_001IST 345.00 - WATERTOWN 345KV CKT 1'	
'BRISTOL - SUMMIT 115KV CKT 1'	111	113.0546	'G09_001IST 345.00 - WATERTOWN 345KV CKT 1'	
'CRESTON - GROTON 115KV CKT 1'	200	132.1055	'G09_001IST 345.00 - WATERTOWN 345KV CKT 1'	
'G13_001IST 115.00 - SUMMIT 115KV CKT 1'	121	112.656	'G09_001IST 345.00 - WATERTOWN 345KV CKT 1'	
'G13_001IST 115.00 - WATERTOWN 115KV CKT 1'	121	126.5149	'G09_001IST 345.00 - WATERTOWN 345KV CKT 1'	
'GR ISLD-LNX3345.00 - GR ISLD3 345.00 345KV CKT Z'	720	123.6821	'ANTELOPE 3345.00 - YANKTON 345KV CKT 1'	Upgrade Holt County-Grand Island 345 kV line to 954 MVA and build 2nd circuit
'GR ISLD-LNX3345.00 - HOLT.CO3 345.00 345KV CKT 1'	720	122.684	'ANTELOPE 3345.00 - YANKTON 345KV CKT 1'	
'GRANITE FALLS - MN VALLEY TAP 230KV CKT 1'	259	101.1342	'GRANITE FALLS - MN VALLEY TAP 230KV CKT 1'	Rebuild 'GRANITE FALLS - MN VALLEY TAP 230KV CKT 1

Table 8-295 Group 15 Cluster ERIS Voltage Constraints

Monitored Element	TC Voltage (PU)	VMIN (PU)	VMAX (PU)	Contingency	Mitigation
HOWARDCI-69kV'	0.813	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
SW173-69kV'	0.823	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-SPNC-69kV'	0.849	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
SW139-69kV'	0.850	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MAD SE-69kV'	0.853	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	

MOS-LKV1-69kV'	0.858	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	1. Install 60.0MVAR Hanlon 230kV switched shunt capacitor. 2. Install 20.0MVAR Flandreau 115kV additional switched shunt capacitor.
LAMESA-69kV'	0.860	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-SALM-69kV'	0.861	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-MSTP-69kV'	0.862	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
WALLLK-69kV'	0.864	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MARIONRD-69kV'	0.864	0.9	1.05	FTTHOM2-LNX3345.00 - GRPRAR2-LNX3 345KV CKT 1'	
HARTSE-69kV'	0.865	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
HARTFORD-69kV'	0.865	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
ELLIS SW-69kV'	0.866	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-MRRD-69kV'	0.870	0.9	1.05	FTTHOM2-LNX3345.00 - GRPRAR2-LNX3 345KV CKT 1'	
SW102-69kV'	0.870	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
SW159-69kV'	0.870	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-ELIS-69kV'	0.872	0.9	1.05	FTTHOM2-LNX3345.00 - GRPRAR2-LNX3 345KV CKT 1'	
MOS-WTWR-69kV'	0.874	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
SUNDOWN-69kV'	0.875	0.9	1.05	FTTHOM2-LNX3345.00 - GRPRAR2-LNX3 345KV CKT 1'	
SXFALLS-69kV'	0.876	0.9	1.05	FTTHOM2-LNX3345.00 - GRPRAR2-LNX3 345KV CKT 1'	
WILOWCRK-69kV'	0.876	0.9	1.05	FTTHOM2-LNX3345.00 - GRPRAR2-LNX3 345KV CKT 1'	
HANLON18 69kV'	0.878	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
DELAPRE-69kV'	0.879	0.9	1.05	FTTHOM2-LNX3345.00 - GRPRAR2-LNX3 345KV CKT 1'	
SW211-69kV'	0.880	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
SW1109-69kV'	0.881	0.9	1.05	FTTHOM2-LNX3345.00 - GRPRAR2-LNX3 345KV CKT 1'	
PUKWANA-69kV'	0.889	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
SW619-69kV'	0.890	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
HILLTOP-69kV'	0.891	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	

SW162-69kV'	0.891	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-PLAT-69kV'	0.892	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-HLTP-69kV'	0.892	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
SW145-69kV'	0.892	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-CLMN-69kV'	0.893	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
NWPS7632-69kV'	0.893	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-HMPA-69kV'	0.895	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-STRP-69kV'	0.898	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-RVR2-69kV'	0.898	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-RVR1-69kV'	0.898	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-P-T-69kV'	0.899	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-C-H-69kV'	0.899	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
MOS-CHNC-69kV'	0.899	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	
CHANCLRS-69kV'	0.899	0.9	1.05	'GRPRAR2-LNX3345.00 - YANKTON 345KV CKT Z'	

Table 8-36 Group 15 Cluster NRIS Voltage Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
All NRIS voltage constraints are mitigated by ERIS assigned upgrades.				

CLUSTER GROUP 16 (WESTERN NORTH DAKOTA)

New requests for this study group as well as prior-queued requests are listed in Appendix C

Below is a list of the upgrades assigned, and the corresponding scenarios in which these upgrades were assigned. Scenario numbers are denoted as “S#”.

Table 8-37 Group 16 Cluster Upgrade Scenarios

<table>
<tr><th>Scenario</th><th>Incremental Mitigation</th></tr>
<tr><td>0</td><td>None</td></tr>
<tr><td rowspan="4">2</td><td>Addition new Emmons County 345kV substation along Antelope Valley Station to Broadland 345kV (500kV) and Fort Thompson to Leland Olds 345kV circuits</td></tr>
<tr><td>Addition new McIntosh County 345kV substation along Groton to Leland Olds 345kV circuit #1</td></tr>
<tr><td>Addition of a Emmons County to McIntosh County 345kV circuit</td></tr>
<tr><td>Addition of a 2nd 345/230kV transformer at Tande station</td></tr>
<tr><td rowspan="5">3</td><td>Re-tap CTs along Antelope Valley Station to Broadland 345kV (500kV) to Huron 230kV circuit #1</td></tr>
<tr><td>Replace Broadland 345/230kV transformer circuit #1</td></tr>
<tr><td>Raise structures & re-tap CTs on Fort Thompson to Leland Olds 345kV circuit #1</td></tr>
<tr><td>Convert Hilken 230kV substation to breaker and a half configuration</td></tr>
<tr><td>Rebuild Neset to Tioga 230kV circuit #1</td></tr>
</table>

Several ERIS non-converged constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations.

Table 8-308 Group 16 Cluster Non-Convergence ERIS Constraints

<table>
<tr><th>Monitored Elements</th><th>Mitigation</th></tr>
<tr><td>'ANTELOP-LNX3345.00 - GI1408_ABN 345.00 345KV CKT 1'</td><td rowspan="25">1. Addition of a new Emmons County 345kV substation along Antelope Valley Station to Broadland 345kV (500kV) and Fort Thompson to Leland Olds 345kV circuits
2. Addition of a new McIntosh County 345kV substation along Groton to Leland Olds 345kV circuit
3. Addition of a new approximately 45 mile Emmons County to McIntosh County 345kV circuit</td></tr>
<tr><td>'BRDLAND-LNX3345.00 - GI1408_ABN 345.00 345KV CKT 1'</td></tr>
<tr><td>'BRDLAND-LNX3345.00 - HURON 345KV CKT Z'</td></tr>
<tr><td>'BROADLAND - HURON 230KV CKT 1'</td></tr>
<tr><td>'FT THOMPSON - FTTHOM1-LNX3345.00 345KV CKT Z'</td></tr>
<tr><td>'FT THOMPSON - FTTHOM1-LNX3345.00 345KV CKT Z'</td></tr>
<tr><td>'FTTHOM1-LNX3345.00 - G16-017-TAP 345.00 345KV CKT 1'</td></tr>
<tr><td>'FTTHOM1-LNX3345.00 - G16-017-TAP 345.00 345KV CKT 1'</td></tr>
<tr><td>'G16-017-TAP 345.00 - LELAND2-LNX3345.00 345KV CKT 1'</td></tr>
<tr><td>'G1617TAP-LELANDOLDS-TLINE-REACTORS-CKT1'</td></tr>
<tr><td>'GEN-2016-017TAP-FTTHOMPSONREACTOR-FTTHOMPSON-CKT1'</td></tr>
<tr><td>'GEN-2016-017TAP-FTTHOMPSONREACTOR-FTTHOMPSON-CKT1'</td></tr>
<tr><td>'GR ISLD-LNX3345.00 - GR ISLD3 345.00 345KV CKT Z'</td></tr>
<tr><td>'GR ISLD-LNX3345.00 - GR ISLD3 345.00 345KV CKT Z'</td></tr>
<tr><td>'GR ISLD-LNX3345.00 - HOLT.CO3 345.00 345KV CKT 1'</td></tr>
<tr><td>'GR ISLD-LNX3345.00 - HOLT.CO3 345.00 345KV CKT 1'</td></tr>
<tr><td>'GRANDPRAIRIE-HOLT-TLINE-REACTOR-CKT1'</td></tr>
<tr><td>'GROTON - GROTON-LNX3 345.00 345KV CKT Z'</td></tr>
<tr><td>'GROTON-LNX3 345.00 - LELAND1-LNX3345.00 345KV CKT 1'</td></tr>
<tr><td>'GRPRAR1-LNX3345.00 - HOLT.CO3 345.00 345KV CKT 1'</td></tr>
<tr><td>'GRPRAR1-LNX3345.00 - YANKTON 345KV CKT Z'</td></tr>
<tr><td>'HURON (BD KU2A) 345/230/13.8KV TRANSFORMER CKT 1'</td></tr>
<tr><td>'LELAND OLDS - LELAND1-LNX3345.00 345KV CKT Z'</td></tr>
<tr><td>'LELANDOLDS-GROTON-TLINE-REACTORS-345kV-CKT1'</td></tr>
<tr><td>'JUDSON 3345.00 - TANDE-LNX 345.00 345KV CKT 1'</td><td rowspan="2">Addition of a 2nd 345/230kV transformer at Tande station</td></tr>
<tr><td>'JUDSON 3345.00 - TANDE-LNX 3345.00 345KV CKT 1'</td></tr>
</table>

Table 8-39 Group 16 Cluster Non-Convergence NRIS Constraints

All non-converged constraints are mitigated by ERIS assigned upgrades.

Several ERIS thermal constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations.

Table 0-40 Group 16 Cluster ERIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
'ANTELOP-LNX3345.00 - AVSBRDTAP 345.00 345KV CKT 1'	478	172.3306	'LELAND2-LNX3345.00 - LLOFTTTAP 345.00 345KV CKT 1'	Re-tap CTs to achieve higher rating
'AVSBRDTAP 345.00 - BRDLAND-LNX3345.00 345KV CKT 1'	478	152.9036	'GEN-2016-017TAP-FTTHOMPSONREACTOR-FTTHOMPSON-CKT1'	Replace Broadland transformer
LELAND2-LNX3345.00 - LLOFTTTAP 345.00 345KV CKT 1'	717	114.3172	'ANTELOP-LNX3345.00 - AVSBRDTAP 345.00 345KV CKT 1'	Raise structures & re-tap CTs to achieve higher rating
BISMARK - HILKEN 4 230.00 230KV CKT 1'	351	121.9286	'GARRISON - JAMES TOWN 230KV CKT 1'	Convert Hilken to breaker and a half bay
BRDLAND-LNX3345.00 - HURON 345KV CKT Z'	478	152.4231	'GEN-2016-017TAP-FTTHOMPSONREACTOR-FTTHOMPSON-CKT1'	Re-Tap CTs to achieve higher rating
NESET 4 230.00 - TIOGA 230KV CKT Z'	506	109.8056	'JUDSON 3345.00 - TANDE-LNX 345.00 345KV CKT 1'	Replace 1 mile of conductor and jumpers

Additional NRIS thermal constraints were observed for single contingency (N-1), and multi-contingency (P1, P2, etc.) conditions. The table below summarizes constraints and associated mitigations.

Table 8-41 Group 16 Cluster NRIS Thermal Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
'BELFIELD - DICKINSON 230KV CKT 1'	263	108.2853	'BOWMAN 4 230.00 - RHAME 4 230.00 230KV CKT 1'	Updated rating sufficient for need.
'GROTON (GROTON KU2A) 345/115/13.8KV TRANSFORMER CKT 1'	257	105.2802	'G09_001IST 345.00 - WATERTOWN 345KV CKT 1'	Updated rating sufficient for need.

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
'J607 POI 230.00 - WISHEK 230KV CKT 1'	257	106.0654	'CENTER - JAMESTOWN 345KV CKT 1'	Not required unless it is identified as constraint in affected system study.
'KENMARE - STANLEY 115KV CKT 1'	61	113.8683	'NESET 7 115.00 - WHTEARTH-MW7115.00 115KV CKT 1'	Not required unless it is identified as constraint in affected system study.
'LELAND OLDS - STANTON 230KV CKT 1'	285.2	118.4344	'GEN615002 2-COAL CREEK'	Not required unless it is identified as constraint in affected system study.
'MCHENRY (230/115) 230/115/12.47KV TRANSFORMER CKT 1'	84	115.4273	'RUGBY - RUGBY OTP 115KV CKT 1'	Not required unless it is identified as constraint in affected system study.
'MERRCRT4 230.00 - WISHEK 230KV CKT 1'	257	104.8077	'CENTER - JAMESTOWN 345KV CKT 1'	Not required unless it is identified as constraint in affected system study.
'STANLEY - TIOGA 115KV CKT 1'	68	129.422	'NESET 7 115.00 - WHTEARTH-MW7115.00 115KV CKT 1'	Not required unless it is identified as constraint in affected system study.

Table 8-42 Group 16 Cluster ERIS Voltage Constraints

Monitored Element	TC Voltage (PU)	VMIN (PU)	VMAX (PU)	Contingency	Mitigation
AUSTIN 115kV'	0.871	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	1. Install 60.0MVAR Hanlon 230kV switched shunt capacitor. 2. Install 20.0MVAR Flandreau 115kV additional switched shunt capacitor.
BELDEN 115kV'	0.871	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
BIGBEND 115kV'	0.88	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
BRDLAND3 345kV'	0.882	0.9	1.05	GROTON-LNX3 345.00 LLOGTNTAP 345.00 345KV CKT 1'	
BROOKBNK 115kV'	0.86	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
DELAPRE 69kV'	0.876	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
ELLIS SW 69kV'	0.861	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
ENEWTWN 115kV'	0.881	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
FINSTAD 115kV'	0.875	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
FTTHOMP3 345kV'	0.882	0.9	1.05	GROTON-LNX3 345.00 LLOGTNTAP 345.00 345KV CKT 1'	
G15_023_1 345kV'	0.882	0.9	1.05	GROTON-LNX3 345.00 LLOGTNTAP 345.00 345KV CKT 1'	
G16-017-TAP 345kV'	0.878	0.9	1.05	GROTON-LNX3 345.00 LLOGTNTAP 345.00 345KV CKT 1'	
GEN-2016-017345kV'	0.878	0.9	1.05	GROTON-LNX3 345.00 LLOGTNTAP 345.00 345KV CKT 1'	
GEN-2016-092345kV'	0.878	0.9	1.05	GROTON-LNX3 345.00 LLOGTNTAP 345.00 345KV CKT 1'	
GEN-2016-103345kV'	0.878	0.9	1.05	GROTON-LNX3 345.00 LLOGTNTAP 345.00 345KV CKT 1'	
GEN-2016-165345kV'	0.869	0.9	1.05	GROTON-LNX3 345.00 LLOGTNTAP 345.00 345KV CKT 1'	
GR PRAIRIE 3345kV'	0.869	0.9	1.05	GROTON-LNX3 345.00 LLOGTNTAP 345.00 345KV CKT 1'	
GR PRAIRIE3 345kV'	0.87	0.9	1.05	GROTON-LNX3 345.00 LLOGTNTAP 345.00 345KV CKT 1'	
HANLON18 69kV'	0.875	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
HARTFORD 69kV'	0.86	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
HARTSE 69kV'	0.859	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
HILLTOP 69kV'	0.889	0.9	1.05	GR ISLD-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
HOLT.CO3 345kV'	0.882	0.9	1.05	GROTON-LNX3 345.00 LLOGTNTAP 345.00 345KV CKT 1'	
HOWARDCI 69kV'	0.808	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
LAMESA 69kV'	0.854	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
LETCHER4 230kV'	0.897	0.9	1.05	GR ISLD-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
LLOGTNTAP 345kV'	0.948	0.95	1.05	'BASE CASE'	

LOSTWOOD 115kV'	0.884	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
MAD SE 69kV'	0.855	0.9	1.05	GRPRAR1-LNX3345.00 YANKTON 345KV CKT Z'	
MARIONRD 69kV'	0.861	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
MOE 115kV'	0.844	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
MOS-CLMN 69kV'	0.897	0.9	1.05	GRPRAR1-LNX3345.00 YANKTON 345KV CKT Z'	
MOS-ELIS 69kV'	0.869	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
MOS-GRNV 69kV'	0.89	0.9	1.05	G09_001IST 345.00 WATERTOWN 345KV CKT 1'	
MOS-HLTP 69kV'	0.89	0.9	1.05	GR ISLD-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
MOS-HMPA 69kV'	0.896	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
MOS-LKV1 69kV'	0.86	0.9	1.05	GRPRAR1-LNX3345.00 YANKTON 345KV CKT Z'	
MOS-MRRD 69kV'	0.867	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
MOS-MSTP 69kV'	0.856	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
MOS-PEEV 69kV'	0.89	0.9	1.05	G09_001IST 345.00 WATERTOWN 345KV CKT 1'	
MOS-PLAT 69kV'	0.89	0.9	1.05	GR ISLD-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
MOS-RVR1 69kV'	0.896	0.9	1.05	GR ISLD-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
MOS-RVR2 69kV'	0.896	0.9	1.05	GR ISLD-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
MOS-SALM 69kV'	0.858	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
MOS-SPNC 69kV'	0.845	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
MOS-WTWR 69kV'	0.876	0.9	1.05	GRPRAR1-LNX3345.00 YANKTON 345KV CKT Z'	
MTVERNS8 69kV'	0.895	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
OSBORN 115kV'	0.88	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
PALERMO 115kV'	0.895	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
PARSHALL 115kV'	0.895	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
PLANKCTY 69kV'	0.888	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
PSVSWTCH 115kV'	0.84	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
PUKWANA 69kV'	0.887	0.9	1.05	GR ISLD-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
PVALLEY 115kV'	0.84	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
RATLAKE 115kV'	0.851	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
RBNSNLAK 115kV'	0.869	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	

ROSS 115kV'	0.853	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
ROSS 115kV'	0.853	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
ROSS 115kV'	0.882	0.9	1.05	PSVSWTCH-MW7115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
ROSS 115kV'	0.882	0.9	1.05	PSVSWTCH-MW7115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
STANLEY 115kV'	0.885	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
SUNDOWN 69kV'	0.872	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
SW102 69kV'	0.866	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
SW102 69kV'	0.866	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
SW1109 69kV'	0.878	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
SW145 69kV'	0.893	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
SW159 69kV'	0.867	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
SW162 69kV'	0.892	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
SW173 69kV'	0.818	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
SW211 69kV'	0.883	0.9	1.05	GRPRAR1-LNX3345.00 YANKTON 345KV CKT Z'	
SW409 69kV'	0.891	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
SW619 69kV'	0.888	0.9	1.05	GR ISLD-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
SW752 69kV'	0.88	0.9	1.05	G09_001IST 345.00 WATERTOWN 345KV CKT 1'	
SXFALLS 69kV'	0.873	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
VANHOOK 115kV'	0.887	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
WALLLK 69kV'	0.858	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	
WHTEARTH 115kV'	0.839	0.9	1.05	NESET 7 115.00 WHTEARTH-MW7115.00 115KV CKT 1'	
WILMOT 69kV'	0.898	0.9	1.05	G09_001IST 345.00 WATERTOWN 345KV CKT 1'	
WILOWCRK 69kV'	0.873	0.9	1.05	GRPRAR1-LNX3345.00 HOLT.CO3 345.00 345KV CKT 1'	

Table 8-43 Group 16 Cluster NRIS Voltage Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
All NRIS voltage constraints are mitigated by ERIS assigned upgrades.				

Table 8-44 Group 16 Cluster NRIS Voltage Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
None meeting mitigation criteria				

CLUSTER GROUP 17 (WESTERN SOUTH DAKOTA)

The requested POI for GEN-2016-094 may not be viable, additional analysis will be required to identify if additional mitigation is required with a POI at Ft. Thompson. The interconnection cost estimate is for a POI at Ft. Thompson. In the event that the requested POI for GEN-2016-094 is not viable, this request may be incorporated into Group 15.

New requests for this study group as well as prior-queued requests are listed in Appendix C.

Table 8-45 Group 17 Cluster ERIS Constraints

Monitored Element	Limiting Rate A/B (MVA)	TC %Loading (%MVA)	Contingency	Mitigation
'FT THOMPSON - G16-094-TAP 230.00 230KV CKT 1'	352	113.1063	'FT THOMPSON - G16-094-TAP 230.00 230KV CKT 2'	Upgrade terminal equipment at Ft. Thompson 230kV
'FT THOMPSON - G16-094-TAP 230.00 230KV CKT 2'	352	113.0186	'FT THOMPSON - G16-094-TAP 230.00 230KV CKT 1'	

CLUSTER GROUP 18 (EASTERN NORTH DAKOTA)

No additional generation was studied for this group.

8.2 LIMITED OPERATION

Limited Operation results are listed below. While these results are based on the criteria listed in GIP 8.4.3, the Interconnection Customer may request additional scenarios for Limited Operation based on higher-queued Interconnection Requests not being placed in service. Requests not being placed in service. Please refer to section 8 for power flow constraint mitigation.

Table 8-46: Limited Operation Results

Group Number	Request	Available MW Before Mitigation	Most-Limiting Constraint
Group1	GEN-2016-118	ERIS - 271.90	DOVER SW - HENESSEY 138KV CKT 1
		NRIS – 180.65	TUPELO - TUPELO TAP 138KV CKT 1

	GEN-2016-131	ERIS – 2.5 MW	No ERIS Results for mitigation
		NRIS - 0	CIMARRON (CIMARON1) 345/138/13.8KV TRANSFORMER CKT 1
Group 2	ASGI-2016-010	ERIS – 48.72	CAPROCK REC-PEMBROOK () 115/69/13.2KV TRANSFORMER CKT 1
	GEN-2016-161	ERIS – 0	MARTIN SUB - PANTEX NORTH SUB 115KV CKT 1
Group 4	GEN-2016-111	ERIS – 226.24	RENO COUNTY (RENO TX-2) 345/115/14.4KV TRANSFORMER CKT 1
		NRIS - 209.89	RENO COUNTY (RENO TX-2) 345/115/14.4KV TRANSFORMER CKT 1
	GEN-2016-112	ERIS - 164.81	RENO COUNTY (RENO TX-2) 345/115/14.4KV TRANSFORMER CKT 1
		NRIS - 152.90	RENO COUNTY (RENO TX-2) 345/115/14.4KV TRANSFORMER CKT 1
	GEN-2016-113	ERIS - 116.11	RENO COUNTY (RENO TX-2) 345/115/14.4KV TRANSFORMER CKT 1
		NRIS - 107.73	RENO COUNTY (RENO TX-2) 345/115/14.4KV TRANSFORMER CKT 1
	GEN-2016-114	ERIS – 232.23	RENO COUNTY (RENO TX-2) 345/115/14.4KV TRANSFORMER CKT 1
		NRIS - 215.46	RENO COUNTY (RENO TX-2) 345/115/14.4KV TRANSFORMER CKT 1
	GEN-2016-122	ERIS - 168.55	RENO COUNTY (RENO TX-2) 345/115/14.4KV TRANSFORMER CKT 1
		NRIS - 156.38	RENO COUNTY (RENO TX-2) 345/115/14.4KV TRANSFORMER CKT 1
	GEN-2016-160	ERIS – 19.8	No ERIS Results for mitigation
		NRIS – 19.8	No NRIS Results for mitigation
Group 6	ASGI-2016-009	ERIS – 0	System Intact
	GEN-2015-039	ERIS – 0	System Intact
		NRIS-ERIS Limited	System Intact
	GEN-2015-040	ERIS – 0	System Intact
		NRIS-ERIS Limited	System Intact
	GEN-2015-078	ERIS – 0	System Intact
		NRIS-ERIS Limited	System Intact
	GEN-2016-039	ERIS – 0	System Intact
	GEN-2015-099	ERIS – 0	System Intact
	GEN-2016-077	ERIS – 0	System Intact
		NRIS-ERIS Limited	System Intact
	GEN-2016-078	ERIS – 0	System Intact
		NRIS-ERIS Limited	System Intact
	GEN-2016-120	ERIS – 0	System Intact
		NRIS-ERIS Limited	System Intact
	GEN-2016-121	ERIS – 0	System Intact
		NRIS-ERIS Limited	System Intact
	GEN-2016-123	ERIS – 0	System Intact
		NRIS-ERIS Limited	System Intact
	GEN-2016-124	ERIS – 0	System Intact
		NRIS-ERIS Limited	System Intact
	GEN-2016-125	ERIS – 0	System Intact
		NRIS-ERIS Limited	System Intact
	GEN-2016-169	ERIS – 0	System Intact
		NRIS-ERIS Limited	System Intact
	GEN-2016-171	ERIS – 0	System Intact
		NRIS-ERIS Limited	System Intact

	GEN-2016-172	ERIS – 0	System Intact
		NRIS-ERIS Limited	System Intact
	GEN-2016-175	ERIS – 0	System Intact
		NRIS-ERIS Limited	System Intact
	GEN-2016-177	ERIS – 0	'National Enrichment Plant Sub - TARGA 3115.00 115KV CKT 1'
Group 7	GEN-2016-091	ERIS – 303.6	No ERIS Results for mitigation
	GEN-2016-095	ERIS - 200	No ERIS Results for mitigation
		NRIS - 200	No NRIS Results for mitigation
	GEN-2016-097	ERIS – 62.91	'CORNVILLE - NORGE ROAD 138KV CKT 1'
		NRIS-ERIS Limited	
	GEN-2016-132	ERIS – 6.12	No ERIS Results for mitigation
		NRIS – 6.12	No NRIS Results for mitigation
Group 8	GEN-2016-024	ERIS – 0	LACYGNE - WAVERLY7 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-072	ERIS – 0	G15063_T 345.00 - MATHWSN7 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-100	ERIS – 0	G16-100-TAP 345.00 - SPRING CREEK 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-101	ERIS – 0	G16-100-TAP 345.00 - SPRING CREEK 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-119	ERIS – 0	G16-100-TAP 345.00 - SPRING CREEK 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-127	ERIS – 0	DOMES - MOUND ROAD 138KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-128	ERIS - 0	G15063_T 345.00 - MATHWSN7 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-133	ERIS – 0	GRDA1 - GREC TAP5 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-134	ERIS – 0	GRDA1 - GREC TAP5 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-135	ERIS – 0	GRDA1 - GREC TAP5 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-136	ERIS – 0	GRDA1 - GREC TAP5 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-137	ERIS – 0	GRDA1 - GREC TAP5 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-138	ERIS – 0	GRDA1 - GREC TAP5 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-139	ERIS – 0	GRDA1 - GREC TAP5 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-140	ERIS – 0	GRDA1 - GREC TAP5 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-141	ERIS – 0	GRDA1 - GREC TAP5 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-142	ERIS – 0	GRDA1 - GREC TAP5 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-143	ERIS – 0	GRDA1 - GREC TAP5 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-144	ERIS – 0	GRDA1 - GREC TAP5 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-145	ERIS – 0	GRDA1 - GREC TAP5 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-146	ERIS – 0	GRDA1 - GREC TAP5 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-148	ERIS – 0	BARTLESVILLE COMANCHE - MOUND ROAD 138KV CKT 1
		NRIS-ERIS Limited	

	GEN-2016-153	ERIS – 0	G15063_T 345.00 - MATHWSN7 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-162	ERIS – 0	LACYGNE - WAVERLY7 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-163	ERIS – 0	LACYGNE - WAVERLY7 345.00 345KV CKT 1
		NRIS-ERIS Limited	
	GEN-2016-173	ERIS – 0	LACYGNE - WAVERLY7 345.00 345KV CKT 1
		NRIS-ERIS Limited	
Group 9	GEN-2016-034	ERIS – 0	'MINGO - RED WILLOW 345KV CKT 1'
	GEN-2016-074	ERIS – 0	'MINGO - RED WILLOW 345KV CKT 1'
		NRIS – ERIS Limited	
	GEN-2016-096	ERIS – 0	'MINGO - RED WILLOW 345KV CKT 1'
	GEN-2016-106	ERIS – 0	'MINGO - RED WILLOW 345KV CKT 1'
		NRIS – ERIS Limited	
	GEN-2016-110	ERIS – 0	'MINGO - RED WILLOW 345KV CKT 1'
		NRIS – ERIS Limited	
	GEN-2016-147	ERIS – 0	'MINGO - RED WILLOW 345KV CKT 1'
		NRIS – ERIS Limited	
	GEN-2016-159	ERIS – 0	'HOSKINS (HOSKN T4) 345/115/13.8KV TRANSFORMER CKT 1'
		NRIS – ERIS Limited	
	GEN-2016-165	ERIS – 0	'GR ISLD-LNX3345.00 - GR ISLD3 345.00 345KV CKT Z'
		NRIS – ERIS Limited	
Group 10	GEN-2016-167	ERIS – 73.5	No ERIS Results for mitigation
		NRIS – 73.5	No NRIS Results for mitigation
Group 12	GEN-2016-166	ERIS - 35	No ERIS Results for mitigation
		NRIS - 35	No NRIS Results for mitigation
Group 13	GEN-2016-088	ERIS – 151.2	No NRIS Results for mitigation
		NRIS – 151.2	No NRIS Results for mitigation
	GEN-2016-115	ERIS – 300	No NRIS Results for mitigation
		NRIS – 300	No NRIS Results for mitigation
	GEN-2016-149	ERIS – 302	No ERIS Results for mitigation
		NRIS – 222.6	166TH STREET - JARBALO JUNCTION SWITCHING STATION 115KV CKT 1
	GEN-2016-150	ERIS -302	No ERIS Results for mitigation
		NRIS – 222.6	166TH STREET - JARBALO JUNCTION SWITCHING STATION 115KV CKT 1
	GEN-2016-157	ERIS – 252	No NRIS Results for mitigation
		NRIS – 252	No NRIS Results for mitigation
	GEN-2016-158	ERIS – 252	No NRIS Results for mitigation
		NRIS – 252	No NRIS Results for mitigation
	GEN-2016-168	ERIS – 20	No NRIS Results for mitigation
		NRIS – 20	No NRIS Results for mitigation
	GEN-2016-174	ERIS -302	No ERIS Results for mitigation
		NRIS – 222.6	166TH STREET - JARBALO JUNCTION SWITCHING STATION 115KV CKT 1
	GEN-2016-176	ERIS -302	No ERIS Results for mitigation
		NRIS – 222.6	166TH STREET - JARBALO JUNCTION SWITCHING STATION 115KV CKT 1
Group 14	GEN-2016-102	ERIS – 92.49	ARBUCKLE - G16-126-TAP 138.00 138KV CKT 1
		NRIS – 92.43	ARBUCKLE - G16-126-TAP 138.00 138KV CKT 1
	GEN-2016-126	ERIS – 105.74	ARBUCKLE - G16-126-TAP 138.00 138KV CKT 1
		NRIS – 105.66	ARBUCKLE - G16-126-TAP 138.00 138KV CKT 1
	GEN-2016-129	ERIS - 132	No ERIS Results for mitigation
		NRIS - 132	No NRIS Results for mitigation

Group 15	GEN-2016-036	ERIS – 0	'SPLIT ROCK - WHITE 345KV CKT 1'
	GEN-2016-087	ERIS – 0	'SPLIT ROCK - WHITE 345KV CKT 1'
	GEN-2016-092	ERIS – 0	'SPLIT ROCK - WHITE 345KV CKT 1'
		NRIS – ERIS Limited	
	GEN-2016-103	ERIS – 0	'SPLIT ROCK - WHITE 345KV CKT 1'
		NRIS – ERIS Limited	
	GEN-2016-164	ERIS – 0	'SPLIT ROCK - WHITE 345KV CKT 1'
		NRIS – ERIS Limited	
Group 16	GEN-2016-108	ERIS – 0	'BRDLAND-LNX3345.00 - HURON 345KV CKT Z'
		NRIS – ERIS Limited	
	GEN-2016-130	ERIS – 0	'MERRCRT4 230.00 - WISHEK 230KV CKT 1'
		NRIS – ERIS Limited	
	GEN-2016-151	ERIS – 0	'MERRCRT4 230.00 - WISHEK 230KV CKT 1'
		NRIS – ERIS Limited	
	GEN-2016-152	ERIS – 0	'MERRCRT4 230.00 - WISHEK 230KV CKT 1'
		NRIS – ERIS Limited	
	GEN-2016-155	ERIS – 0	'BISMARK - HILKEN 4 230.00 230KV CKT 1'
		NRIS – ERIS Limited	
Group 17	GEN-2016-094	ERIS – 129.9	FT THOMPSON - G16-094-TAP 230.00 230KV CKT 1
		NRIS-ERIS Limited	

8.3 CURTAILMENT AND SYSTEM RELIABILITY

In no way does this study guarantee operation for all periods of time. It should be noted that although this study analyzed many of the most probable contingencies, it is not an all-inclusive list and cannot account for every operational situation. Because of this, it is likely that the Customer(s) may be required to reduce their generation output to 0 MW, also known as curtailment, under certain system conditions to allow system operators to maintain the reliability of the transmission network.

9 STABILITY & SHORT CIRCUIT ANALYSIS

A stability and short-circuit analysis was conducted for each Interconnection Request using modified versions of the MDWG Models dynamic cases. The stability analysis assumes that all upgrades identified in the power flow analysis are in-service unless otherwise noted in the individual group stability study.

For each group, the interconnection requests are studied at 100% nameplate output while the other groups are dispatched at 20% output for Variable Energy Resource (VER) requests and 100% output for other requests. The output of the Interconnection Customer's facility is offset in each model by a reduction in output of existing online SPP generation.

A synopsis is included for each group. The detailed stability study for each group can be found in the Appendices.

A preliminary short-circuit analysis was performed for this study and will be refined in the Interconnection Facilities Study with any additional required upgrades and cost assignment identified at that time.

9.1 POWER FACTOR REQUIREMENTS SUMMARY

Power factor requirements will be in accordance with FERC Order No. 827, Final Rule, Issued June 16, 2016.

9.2 CLUSTER STABILITY AND SHORT-CIRCUIT SUMMARY

CLUSTER GROUP 1 (WOODWARD AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

The Group 1 stability analysis for this area was performed by S&C Electric (S&C). With the new requests modeled, violations of stability damping criteria and voltage recovery criteria were observed.

The consultant observed that certain prior outage contingencies require curtailment of study generation as a system adjustment.

With all previously-assigned and currently-assigned Network Upgrades placed in service and identified system adjustments applied, no violations were observed, including violations of low-voltage ride-through requirements, for the probable contingencies studied.

CLUSTER GROUP 2 (HITCHLAND AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

The Group 2 stability analysis for this area was performed by Quanta Technology (Quanta). With the new requests modeled, violations of stability damping criteria and voltage recovery criteria were observed. Upgrades identified in the power flow analysis were also tested in the stability analysis.

The consultant has identified some reactor banks on the 345kV system with proximity to the Woodward EHV station may need to be switched out of service under system conditions of high wind generation in the Hitchland area. Reactors located on the following facilities were initialized to 0 Mvar:

- Beaver County - Badger 345kV
- Woodward - GEN-2016-003-Tap 345kV
- Woodward 345kV (located on Transformer Tertiaries)
- Woodward - Thistle 345kV
- Thistle - GEN-2016-005-Tap 345kV
- Buffalo - Thistle 345kV
- Buffalo - Wichita 345kV

With all previously-assigned and currently-assigned Network Upgrades placed in service and identified system adjustments applied, no violations were observed, including violations of low-voltage ride-through requirements, for the probable contingencies studied.

CLUSTER GROUP 3 (SPEARVILLE AREA)

No new interconnection requests in this group.

CLUSTER GROUP 4 (NORTHWEST KANSAS AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

The Group 4 stability analysis for this area was performed by POWER-tek Global Inc. (POWER-tek). With the new requests modeled, violations of stability damping criteria and voltage recovery criteria were not observed.

There were no impacts on the stability performance of the SPP system.

With all previously-assigned and currently-assigned Network Upgrades placed in service, no violations were observed, including violations of low-voltage ride-through requirements, for the probable contingencies studied.

CLUSTER GROUP 6 (SOUTH TEXAS PANHANDLE/NEW MEXICO AREA)

The requested POI for GEN-2016-077 is not viable, additional analysis will be required to identify if additional mitigation is required with a viable POI on the requested circuit. The interconnection cost estimate is for a valid POI on the requested circuit.

New requests for this study group as well as prior-queued requests are listed in Appendix C.

The Group 6 cases included the following system adjustments of dispatching, to maximum output, generation interconnected at the same or adjacent substations to a current study request:

- Mustang units: GEN-2015-040 & GEN-2015-078
- TUCO units: GEN-2016-120 & GEN-2016-175
- Tolk units: GEN-2016-123, GEN-2016-124, & GEN-2016-125
- Hobbs & Gaines units: GEN-2016-169 & GEN-2016-171
- Plant X units: GEN-2015-039 & GEN-2016-172

The Group 6 stability analysis for this area was performed by Mitsubishi Electric Power Products (MEPPI). With the new requests modeled, voltage instability, violations of voltage recovery criteria, and generation tripping off were observed. Upgrades identified in the power flow analysis were also tested in the stability analysis.

To mitigate the voltage instability, violations of voltage recovery criteria, and generation tripping off the following upgrades were implemented in each season:

- Crawfish Draw +600 MVAR SVC injection at the 765 kV bus
- Crawfish Draw 345/230 kV autotransformer #2
- Crawfish Draw – Crossroads 765 kV circuit #1
- Crawfish Draw – Midpoint Substation – Seminole (OKGE) 765 kV circuit #1 & #2
    - Due to reactive power demand from line loadings, in-line reactors were switched off
- Crossroads 765/345 kV transformer #1 and #2
- Crawfish Draw 765/345 kV transformer #1 and #2
- Seminole 765/345 kV transformer #1 and #2
- Hobbs to Yoakum to Tuco 345 kV circuit #1 (advancement in 17W and 18S)
- Yoakum 345/230 kV transformer #1 (advancement in 17W and 18S)
- Tolk 345/230 kV transformer #3

During the analysis it was determined that the addition of a substation tying both 765 kV circuits together at approximately 50% of the line length reduced the severity of a single circuit outage and resulted in significant reduction in the dynamic reactive equipment required to maintain system stability for outages in the Crawfish Draw/Seminole region.

SPP determined the 765 kV Network Upgrade cost estimates using conceptual amounts which require a facility study to substantiate.

Prior to completion of Facility Study, the GEN-2016-077 & GEN-2016-078 customers must provide SPP with an updated model or fault simulation instructions from the inverter vendor that mitigates the simulation tripping identified.

The consultant also noted that for certain prior outage conditions curtailment (system adjustment) will be needed to maintain system stability for subsequent circuit outages.

With all previously-assigned and currently-assigned Network Upgrades placed in service and identified system adjustments applied, no violations were observed (except as noted earlier), including violations of low-voltage ride-through requirements, for the probable contingencies studied.

CLUSTER GROUP 7 (SOUTHWESTERN OKLAHOMA AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

The Group 7 cases included the following system adjustments of dispatching, to maximum output, generation interconnected at the same or adjacent substations to a current study request:

- Southwestern Station & Anadarko units: GEN-2016-097

The Group 7 stability analysis for this area was performed by S&C Electric Company (S&C). With the new requests modeled system instability was observed.

The consultant noted that for certain faults, the generating facility comprised of the higher queued requests GEN-2003-004, GEN-2004-023, & GEN-2005-003 exhibited a simulation numerical issue; the GNET command was implemented for that facility. Additionally, abnormal oscillations were observed for a prior outage condition which was not improved through curtailment of current study generation. The system adjustment necessary to remedy the observed oscillations may involve curtailment of other generating units which requires analysis beyond the scope of this study.

With all previously-assigned and currently-assigned Network Upgrades placed in service and identified system adjustments applied, no violations were observed (except as noted earlier), including violations of low-voltage ride-through requirements, for the probable contingencies studied.

CLUSTER GROUP 8 (NORTH OKLAHOMA/SOUTH CENTRAL KANSAS AREA)

Complete results for requests in this cluster group including the transmission reinforcement upgrades identified during the evaluation of the Gerald Gentleman Station registered NERC flowgate #6006, refined upgrades to address stuck breaker conditions, and curtailment for prior outage conditions will be provided in a later update.

New requests for this study group as well as prior-queued requests are listed in Appendix C.

The Group 8 cases included the following system adjustments of dispatching, to maximum output, generation interconnected at the same or adjacent substations to a current study request:

- Sooner & Spring Creek units: GEN-2016-100, GEN-2016-101, GEN-2016-119, & GEN-2016-128
- West Pawhuska unit: GEN-2016-127 & GEN-2016-148
- Northeastern units & GRDA Energy Center: GEN-2016-133 – GEN-2016-146

The Group 8 stability analysis for this area was performed by Mitsubishi Electric Power Products (MEPPI). With the new requests modeled, voltage instability, violations of voltage recovery criteria, and generation tripping off were observed. Upgrades identified in the power flow analysis were also tested in the stability analysis.

To mitigate the voltage instability, violations of voltage recovery criteria, and generation tripping off the following upgrades were implemented in each season:

- Redington to Woodring 345 kV circuit #2
- Hunter to Woodring 345 kV circuit #2
- Redington to Spring Creek 345 kV circuit #1
- Tulsa North 345/138 kV transformer #2
- Static Var Compensators (SVC)
    - +300 Mvar SVC at Tulsa North 345 kV bus (wind plant side of 765 kV line)
    - +300 Mvar SVC at Tulsa North 345 kV bus (transmission side of 765 kV line)

MEPPI noted that the SVC solutions at the Tulsa North 345kV bus mitigated a portion of the contingencies around the substation. For a few contingencies a reasonable solution was not determined due to the 2500MW of generation interconnected at the Tulsa North 345kV substation being through 360 miles of 765kV transmission line. For certain contingencies the long transmission line caused GEN-2016-133 through GEN-2016-146 to trip offline due to overvoltage protection. With overvoltage protection disabled these projects remained online. Prior to completion of Facility Study these interconnection customers must provide SPP a modified project design that will meet the voltage ride through requirements of FERC Order #661A.

Prior to completion of Facility Study, the GEN-2016-173 customer must provide SPP with an updated model or fault simulation instructions from the inverter vendor that mitigates the simulation tripping identified.

The consultant also noted that for certain prior outage conditions curtailment (system adjustment) will be needed to maintain stability for subsequent outages.

With all previously-assigned and currently-assigned Network Upgrades placed in service and identified system adjustments applied, no violations were observed (except as noted earlier), including violations of low-voltage ride-through requirements, for the probable contingencies studied.

CLUSTER GROUP 9 (NEBRASKA AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

Generation in this area may require additional upgrades to relieve system reliability constraints related to NERC registered flowgates #5221, #6006, #6007, & #6008. These flowgates require additional review and updates resultant from the inclusion of the assigned network upgrades.

The Group 9 cases included the following system adjustments of dispatching, to maximum output, generation interconnected at the same or adjacent substations to a current study request:

- Laramie River Station units: GEN-2016-034 & GEN-2016-110
- Sheldon units: GEN-2016-096
- Gerald Gentleman Station units: GEN-2016-074 & GEN-2016-106
- Neal units: GEN-2016-059

The Group 9 stability analysis for this area was performed by Mitsubishi Electric Power Products (MEPPI). With the new requests modeled, violations of stability damping criteria and voltage recovery criteria were observed. Upgrades identified in the power flow analysis were also tested in the stability analysis.

To mitigate the voltage instability, violations of voltage recovery criteria, and generation tripping off the following upgrades were implemented in each season:

- Addition of Keystone to Red Willow 345kV circuit #1
- Addition of Post Rock to Red Willow 345kV circuit #1
- Addition of Antelope to Grand Prairie 345kV circuit #1
- Reroute Laramie River Station (GEN-2016-110-Tap) to Stegall 345kV circuit #1 through the GEN-2016-023-Tap substation
- Addition of SVC with +100MVAR injection at Keystone 345kV

It should be noted that for certain prior outage conditions curtailment (system adjustment) will be needed to maintain system stability for subsequent circuit outages.

The High GGS Scenario Stability Analysis determined that with the mitigations applied from the normal dispatch scenario no violations of stability damping criteria and voltage recovery criteria were observed. With all previously-assigned and currently-assigned Network Upgrades placed in service and identified system adjustments applied, no violations were observed, including violations of low-voltage ride-through requirements, for the probable contingencies studied.

CLUSTER GROUP 10 (SOUTHEAST OKLAHOMA/NORTHEAST TEXAS AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

The Group 10 cases included the following system adjustments of dispatching, to maximum output, generation interconnected at the same or adjacent substations to a current study request:

- Lieberman units: GEN-2016-167

The Group 10 stability analysis for this area was performed by Aneden Consulting (Aneden). With the new requests modeled, violations of stability damping criteria and voltage recovery criteria were observed.

The consultant reported the following:

- For certain contingencies at and near the POI, the GEN-2016-167 generator was tripped offline under both under and over frequency relays. Certain limitations within the generator stability model and/or low-inertia within the network can result in drastic changes to the bus reference angles which may then cause spikes in quantities such as the calculated frequencies. According to Siemens PTI, this is a well-known issue with the modeling of PV type devices in simulation software like PSS/E. Some of the frequency relay settings associated with GEN-2016-167 generator were adjusted to prevent the tripping of the generator caused by this modeling issue.

- The consultant observed that certain prior outage contingencies require curtailment of study generation as a system adjustment.

Prior to completion of Facility Study, the GEN-2016-167 customer must provide SPP with an updated model or fault simulation instructions from the inverter vendor that mitigates the simulation tripping identified.

With all previously-assigned and currently-assigned Network Upgrades placed in service and identified system adjustments applied, no violations were observed, including violations of low-voltage ride-through requirements, for the probable contingencies studied.

CLUSTER GROUP 12 (NORTHWEST ARKANSAS AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

The Group 12 stability analysis for this area was performed by ABB Inc. (ABB). With the new requests modeled, violations of stability damping criteria and voltage recovery criteria were observed.

For certain contingencies at and near the POI GEN-2016-166 tripped offline due to frequency relay initiated tripping. The Interconnection Customer (IC) should review with the generator vendor the frequency relay settings, including the frequency measurement location, as well as dynamic response of the inverter model to avoid such type of tripping.

Prior to completion of Facility Study, the GEN-2016-166 customer must provide SPP with an updated model or fault simulation instructions from the inverter vendor that mitigates the simulation tripping identified.

With all previously-assigned and currently-assigned Network Upgrades placed in service and identified system adjustments applied, no violations were observed, including violations of low-voltage ride-through requirements, for the probable contingencies studied.

CLUSTER GROUP 13 (NORTHEAST KANSAS/NORTHWEST MISSOURI AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

The Group 13 cases included the following system adjustments of dispatching, to maximum output, generation interconnected at the same or adjacent substations to a current study request:

- Sibley units: GEN-2016-088 & GEN-2016-115
- Nebraska City units: GEN-2016-088 & GEN-2016-115
- Iatan units: GEN-2016-149, GEN-2016-150, GEN-2016-174, & GEN-2016-176

- West Gardner units: GEN-2016-157 & GEN-2016-158
- Higginsville units: GEN-2016-168

The Group 13 stability analysis for this area was performed by POWER-tek Global Inc. (POWER-tek). With the new requests modeled, violations of stability damping criteria and voltage recovery criteria were observed.

For certain contingencies at and near the POI, GEN-2016-168 tripped offline due to frequency relay initiated tripping. The Interconnection Customer (IC) should review with the generator vendor the frequency relay settings, including the frequency measurement location, as well as dynamic response of the inverter model to avoid such type of tripping.

Prior to completion of Facility Study, the GEN-2016-168 customer must provide SPP with an updated model or fault simulation instructions from the inverter vendor that mitigates the simulation tripping identified.

The consultant noted that for the outage of the Holt to Nebraska City 345 kV circuit #1, system oscillations were observed. It was determined that the combination of the existing bus reactor switching set points and a voltage control response from the higher queued request GEN-2014-021 results in a stable response.

With all previously-assigned and currently-assigned Network Upgrades placed in service and identified system adjustments applied, no violations were observed, including violations of low-voltage ride-through requirements, for the probable contingencies studied.

CLUSTER GROUP 14 (SOUTH CENTRAL OKLAHOMA AREA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

The Group 14 cases included the following system adjustments of dispatching, to maximum output, generation interconnected at the same or adjacent substations to a current study request:

- Seminole units: GEN-2016-102 & GEN-2016-126
- Hugo Power Plant unit: GEN-2016-129

The Group 14 stability analysis for this area was performed by S&C. With the new requests modeled, violations of stability damping criteria and voltage recovery criteria were observed. Upgrades identified in the power flow analysis were also tested in the stability analysis.

Analysis of Group 14 dynamic simulation results showed that for some contingencies, the voltages in the area close to interconnection requests, GEN-2016-126 and GEN-2016-102, reach high voltages of 1.37 p.u. at the POI of GEN-2016-126 and other nearby buses, immediately following fault clearing. To mitigate the observed overvoltage instances, the base cases were updated to set GEN-2016-126 to inject 0 MVAR in the power flow case.

With all previously-assigned and currently-assigned Network Upgrades placed in service and identified system adjustments applied, no violations were observed, including violations of low-voltage ride-through requirements, for the probable contingencies studied.

CLUSTER GROUP 15 (EASTERN SOUTH DAKOTA)

In the event that the requested POI for GEN-2016-094 is not viable, this request may be incorporated into Group 15.

Generation in this area may require additional upgrades to relieve system reliability constraints related to NERC registered flowgate #6008. This flowgate requires additional review and updates resultant from the inclusion of the assigned network upgrades.

New requests for this study group as well as prior-queued requests are listed in Appendix C.

The Group 15 cases included the following system adjustments of dispatching, to maximum output, generation interconnected at the same or adjacent substations to a current study request:

- Aberdeen, Groton, & Redfield units: GEN-2016-164
- Big Bend & Leland Olds units: GEN-2016-092 & GEN-2016-103

The Group 15 stability analysis for this area was performed by Burns & McDonnell Engineering Company, Inc. (B&McD). With the new requests modeled, violations of stability damping criteria and voltage recovery criteria were observed. Upgrades identified in the power flow analysis were also tested in the stability analysis.

To mitigate the voltage instability, violations of voltage recovery criteria, and generation tripping off the following upgrades were implemented in each season:

- Addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit

The consultant also noted that for certain prior outage conditions curtailment (system adjustment) will be needed to maintain system stability for subsequent circuit outages.

With all previously-assigned and currently-assigned Network Upgrades placed in service and identified system adjustments applied, no violations were observed, including violations of low-voltage ride-through requirements, for the probable contingencies studied.

CLUSTER GROUP 16 (WESTERN NORTH DAKOTA)

New requests for this study group as well as prior-queued requests are listed in Appendix C.

The Group 16 cases included the following system adjustments of dispatching, to maximum output, generation interconnected at the same or adjacent substations to a current study request:

- Antelope Valley Station units: GEN-2016-108, GEN-2016-130
- Garrison & Leland Olds units: GEN-2016-130

The Group 16 stability analysis for this area was performed by POWER-tek Global Inc. (Power-tek). With the new requests modeled, violations of stability damping criteria and voltage recovery criteria were observed. Upgrades identified in the power flow analysis were also tested in the stability analysis.

To mitigate the voltage instability, violations of voltage recovery criteria, and generation tripping off the following upgrades were implemented in each season:

- Addition of a 2nd 345/230kV transformer at Tande station
- Addition of a new Emmons County 345kV substation along Antelope Valley Station to Broadland 345kV (500kV) and Fort Thompson to Leland Olds 345kV circuits
- Addition of a new McIntosh County 345kV substation along Groton to Leland Olds 345kV circuit
- Addition of a new approximately 45 mile Emmons County to McIntosh County 345kV circuit
- Upgrade Broadland 345kV (500kV) to Huron 230kV transformer

The consultant also noted that for certain prior outage conditions curtailment (system adjustment) will be needed to maintain system stability for subsequent circuit outages.

CLUSTER GROUP 17 (WESTERN SOUTH DAKOTA)

The requested POI for GEN-2016-094 may not be viable, additional analysis will be required to identify if additional mitigation is required with a POI at Ft. Thompson. The interconnection cost estimate is for a POI at Ft. Thompson. In the event that the requested POI for GEN-2016-094 is not viable, this request may be incorporated into Group 15.

New requests for this study group as well as prior-queued requests are listed in Appendix C.

The Group 17 cases included the following system adjustments of dispatching, to maximum output, generation interconnected at the same or adjacent substations to a current study request:

- Big Bend, Fort Randal, & OAHE units: GEN-2016-094

The Group 17 stability analysis for this area was performed by ABB Inc. (ABB). With the new requests modeled, violations of stability damping criteria and voltage recovery criteria were not observed.

There were no impacts on the stability performance of the SPP system.

With all previously-assigned and currently-assigned Network Upgrades placed in service, no violations were observed, including violations of low-voltage ride-through requirements, for the probable contingencies studied.

CLUSTER GROUP 18 (EASTERN NORTH DAKOTA)

No new interconnection requests in this group.

9.3 CURTAILMENT AND SYSTEM RELIABILITY

In no way does this study guarantee operation for all periods of time. It should be noted that although this study analyzed many of the most probable contingencies, it is not an all-inclusive list and cannot account for every operational situation. Because of this, it is likely that the Customer(s) may be required to reduce their generation output to 0 MW, also known as curtailment, under certain system conditions to allow system operators to maintain the reliability of the transmission network.

10 CONCLUSION

The minimum cost of interconnecting all new generation interconnection requests included in this Definitive Interconnection System Impact Study is estimated at **$6.212**Billion, not including the exceptions noted in Section 5.

Allocated costs for Network Upgrades and Transmission Owner Interconnection Facilities are listed in Appendix E and F. For Interconnection Requests that result in an interconnection to, or modification of, the transmission facilities of the Western-UGP (WAPA), a National Environmental Policy Act (NEPA) Environmental Review will be required. The Interconnection Customer will be required to execute an Environmental Review Agreement per Section 8.6.1 of the GIP.

These costs do not include the cost of upgrades of other transmission facilities listed in Appendix H which are Network Constraints. These interconnection costs do not include any cost of any Network Upgrades that are identified as required through the short circuit analysis. Potential over-duty circuit breakers capability will be identified by the Transmission Owner in the Interconnection Facilities Study.

Further refinement of total estimated interconnection costs will be provided, should the Interconnection Customer meet the requirements for acceptance and choose to move into the Interconnection Facilities Study following the posting of this DISIS. The Interconnection Facilities Study may include additional study analysis, additional facility upgrades not yet identified by this DISIS, such as circuit breaker replacements and affected system facilities, and further refinement of existing cost estimates.

The required interconnection costs listed in Appendices E, and F, and other upgrades associated with Network Constraints do not include all costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer submits a Transmission Service Request (TSR) through SPP's Open Access Same Time Information System (OASIS) as required by Attachment Z1 of the SPP Open Access Transmission Tariff (OATT).

11 APPENDICES

11.1 A: GENERATION INTERCONNECTION REQUESTS CONSIDERED FOR IMPACT STUDY

A: Generation Interconnection Requests Considered for Study

Request	Group Number	Amount	Service	Area	Requested Point of Interconnection	Proposed Point of Interconnection	Requested In-Service Date
ASGI-2016-009	06	3.00	ER	SPS	Wolfforth 115kV	Wolfforth 115kV	12/1/2018
ASGI-2016-010	02	200.00	ER	SPS	Powell Corner 115kV	Powell Corner 115kV	
GEN-2015-039	06	50.10	ER/NR	SPS	Tap Deaf Smith - Plant X 230kV	Tap Deaf Smith - Plant X 230kV	12/31/2016
GEN-2015-040	06	50.10	ER/NR	SPS	Mustang 230kV	Mustang 230kV	12/31/2016
GEN-2015-078	06	50.10	ER/NR	SPS	Mustang 115kV	Mustang 115kV	12/31/2016
GEN-2015-099	06	73.30	ER	SPS	Maddox 115kV	Maddox 115kV	12/31/2016
GEN-2016-024	08	55.90	ER/NR	WERE	Midian 138kV	Midian 138kV	12/31/2018
GEN-2016-034	09	90.00	ER	WAPA	Tap Laramie River – Sidney 345kV	Tap Laramie River – Sidney 345kV	6/1/2018
GEN-2016-036	15	44.60	ER	WAPA	Granite Falls 115kV	Granite Falls 115kV Sub	12/31/2018
GEN-2016-036	15	44.60	ER	WAPA	Granite Falls 115kV Sub	Granite Falls 115kV Sub	12/31/2018
GEN-2016-039	06	112.00	ER	SPS	Swisher 115kV	Swisher 115kV	12/31/2017
GEN-2016-072	08	300.00	ER	OKGE	Renfrow 345kV	Renfrow 345kV	7/31/2018
GEN-2016-072	08	300.00	ER	OKGE	Tap Hunter - Renfrow 345kV	Renfrow 345kV	7/31/2018
GEN-2016-074	09	200.00	ER/NR	NPPD	Sweetwater 345kV	Sweetwater 345kV	12/31/2018
GEN-2016-077	06	54.00	ER/NR	SPS	Ozark Mahoning #1 69kV (526770)	Ozark Mahoning #1 69kV (526770)	11/30/2018
GEN-2016-078	06	108.00	ER/NR	SPS	Bailey County 115kV (525028)	Bailey County 115kV (525028)	11/30/2018
GEN-2016-087	15	98.90	ER	WAPA	Bismarck-Glenham 230kV	Bismarck-Glenham 230kV	10/1/2017
GEN-2016-088	13	151.20	ER/NR	KCPL	Transource Ketchem 345kV Station	Transource Ketchem 345kV Station	12/31/2018
GEN-2016-091	07	303.60	ER	AEPW	New tap on PSE&G (AEP) 345kV Gracemont-Lawton	New tap on PSE&G (AEP) 345kV Gracemont-Lawton	12/31/2018
GEN-2016-092	15	250.70	ER/NR	WAPA	Tap Leland Olds-Ft Thompson 345kV	Tap Leland Olds-Ft Thompson 345kV	12/1/2018
GEN-2016-094	17	200.00	ER/NR	WAPA	Tap Ft Thompson-Oahe 230kV	Tap Ft Thompson-Oahe 230kV	12/1/2018
GEN-2016-095	07	200.00	ER/NR	AEPW	Tap Gracemont - Lawton 345kV	Tap Gracemont - Lawton 345kV	10/1/2019
GEN-2016-096	09	227.70	ER	NPPD	Tap Pauline-Moore 345kV	Tap Pauline-Moore 345kV	12/31/2019
GEN-2016-097	07	100.00	ER/NR	AEPW	Tap Southwestern-Fletcher Tap 138kV	Tap Southwestern-Fletcher Tap 138kV	10/1/2019
GEN-2016-100	08	100.00	ER/NR	OKGE	Tap Sooner-Spring Creek 345kV	Tap Sooner-Spring Creek 345kV	12/1/2018
GEN-2016-101	08	195.00	ER/NR	OKGE	Tap Sooner-Spring Creek 345kV	Tap Sooner-Spring Creek 345kV	12/1/2018
GEN-2016-102	14	150.90	ER/NR	OKGE	Blue River 138kV Substation	Blue River 138kV Substation	12/31/2018
GEN-2016-103	15	250.70	ER/NR	WAPA	Tap Leland Olds- Ft Thompson 345kV	Tap Leland Olds- Ft Thompson 345kV	12/1/2018
GEN-2016-106	09	400.00	ER/NR	NPPD	Gentleman Substation 345kV	Gentleman Substation 345kV	10/15/2018
GEN-2016-108	16	200.00	ER/NR	WAPA	Tap Antelope Valley Substation (AVS)-Charlie Creek 345kV	Tap Antelope Valley Substation (AVS)-Charlie Creek 345kV	6/1/2019
GEN-2016-110	09	152.00	ER/NR	WAPA	Tap Laramie River-Stegall 345kV Line	Tap Laramie River-Stegall 345kV Line	12/31/2019
GEN-2016-111	04	302.00	ER/NR	WERE	Tap Summit – Reno 345kV Line	Tap Summit – Reno 345kV Line	12/31/2018
GEN-2016-112	04	220.00	ER/NR	WERE	Tap Reno-Summit 345kV (proposed Cross-County Wind 1 345kV Substation GEN-2016-122)	Tap Reno-Summit 345kV (proposed Cross-County Wind 1 345kV Substation GEN-2016-122)	12/1/2018
GEN-2016-113	04	155.00	ER/NR	WERE	Tap Reno-Summit 345kV (proposed Cross-County Wind 1 345kV Substation GEN-2016-122)	Tap Reno-Summit 345kV (proposed Cross-County Wind 1 345kV Substation GEN-2016-122)	12/1/2018
GEN-2016-114	04	310.00	ER/NR	WERE	Tap Reno-Summit 345kV	Tap Reno-Summit 345kV	12/31/2018

Request	Group Number	Amount	Service	Area	Requested Point of Interconnection	Proposed Point of Interconnection	Requested In-Service Date
GEN-2016-115	13	300.00	ER/NR	KCPL	Holt County Switching Station 345kV	Holt County Switching Station 345kV	12/1/2019
GEN-2016-118	01	288.00	ER/NR	WFEC	Dover Switchyard 138kV	Dover Switchyard 138kV	12/1/2019
GEN-2016-119	08	600.00	ER/NR	OKGE	Tap Spring Creek-Sooner 345 kV	Tap Spring Creek-Sooner 345 kV	12/1/2019
GEN-2016-120	06	400.00	ER/NR	SPS	Tap Tuco-Border 345kV Line	Tap Tuco-Border 345kV Line	6/1/2020
GEN-2016-121	06	110.00	ER/NR	SPS	Roadrunner 115kV Sub (528028 "RDRUNNER")	Roadrunner 115kV Sub (528028 "RDRUNNER")	12/31/2018
GEN-2016-122	04	225.00	ER/NR	WERE	Tap Reno-Summit 345kV	Tap Reno-Summit 345kV	12/1/2018
GEN-2016-123	06	298.00	ER/NR	SPS	Crossroads 345kV	Crossroads 345kV	12/31/2019
GEN-2016-124	06	150.00	ER/NR	SPS	Crossroads 345kV	Crossroads 345kV	12/31/2019
GEN-2016-125	06	74.00	ER/NR	SPS	Crossroads 345kV	Crossroads 345kV	12/31/2019
GEN-2016-126	14	172.50	ER/NR	OKGE	Tap Arbuckle - Blue River 138kV	Tap Arbuckle - Blue River 138kV	12/31/2019
GEN-2016-127	08	200.10	ER/NR	AEPW	Shidler 138kV Substation	Shidler 138kV Substation	12/31/2019
GEN-2016-128	08	176.00	ER/NR	OKGE	Woodring 345kV Substation	Woodring 345kV Substation	12/31/2019
GEN-2016-129	14	132.00	ER/NR	AEPW	Valliant 345kV substation	Valliant 345kV substation	12/31/2019
GEN-2016-130	16	202.00	ER/NR	WAPA	Leland Olds 345kV	Leland Olds 345kV	12/31/2019
GEN-2016-131	01	2.50	ER/NR	OKGE	Minco Substation 345kV	Minco Substation 345kV	12/31/2017
GEN-2016-132	07	6.10	ER/NR	AEPW	Sweetwater 230kV	Sweetwater 230kV	12/31/2017
GEN-2016-133	08	187.50	ER/NR	AEPW	Tulsa North 345kV Substation	Tulsa North 345kV Substation	6/1/2020
GEN-2016-134	08	187.50	ER/NR	AEPW	Tulsa North 345kV Substation	Tulsa North 345kV Substation	6/1/2020
GEN-2016-135	08	100.00	ER/NR	AEPW	Tulsa North 345kV Substation	Tulsa North 345kV Substation	6/1/2020
GEN-2016-136	08	75.00	ER/NR	AEPW	Tulsa North 345kV Substation	Tulsa North 345kV Substation	6/1/2020
GEN-2016-137	08	187.50	ER/NR	AEPW	Tulsa North 345kV Substation	Tulsa North 345kV Substation	6/1/2020
GEN-2016-138	08	187.50	ER/NR	AEPW	Tulsa North 345kV Substation	Tulsa North 345kV Substation	6/1/2020
GEN-2016-139	08	100.00	ER/NR	AEPW	Tulsa North 345kV Substation	Tulsa North 345kV Substation	6/1/2020
GEN-2016-140	08	75.00	ER/NR	AEPW	Tulsa North 345kV Substation	Tulsa North 345kV Substation	6/1/2020
GEN-2016-141	08	350.00	ER/NR	AEPW	Tulsa North 345kV Substation	Tulsa North 345kV Substation	6/1/2020
GEN-2016-142	08	350.00	ER/NR	AEPW	Tulsa North 345kV Substation	Tulsa North 345kV Substation	6/1/2020
GEN-2016-143	08	175.00	ER/NR	AEPW	Tulsa North 345kV Substation	Tulsa North 345kV Substation	6/1/2020
GEN-2016-144	08	175.00	ER/NR	AEPW	Tulsa North 345kV Substation	Tulsa North 345kV Substation	6/1/2020
GEN-2016-145	08	175.00	ER/NR	AEPW	Tulsa North 345kV Substation	Tulsa North 345kV Substation	6/1/2020
GEN-2016-146	08	175.00	ER/NR	AEPW	Tulsa North 345kV Substation	Tulsa North 345kV Substation	6/1/2020
GEN-2016-147	09	40.00	ER/NR	NPPD	Sidney 115kV Sub	Sidney 115kV Sub	12/31/2019
GEN-2016-148	08	150.00	ER/NR	WFEC	Hardy 138kV Substation	Hardy 138kV Substation	12/1/2019
GEN-2016-149	13	302.00	ER/NR	WERE	Stranger Creek 345kV Sub	Stranger Creek 345kV Sub	12/31/2019
GEN-2016-150	13	302.00	ER/NR	WERE	Stranger Creek 345kV Sub	Stranger Creek 345kV Sub	12/31/2019
GEN-2016-151	16	202.00	ER/NR	WAPA	Tande 345kV Sub	Tande 345kV Sub	12/31/2019
GEN-2016-152	16	102.00	ER/NR	WAPA	Tande 345kV Sub	Tande 345kV Sub	12/31/2019
GEN-2016-153	08	134.00	ER/NR	WERE	Viola 345kV Substation	Viola 345kV Substation	12/31/2018
GEN-2016-155	16	1.30	ER/NR	WAPA	Hilken 230kV switching station	Hilken 230kV switching station	12/31/2017
GEN-2016-157	13	252.00	ER/NR	KCPL	West Gardner 345kV Sub	West Gardner 345kV Sub	12/31/2019
GEN-2016-158	13	252.00	ER/NR	KCPL	West Gardner 345kV Sub	West Gardner 345kV Sub	12/31/2019
GEN-2016-159	09	427.80	ER/NR	NPPD	Hoskins 345kV Substation	Hoskins 345kV Substation	11/1/2020
GEN-2016-160	04	20.00	ER/NR	MIDW	Post Rock 230kV Substation (530584)	Post Rock 230kV Substation (530584)	12/31/2018
GEN-2016-161	02	3.00	ER/NR	SPS	Martin 115kV	Martin 115kV	12/31/2017
GEN-2016-162	08	252.00	ER/NR	WERE	Benton 345kV	Benton 345kV	12/31/2019
GEN-2016-163	08	252.00	ER/NR	WERE	Benton 345kV	Benton 345kV	12/31/2019

Request	Group Number	Amount	Service	Area	Requested Point of Interconnection	Proposed Point of Interconnection	Requested In-Service Date
GEN-2016-164	15	7.90	ER/NR	WAPA	Groton 115kV substation	Groton 115kV substation	12/31/2017
GEN-2016-165	09	202.00	ER/NR	WAPA	Tap Fort Thompson - Grand Island 345kV	Tap Fort Thompson - Grand Island 345kV	12/31/2019
GEN-2016-166	12	35.00	ER/NR	AEPW	Prairie Grove 69kV Substation	Prairie Grove 69kV Substation	12/1/2019
GEN-2016-167	10	73.50	ER/NR	AEPW	Tap Lieberman - North Benton 138kV	Tap Lieberman - North Benton 138kV	12/1/2019
GEN-2016-168	13	20.00	ER/NR	KCPL	Higginsville 69kV Sub	Higginsville 69kV Sub	9/15/2019
GEN-2016-169	06	260.00	ER/NR	SPS	Hobbs Interchange 345kV	Hobbs Interchange 345kV	12/29/2018
GEN-2016-171	06	64.00	ER/NR	SPS	Tap Hobbs –Yoakum 230kV Line	Tap Hobbs –Yoakum 230kV Line	12/20/2020
GEN-2016-172	06	231.00	ER/NR	SPS	Newhart 115kV	Newhart 115kV	12/31/2018
GEN-2016-173	08	42.00	ER/NR	WERE	Creswell 69kV Sub	Creswell 69kV Sub	9/15/2019
GEN-2016-174	13	302.00	ER/NR	WERE	Stranger Creek 345kV Sub	Stranger Creek 345kV Sub	12/31/2019
GEN-2016-175	06	150.00	ER/NR	SPS	Tap Tuco-Border 345kV Line	Tap Tuco-Border 345kV Line	6/1/2020
GEN-2016-176	13	302.00	ER/NR	WERE	Stranger Creek 345kV Sub	Stranger Creek 345kV Sub	12/31/2019
GEN-2016-177	06	17.00	ER	SPS	Tap Ink Basin - Denver City 115kV	Tap Ink Basin - Denver City 115kV	
Total:	**15,938.10**						

*In-Service Date for each request is to be determined after the Interconnection Facility Study is completed.

11.2 B: PRIOR-QUEUED INTERCONNECTION REQUESTS

B: Prior Queued Interconnection Requests

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
ASGI-2010-006	150.00	AECI	Remington 138kV	AECI queue Affected Study
ASGI-2010-010	42.20	SPS	Lovington 115kV	Lea County Affected Study
ASGI-2010-020	30.00	SPS	Tap LE-Tatum - LE-Crossroads 69kV	Lea County Affected Study
ASGI-2010-021	15.00	SPS	Tap LE-Saunders Tap - LE-Anderson 69kV	Lea County Affected Study
ASGI-2011-001	27.30	SPS	Lovington 115kV	On-Line
ASGI-2011-002	20.00	SPS	Herring 115kV	On-Line
ASGI-2011-003	10.00	SPS	Hendricks 69kV	On-Line
ASGI-2011-004	20.00	SPS	Pleasant Hill 69kV	Under Study (DISIS-2011-002)
ASGI-2012-002	18.15	SPS	FE-Clovis Interchange 115kV	Under Study (DISIS-2012-002)
ASGI-2012-006	22.50	SUNCMKEC	Tap Hugoton - Rolla 69kV	Under Study (DISIS-2012-001)
ASGI-2013-001	11.50	SPS	PanTex South 115kV	Under Study (DISIS-2013-001)
ASGI-2013-002	18.40	SPS	FE Tucumcari 115kV	Under Study (DISIS-2013-001)
ASGI-2013-003	18.40	SPS	FE Clovis 115kV	Under Study (DISIS-2013-001)
ASGI-2013-004	36.60	SUNCMKEC	Morris 115kV	Under Study (DISIS-2013-002)
ASGI-2013-005	1.65	SPS	FE Clovis 115kV	Under Study (DISIS-2013-002)
ASGI-2014-014	56.40	GRDA	Ferguson 69kV	Under Study (DISIS-2014-002)
ASGI-2015-001	6.13	SUNCMKEC	Ninnescah 115kV	Under Study (DISIS-2015-001)
ASGI-2015-002	2.00	SPS	SP-Yuma 69kV	Under Study (DISIS-2015-001)
ASGI-2015-004	56.36	GRDA	Coffeyville City 69kV	Under Study (DISIS-2015-001)
ASGI-2015-006	9.00	SWPA	Tupelo 138kV	Under Study (DISIS-2015-002)
ASGI-2016-002	0.35	SPS	SP-Yuma 115kV	DISIS STAGE
ASGI-2016-003	6.00	KCPL	Paola 161kV	DISIS STAGE
ASGI-2016-004	9.60	SPS	Palo Duro 115kV	DISIS STAGE
ASGI-2016-005	20.00	WAPA	Tap White Lake - Stickeny 69kV	Northwester Queued Request
ASGI-2016-006	20.00	WAPA	Mitchall	Northwester Queued Request
ASGI-2016-007	20.00	WAPA	Kimball 69kV	Northwester Queued Request
ASGI-2016-011	7.41	SWPA	Allen 138 kV	PEC Study
ASGI-2016-012	61.73	SWPA	Tupelo 138 kV	PEC Study
ASGI-2016-013	4.94	WFEC	Ashland 138 kV	PEC Study
ASGI-2017-006	238.00	AECI	Maryville 161 kV	AECI study
ASGI-2017-008	158.60	AECI	Remington to Shidler 138 kV	AECI study
G176	100.00	XEL	Yankee 115kV	
G255	100.00	XEL	Yankee 115kV	MISO Queued Request
G380	150.00	OTP	Rugby 115kV	MISO Queued Request
G408	12.00	XEL	Tap McHenry - Souris 115kV	MISO Queued Request
G502	50.60	MP	Milton Young 230kV	MISO Queued Request
G586	30.00	XEL	Yankee 115kV	
G645	50.00	GRE	Ladish 115kV	MISO Queued Request
G723	10.00	MDU	Haskett 115kV	MISO Queued Request
G736	200.00	OTP	Big Stone South 230kV	
G752	150.00	MDU	Tap Bison - Hettinger 230kV	MISO Queued Request
G788	49.00	GRE	Ladish 115kV	MISO Queued Request
G830	99.00	GRE	GRE McHenry 115kV	MISO Queued Request
GEN-2001-014	96.00	WFEC	Ft Supply 138kV	On-Line
GEN-2001-026	74.30	WFEC	Washita 138kV	On-Line
GEN-2001-033	180.00	SPS	San Juan Tap 230kV	On-Line at 120MW

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2001-036	80.00	SPS	Norton 115kV	On-Line
GEN-2001-037	100.00	OKGE	FPL Moreland Tap 138kV	On-Line
GEN-2001-039A	105.00	SUNCMKEC	Shooting Star Tap 115kV	On-Line
GEN-2001-039M	100.00	SUNCMKEC	Central Plains Tap 115kV	On-Line
GEN-2002-004	200.00	WERE	Latham 345kV	On-Line at 150MW
GEN-2002-005	120.00	WFEC	Red Hills Tap 138kV	On-Line
GEN-2002-008	240.00	SPS	Hitchland 345kV	On-Line at 120MW
GEN-2002-008IS	40.50	WAPA	Edgeley 115kV [Pomona 115kV]	Commercial Operation
GEN-2002-009	80.00	SPS	Hansford 115kV	On-Line
GEN-2002-009IS	40.00	WAPA	Ft Thompson 69kV [Hyde 69kV]	Commercial Operation
GEN-2002-022	240.00	SPS	Bushland 230kV	On-Line
GEN-2002-023N	0.80	NPPD	Harmony 115kV	On-Line
GEN-2002-025A	150.00	SUNCMKEC	Spearville 230kV	On-Line
GEN-2003-004	100.00	WFEC	Washita 138kV	On-Line
GEN-2003-005	100.00	WFEC	Anadarko - Paradise (Blue Canyon) 138kV	On-Line
GEN-2003-006A	200.00	SUNCMKEC	Elm Creek 230kV	On-Line
GEN-2003-019	250.00	MIDW	Smoky Hills Tap 230kV	On-Line
GEN-2003-020	160.00	SPS	Martin 115kV	On-Line
GEN-2003-021N	75.00	NPPD	Ainsworth Wind Tap 115kV	On-Line
GEN-2003-022	120.00	AEPW	Weatherford 138kV	On-Line
GEN-2004-014	154.50	SUNCMKEC	Spearville 230kV	On-Line at 100MW
GEN-2004-020	27.00	AEPW	Weatherford 138kV	On-Line
GEN-2004-023	20.60	WFEC	Washita 138kV	On-Line
GEN-2004-023N	75.00	NPPD	Columbus Co 115kV	On-Line
GEN-2005-003	30.60	WFEC	Washita 138kV	On-Line
GEN-2005-003IS	100.00	WAPA	Nelson 115kV	Commercial Operation
GEN-2005-008	120.00	OKGE	Woodward 138kV	On-Line
GEN-2005-008IS	50.00	WAPA	Hilken 230kV [Ecklund 230kV]	Commercial Operation
GEN-2005-012	250.00	SUNCMKEC	Ironwood 345kV	On-Line at 160MW
GEN-2005-013	201.00	WERE	Caney River 345kV	On-Line
GEN-2006-001IS	10.00	XEL	Marshall 115kV	Commercial Operation
GEN-2006-002	101.00	AEPW	Sweetwater 230kV	On-Line
GEN-2006-002IS	51.00	WAPA	Wessington Springs 230kV	Commercial Operation
GEN-2006-006IS	10.00	XEL	Marshall 115kV	Commercial Operation
GEN-2006-015IS	50.00	WAPA	Hilken 230kV [Ecklund 230kV]	Commercial Operation
GEN-2006-018	170.00	SPS	TUCO Interchange 230kV	On-Line
GEN-2006-020N	42.00	NPPD	Bloomfield 115kV	On-Line
GEN-2006-020S	18.90	SPS	DWS Frisco 115kV	On-Line
GEN-2006-021	101.00	SUNCMKEC	Flat Ridge Tap 138kV	On-Line
GEN-2006-024S	19.80	WFEC	Buffalo Bear Tap 69kV	On-Line
GEN-2006-026	502.00	SPS	Hobbs 230kV & Hobbs 115kV	On-Line
GEN-2006-031	75.00	MIDW	Knoll 115kV	On-Line
GEN-2006-035	225.00	AEPW	Sweetwater 230kV	On-Line at 132MW
GEN-2006-037N1	75.00	NPPD	Broken Bow 115kV	On-Line
GEN-2006-038N005	80.00	NPPD	Broken Bow 115kV	On-Line
GEN-2006-038N019	80.00	NPPD	Petersburg North 115kV	On-Line
GEN-2006-043	99.00	AEPW	Sweetwater 230kV	On-Line
GEN-2006-044	370.00	SPS	Hitchland 345kV	On-Line at 120MW
GEN-2006-044N	40.50	NPPD	North Petersburg 115kV	On-Line
GEN-2006-046	131.00	OKGE	Dewey 138kV	On-Line

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2007-011N08	81.00	NPPD	Bloomfield 115kV	On-Line
GEN-2007-013IS	50.00	WAPA	Wessington Springs 230kV	Commercial Operation
GEN-2007-014IS	100.00	WAPA	Wessington Springs 230kV	Commercial Operation
GEN-2007-015IS	100.00	WAPA	Hilken 230kV [Ecklund 230kV]	Commercial Operation
GEN-2007-017IS	166.00	WAPA	Ft Thompson-Grand Island 345kV	On Schedule
GEN-2007-018IS	234.00	WAPA	Ft Thompson-Grand Island 345kV	On Schedule
GEN-2007-020IS	16.00	WAPA	Nelson 115kV	Commercial Operation
GEN-2007-021	201.00	OKGE	Tatonga 345kV	On-Line
GEN-2007-023IS	50.00	WAPA	Formit-Summit 115kV	On Suspension
GEN-2007-025	300.00	WERE	Viola 345kV	On-Line
GEN-2007-040	200.00	SUNCMKEC	Buckner 345kV	On-Line at 132MW
GEN-2007-043	200.00	OKGE	Minco 345kV	On-Line
GEN-2007-044	300.00	OKGE	Tatonga 345kV	On-Line at 199MW
GEN-2007-046	200.00	SPS	Hitchland 115kV	On-Line
GEN-2007-050	170.00	OKGE	Woodward EHV 138kV	On-Line at 150MW
GEN-2007-052	150.00	WFEC	Anadarko 138kV	On-Line
GEN-2007-062	425.00	OKGE	Woodward EHV 345kV	On-Line for 225MW, On Schedule and 2017
GEN-2008-003	101.00	OKGE	Woodward EHV 138kV	On-Line
GEN-2008-008IS	5.00	WAPA	Nelson 115kV	Commercial Operation
GEN-2008-013	300.00	OKGE	Hunter 345kV	On-Line at 235MW
GEN-2008-018	250.00	SPS	Finney 345kV	On-Line
GEN-2008-021	42.00	WERE	Wolf Creek 345kV	On-Line
GEN-2008-022	300.00	SPS	Crossroads 345kV	On-Line
GEN-2008-023	150.00	AEPW	Hobart Junction 138kV	On-Line
GEN-2008-037	101.00	WFEC	Slick Hills 138kV	On-Line
GEN-2008-044	197.80	OKGE	Tatonga 345kV	On-Line
GEN-2008-047	300.00	OKGE	Beaver County 345kV	On-Line
GEN-2008-051	322.00	SPS	Potter County 345kV	On-Line at 161MW
GEN-2008-079	99.20	SUNCMKEC	Crooked Creek 115kV	On-Line
GEN-2008-086N02	201.00	NPPD	Meadow Grove 230kV	On-Line
GEN-2008-092	200.60	MIDW	Post Rock 230kV	On-Line
GEN-2008-098	100.80	WERE	Waverly 345kV	On-Line
GEN-2008-119O	60.00	OPPD	S1399 161kV	On-Line
GEN-2008-123N	89.70	NPPD	Tap Pauline - Guide Rock (Rosemont) 115kV	On Schedule for 2016
GEN-2008-124	200.10	SUNCMKEC	Ironwood 345kV	On Schedule for 2016
GEN-2008-129	80.00	KCPL	Pleasant Hill 161kV	On-Line
GEN-2009-001IS	200.00	WAPA	Groton-Watertown 345kV	On Schedule
GEN-2009-006IS	90.00	WAPA	Mission 115kV	On Suspension
GEN-2009-007IS	100.00	WAPA	Mission 115kV	On Suspension
GEN-2009-008	199.50	MIDW	South Hays 230kV	On-Line
GEN-2009-018IS	99.50	WAPA	Groton 115kV	Commercial Operation
GEN-2009-020	48.30	MIDW	Walnut Creek 69kV	On-Line
GEN-2009-020AIS	130.50	WAPA	Tripp Junction 115kV	Commercial Operation
GEN-2009-025	59.80	OKGE	Nardins 69kV	On-Line
GEN-2009-026IS	110.00	WAPA	Dickenson-Heskett 230kV	On Schedule
GEN-2009-040	73.80	WERE	Marshall 115kV	On-Line
GEN-2010-001	300.00	OKGE	Beaver County 345kV	On-Line
GEN-2010-001IS	99.00	WAPA	Bismarck-Glenham 230kV	On Schedule
GEN-2010-003	100.80	WERE	Waverly 345kV	On-Line

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2010-003IS	34.00	WAPA	Wessington Springs 230kV	Commercial Operation
GEN-2010-005	299.20	WERE	Viola 345kV	On-Line at 170MW
GEN-2010-006	205.00	SPS	Jones 230kV	On-Line
GEN-2010-007IS	172.50	WAPA	Antelope Valley 345kV	On Suspension
GEN-2010-009	165.60	SUNCMKEC	Buckner 345kV	On-Line
GEN-2010-011	29.70	OKGE	Tatonga 345kV	On-Line
GEN-2010-014	358.80	SPS	Hitchland 345kV	On Schedule for 2018
GEN-2010-036	4.60	WERE	6th Street 115kV	On-Line
GEN-2010-040	300.00	OKGE	Cimarron 345kV	On-Line
GEN-2010-041	10.50	OPPD	S1399 161kV	On Schedule for 2015
GEN-2010-046	56.00	SPS	TUCO Interchange 230kV	On Schedule for 2016
GEN-2010-051	200.00	NPPD	Tap Hoskins - Twin Church (Dixon County) 230kV	On Suspension
GEN-2010-055	4.50	AEPW	Wekiwa 138kV	On-Line
GEN-2010-057	201.00	MIDW	Rice County 230kV	On-Line
GEN-2011-008	600.00	SUNCMKEC	Clark County 345kV	On-Line
GEN-2011-010	100.80	OKGE	Minco 345kV	On-Line
GEN-2011-011	50.00	KCPL	Iatan 345kV	On-Line
GEN-2011-014	201.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (GEN-2011-014 Tap) 345kV	On-Line
GEN-2011-016	200.10	SUNCMKEC	Ironwood 345kV	On Suspension
GEN-2011-018	73.60	NPPD	Steele City 115kV	On-Line
GEN-2011-019	175.00	OKGE	Woodward 345kV	On Schedule for 2017
GEN-2011-020	165.60	OKGE	Woodward 345kV	On Schedule for 2017
GEN-2011-022	299.00	SPS	Hitchland 345kV	On Schedule for 2016 (150MW) and 2017 (149MW)
GEN-2011-025	80.00	SPS	Tap Floyd County - Crosby County 115kV	On Schedule for 2016
GEN-2011-027	120.00	NPPD	Tap Hoskins - Twin Church (Dixon County) 230kV	On Schedule for 2018
GEN-2011-037	7.00	WFEC	Blue Canyon 5 138kV	On-Line
GEN-2011-040	111.00	OKGE	Carter County 138kV	On-Line
GEN-2011-045	205.00	SPS	Jones 230kV	On-Line
GEN-2011-046	27.00	SPS	Lopez 115kV	On-Line
GEN-2011-048	175.00	SPS	Mustang 230kV	On-Line
GEN-2011-049	250.70	OKGE	Border 345kV	On Schedule for 2016
GEN-2011-050	109.80	AEPW	Santa Fe Tap 138kV	On-Line
GEN-2011-054	300.00	OKGE	Cimarron 345kV	On-Line
GEN-2011-056	3.60	NPPD	Jeffrey 115kV	On-Line
GEN-2011-056A	3.60	NPPD	John 1 115kV	On-Line
GEN-2011-056B	4.50	NPPD	John 2 115kV	On-Line
GEN-2011-057	150.40	WERE	Creswell 138kV	On-Line
GEN-2012-001	61.20	SPS	Cirrus Tap 230kV	On-Line
GEN-2012-004	41.40	OKGE	Carter County 138kV	On-Line
GEN-2012-007	120.00	SUNCMKEC	Rubart 115kV	On-Line
GEN-2012-009IS	99.00	WAPA	Fort Randall 115kV	On Suspension
GEN-2012-012IS	75.00	WAPA	Wolf Point-Circle 115kV	On Suspension
GEN-2012-014IS	99.50	WAPA	Groton 115kV	On Schedule
GEN-2012-020	478.00	SPS	TUCO 230kV	On Schedule for 2016
GEN-2012-021	4.80	LES	Terry Bundy Generating Station 115kV	On-Line
GEN-2012-024	180.00	SUNCMKEC	Clark County 345kV	On Schedule for 2016
GEN-2012-028	74.80	WFEC	Gotebo 69kV	On-Line
GEN-2012-032	300.00	OKGE	Open Sky 345kV	On-Line

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2012-033	98.10	OKGE	Tap and Tie South 4th - Bunch Creek & Enid Tap - Fairmont (GEN-2012-033T) 138kV	On-Line
GEN-2012-034	7.00	SPS	Mustang 230kV	On-Line
GEN-2012-035	7.00	SPS	Mustang 230kV	On-Line
GEN-2012-036	7.00	SPS	Mustang 230kV	On-Line
GEN-2012-037	203.00	SPS	TUCO 345kV	On-Line
GEN-2012-041	121.50	OKGE	Ranch Road 345kV	On-Line
GEN-2013-001IS	90.00	WAPA	Summit-Watertown 115kV	On Suspension
GEN-2013-002	50.60	LES	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2	On Suspension
GEN-2013-007	100.30	OKGE	Tap Prices Falls - Carter 138kV	On-Line
GEN-2013-008	1.20	NPPD	Steele City 115kV	On-Line
GEN-2013-009IS	19.50	WAPA	Redfield NW 115kV	Commercial Operation
GEN-2013-010	99.00	SUNCMKEC	Tap Spearville - Post Rock (North of GEN-2011-017 Tap) 345kV	On Suspension
GEN-2013-011	30.00	AEPW	Turk 138kV	On-Line
GEN-2013-012	147.00	OKGE	Redbud 345kV	On-Line
GEN-2013-016	203.00	SPS	TUCO 345kV	On Schedule for 2017
GEN-2013-019	73.60	LES	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2	On Suspension
GEN-2013-022	25.00	SPS	Norton 115kV	On-Line
GEN-2013-027	150.00	SPS	Tap Tolk - Yoakum 230kV	On Schedule for 2018
GEN-2013-028	559.50	GRDA	Tap N Tulsa - GRDA 1 345kV	On Schedule for 2017
GEN-2013-029	300.00	OKGE	Renfrow 345kV	On-Line for 151.6MW
GEN-2013-030	300.00	OKGE	Beaver County 345kV	On Schedule for 2016 (200MW) and 2017 (100MW)
GEN-2013-032	204.00	NPPD	Antelope 115kV	On Schedule for 2017
GEN-2013-033	28.00	MIDW	Knoll 115kV	On-Line
GEN-2014-001	200.60	WERE	Tap Wichita - Emporia Energy Center (GEN-2014-001 Tap) 345kV	On Suspension
GEN-2014-001IS	103.70	WAPA	Newell-Maurine 115kV	On Suspension
GEN-2014-002	10.50	OKGE	Tatonga 345kV (GEN-2007-021 POI)	On Schedule for 2015
GEN-2014-003	15.80	OKGE	Tatonga 345kV (GEN-2007-044 POI)	On Schedule for 2015
GEN-2014-003IS	91.00	WAPA	Culbertson 115kV	On Schedule
GEN-2014-004	4.00	NPPD	Steele City 115kV (GEN-2011-018 POI)	On-Line
GEN-2014-004IS	384.20	WAPA	Charlie Creek 345kV	IA Pending
GEN-2014-005	5.70	OKGE	Minco 345kV (GEN-2011-010 POI)	On-Line
GEN-2014-006IS	125.00	WAPA	Williston 115kV	On Schedule
GEN-2014-010IS	150.00	WAPA	Neset 115kV	On Schedule
GEN-2014-012	225.00	SPS	Tap Hobbs Interchange - Andrews 230kV	On Suspension
GEN-2014-013	73.50	NPPD	Meadow Grove (GEN-2008-086N2 Sub) 230kV	On-Line
GEN-2014-014IS	151.50	WAPA	Belfield-Rhame 230kV	On Schedule
GEN-2014-020	100.00	AEPW	Tuttle 138kV	On Schedule for 2017
GEN-2014-021	300.00	KCPL	Tap Nebraska City - Mullin Creek (Holt) 345kV	On Schedule for 2016
GEN-2014-025	2.40	MIDW	Walnut Creek 69kV	On-Line
GEN-2014-028	35.00	EMDE	Riverton 161kV	On-Line
GEN-2014-031	35.80	NPPD	Meadow Grove 230kV	On-Line
GEN-2014-032	10.20	NPPD	Meadow Grove 230kV	On Schedule for 2016
GEN-2014-033	70.00	SPS	Chaves County 115kV	On-Line
GEN-2014-034	70.00	SPS	Chaves County 115kV	On-Line
GEN-2014-035	30.00	SPS	Chaves County 115kV	On Schedule for 2018

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2014-037	200.00	SPS	Tap Hitchland - Beaver County Dbl Ckt (Optima) 345kV	FACILITY STUDY STAGE
GEN-2014-039	73.40	NPPD	Friend 115kV	On Schedule for 2017
GEN-2014-040	320.40	SPS	Castro 115kV	On-Line
GEN-2014-047	40.00	SPS	Crossroads 345kV	On Schedule for 2017
GEN-2014-056	250.00	OKGE	Minco 345kV	On Schedule for 2016
GEN-2014-057	250.00	AEPW	Tap Lawton - Sunnyside (Terry Road) 345kV	On-Line
GEN-2014-064	248.40	OKGE	Otter 138kV	On Suspension
GEN-2015-001	200.00	OKGE	Ranch Road 345kV	On-Line
GEN-2015-004	52.90	OKGE	Border 345kV	On Schedule for 2017
GEN-2015-005	200.10	KCPL	Tap Nebraska City - Sibley (Ketchem) 345kV	On-Line
GEN-2015-007	160.00	NPPD	Hoskins 345kV	FACILITY STUDY STAGE
GEN-2015-013	120.00	WFEC	Synder 138kV	FACILITY STUDY STAGE
GEN-2015-014	150.00	SPS	Tap Cochran - Lehman 115kV	FACILITY STUDY STAGE
GEN-2015-015	154.60	OKGE	Road Runner 138kV	FACILITY STUDY STAGE
GEN-2015-016	200.00	KCPL	Tap Marmaton - Centerville 161kV	FACILITY STUDY STAGE
GEN-2015-020	100.00	SPS	Oasis 115kV	FACILITY STUDY STAGE
GEN-2015-021	20.00	SUNCMKEC	Johnson Corner 115kV	FACILITY STUDY STAGE
GEN-2015-022	112.00	SPS	Swisher 115kV	FACILITY STUDY STAGE
GEN-2015-023	300.70	NPPD	Holt County 345kV	FACILITY STUDY STAGE
GEN-2015-024	220.00	WERE	Tap Thistle - Wichita 345kV Dbl CKT	On-Line
GEN-2015-025	220.00	WERE	Tap Thistle - Wichita 345kV Dbl CKT	On-Line
GEN-2015-029	161.00	OKGE	Tatonga 345kV	On Suspension
GEN-2015-030	200.10	OKGE	Sooner 345kV	On Suspension
GEN-2015-031	150.50	SPS	Tap Amarillo South - Swisher 230kV	FACILITY STUDY STAGE
GEN-2015-034	200.00	OKGE	Ranch Road 345kV	FACILITY STUDY STAGE
GEN-2015-036	303.60	OKGE	Johnston County 345kV	DISIS STAGE
GEN-2015-041	5.00	SPS	TUCO Interchange 345kV	DISIS STAGE
GEN-2015-045	20.00	AEPW	Tap Lawton - Sunnyside (Terry Road) 345kV	FACILITY STUDY STAGE
GEN-2015-046	300.00	WAPA	Tande 345kV	FACILITY STUDY STAGE
GEN-2015-047	300.00	OKGE	Sooner 345kV	FACILITY STUDY STAGE
GEN-2015-048	200.00	OKGE	Cleo Corner 138kV	FACILITY STUDY STAGE
GEN-2015-052	300.00	WERE	Tap Open Sky - Rose Hill 345kV	FACILITY STUDY STAGE
GEN-2015-053	50.00	NPPD	Antelope 115kV	FACILITY STUDY STAGE
GEN-2015-055	40.00	WFEC	Erick 138kV	FACILITY STUDY STAGE
GEN-2015-056	101.20	SPS	Crossroads 345kV	FACILITY STUDY STAGE
GEN-2015-057	100.00	OKGE	Minco 345kV	FACILITY STUDY STAGE
GEN-2015-058	50.00	SPS	Atoka 115kV	FACILITY STUDY STAGE
GEN-2015-062	4.50	OKGE	Tap and Tie South 4th - Bunch Creek & Enid Tap - Fairmont (GEN-2012-033T) 138kV	FACILITY STUDY STAGE
GEN-2015-063	300.00	OKGE	Tap Woodring - Mathewson 345kV	FACILITY STUDY STAGE
GEN-2015-064	197.80	SUNCMKEC	Mingo 115kV	FACILITY STUDY STAGE
GEN-2015-065	202.40	SUNCMKEC	Mingo 345kV	FACILITY STUDY STAGE
GEN-2015-066	248.40	OKGE	Tap Cleveland - Sooner 345kV	FACILITY STUDY STAGE
GEN-2015-068	300.00	SPS	TUCO Interchange 345kV	FACILITY STUDY STAGE
GEN-2015-069	300.00	WERE	Union Ridge 230kV	FACILITY STUDY STAGE
GEN-2015-071	200.00	AEPW	Chisholm 345kV	FACILITY STUDY STAGE
GEN-2015-073	200.10	WERE	Emporia Energy Center 345kV	FACILITY STUDY STAGE
GEN-2015-075	51.50	SPS	Carlisle 69kV	FACILITY STUDY STAGE
GEN-2015-076	158.40	NPPD	Belden 115kV	FACILITY STUDY STAGE
GEN-2015-079	129.20	SPS	Tap Yoakum - Hobbs Interchange 230kV	FACILITY STUDY STAGE

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2015-080	129.20	SPS	Tap Yoakum - Hobbs Interchange 230kV	FACILITY STUDY STAGE
GEN-2015-082	200.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (GEN-2011-014 Tap) 345kV	FACILITY STUDY STAGE
GEN-2015-083	125.00	WERE	Belle Plain 138kV	FACILITY STUDY STAGE
GEN-2015-084	51.30	AEPW	Hollis 138kV	FACILITY STUDY STAGE
GEN-2015-085	122.40	AEPW	Altus Junction 138kV	FACILITY STUDY STAGE
GEN-2015-087	66.00	NPPD	Tap Fairbury - Hebron 115kV	FACILITY STUDY STAGE
GEN-2015-088	300.00	NPPD	Tap Moore - Pauline 345kV	FACILITY STUDY STAGE
GEN-2015-090	220.00	WERE	Tap Thistle - Wichita 345kV Dbl CKT	FACILITY STUDY STAGE
GEN-2015-092	250.00	AEPW	Tap Lawton - Sunnyside (Terry Road) 345kV	FACILITY STUDY STAGE
GEN-2015-093	250.00	OKGE	Gracemont 345kV	FACILITY STUDY STAGE
GEN-2015-095	176.00	WFEC	DeGrasse 138kV	FACILITY STUDY STAGE
GEN-2015-096	150.00	WAPA	Tap Belfied - Rhame 230kV	On-Line
GEN-2015-098	100.00	WAPA	Mingusville 230kV	FACILITY STUDY STAGE
GEN-2016-003	248.40	OKGE	Tap Badger - Woodward 345kV	FACILITY STUDY STAGE
GEN-2016-004	202.00	WAPA	Leland Olds 230kV	FACILITY STUDY STAGE
GEN-2016-005	150.00	SUNCMKEC	Tap Clark County - Thistle 345kV	FACILITY STUDY STAGE
GEN-2016-007	100.00	WAPA	Valley City 115kV	FACILITY STUDY STAGE
GEN-2016-009	29.00	OKGE	Osage 69kV	FACILITY STUDY STAGE
GEN-2016-013	10.00	EMDE	La Russell 161kV	FACILITY STUDY STAGE
GEN-2016-014	10.00	EMDE	La Russell 161kV	FACILITY STUDY STAGE
GEN-2016-015	100.00	SPS	Andrews 230kV	FACILITY STUDY STAGE
GEN-2016-016	78.20	MIDW	North Kinsley 115kV	FACILITY STUDY STAGE
GEN-2016-017	250.70	WAPA	Tap Fort Thompson - Leland Olds 345kV	FACILITY STUDY STAGE
GEN-2016-020	150.00	WFEC	Mooreland 138kV	FACILITY STUDY STAGE
GEN-2016-021	300.00	NPPD	Hoskins 345kV	FACILITY STUDY STAGE
GEN-2016-022	151.80	OKGE	Ranch Road 345kV	FACILITY STUDY STAGE
GEN-2016-023	150.50	WAPA	Tap Laramie River – Sidney 345kV	FACILITY STUDY STAGE
GEN-2016-028	100.00	AEPW	Clayton 138kV	FACILITY STUDY STAGE
GEN-2016-029	150.00	WAPA	Tap Laramie River – Sidney 345kV	FACILITY STUDY STAGE
GEN-2016-030	100.00	OKGE	Brown 138kV	FACILITY STUDY STAGE
GEN-2016-031	1.50	OKGE	Ranch Road 345kV	FACILITY STUDY STAGE
GEN-2016-032	200.00	OKGE	Tap Marshall - Cottonwood Creek 138kV	FACILITY STUDY STAGE
GEN-2016-037	300.00	AEPW	Tap Chisholm - Gracemont 345kV	FACILITY STUDY STAGE
GEN-2016-043	230.00	NPPD	Hoskins 345kV	FACILITY STUDY STAGE
GEN-2016-045	499.10	OKGE	Mathewson 345kV	FACILITY STUDY STAGE
GEN-2016-046	299.00	SUNCMKEC	Tap Clark County - Ironwood 345kV	FACILITY STUDY STAGE
GEN-2016-047	24.00	OKGE	Mustang 69kV	FACILITY STUDY STAGE
GEN-2016-050	250.70	NPPD	Tap Axtell - Post Rock 345kV	FACILITY STUDY STAGE
GEN-2016-051	9.80	AEPW	Tap Clinton Junction - Weatherford Southeast 138kV	FACILITY STUDY STAGE
GEN-2016-052	3.30	WAPA	Hilken 230kV	FACILITY STUDY STAGE
GEN-2016-053	3.30	WAPA	Hilken 230kV	FACILITY STUDY STAGE
GEN-2016-054	3.40	WAPA	Wessington Springs 230kV	FACILITY STUDY STAGE
GEN-2016-056	200.00	SPS	Carlisle 230kV	FACILITY STUDY STAGE
GEN-2016-057	499.10	OKGE	Mathewson 345kV	FACILITY STUDY STAGE
GEN-2016-060	25.30	WERE	Belle Plain 138kV	FACILITY STUDY STAGE
GEN-2016-061	250.70	OKGE	Tap Woodring - Sooner 345kV	FACILITY STUDY STAGE
GEN-2016-062	250.70	SPS	Andrews 230kV	FACILITY STUDY STAGE
GEN-2016-063	200.00	OKGE	Tap Sunnyside – Hugo 345kV	FACILITY STUDY STAGE
GEN-2016-067	73.60	SUNCMKEC	Mingo 345kV	FACILITY STUDY STAGE

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2016-068	250.00	OKGE	Woodring 345kV	FACILITY STUDY STAGE
GEN-2016-069	31.40	SPS	Chaves County 115kV	FACILITY STUDY STAGE
GEN-2016-070	5.30	SPS	Martin 115kV	FACILITY STUDY STAGE
GEN-2016-071	200.10	WFEC	Chilocco 138kV	FACILITY STUDY STAGE
GEN-2016-073	220.00	WERE	Tap Thistle – Wichita 345kV Dbl CKT	FACILITY STUDY STAGE
Gray County Wind (Montezuma)	110.00	SUNCMKEC	Gray County Tap 115kV	On-Line
H081	200.00	XEL	Tap Brookings - Lyons County 345kV	Under Study DPP-2016-FEB-West
J003	20.00	MDU	Baker 115kV	MISO Queued Request
J233-J514	232.00	ITCM	Existing ITC Midwest Marshalltown substation (M-Town 161 kV POI #631081)	Under MISO DPP Study
J249	180.00	MDU	MDU Tatanka 230kV	MISO Queued Request
J262	100.00	OTP	Jamestown 345	MISO Queued Request
J263	100.00	OTP	Jamestown 345	MISO Queued Request
J290	150.00	XEL	Tap Glenboro South - Rugby 230kV	MISO Queued Request
J302	101.00	MDU	230kV Heskett-Wishek	Under MISO DPP Study
J316	150.00	MDU	MDU 230 kV Tatanka-Ellendale line	MISO Queued Request
J414	120.00	ITCM	Freeborn 161kV Substation on the Hayword - Freeborn - Winnebago 161kV line	Under MISO DPP Study
J415	188.50	MEC	New 345 kV Switchyard on the ROW of the proposed 345 kV Emery - Blackhawk line (MVP4)	Under MISO DPP Study
J432	98.00	XEL	Brookings 345kV	Under Study DPP-2016-FEB-West
J436	150.00	OTP	Big Stone South 345kV	MISO Queued Request
J437	150.00	OTP	Big Stone South 345kV	MISO Queued Request
J439	500.00	MEC	Dickens, IA 51333 at O'Brien to Kossuth 345 kV (J439 POI)	Under MISO DPP Study
J442	200.00	OTP	Big Stone 230 kV	MISO Queued Request
J457	150.00	MDU	Merricourt Substation	Under MISO DPP Study
J459	200.00	OTP	Big Stone - Brookings 345kV (J459 POI)	Under MISO DPP Study
J460	200.00	XEL	Tap Brookings - Lyons County 345kV	Under Study DPP-2016-FEB-West
J475	200.00	MEC	Existing 345 kV Montezuma Substation	Under MISO DPP Study
J476	246.00	MEC	Atchison County to Booneville 345 kV Line Tap	Under MISO DPP Study
J485	46.85	RPU	West Side Substation - 5846 19th Street NW, Rochester, MN	Under MISO DPP Study
J488	151.80	OTP	Tap Big Stone - Ellendale 345kV	Under Study DPP-2016-FEB-West
J489	151.80	OTP	Tap Big Stone - Ellendale 345kV	Under Study DPP-2016-FEB-West
J493	150.00	OTP	Burr 115kV	Under Study DPP-2016-FEB-West
J495	200.00	ITCM	Ledyard-Colby 345kV line	Under MISO DPP Study
J498	340.00	MEC	MEC 345 kV Grimes-Lehigh line (18 miles south of Leigh substation)	Under MISO DPP Study
J499	340.00	MEC	MEC 345 kV Fallow-Grimes line (18 miles east of Fallow substation)	Under MISO DPP Study
J500	500.00	MEC	New substation at intersection of MEC 345 kV Boone-Atchison and MEC 345 kV Rolling Hills-Madison County substation	Under MISO DPP Study
J503	100.00	MDU	230 kV Heskett-Wishek, 20 miles NW of Wishek	Under MISO DPP Study
J504	50.00	ITCM	J505	Under MISO DPP Study
J506	200.00	MEC	Raun-Lakefield Jct 345 kV line tap (T-19N, R-43W)	Under MISO DPP Study
J510	326.90	OTP	Tap Brookings - Big Stone 345kV	Under Study DPP-2016-FEB-West

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
J511	200.00	GRE	GRE Stanton Substation 230 kV bus, Stanton ND	Under MISO DPP Study
J512	250.00	NSP	Nobles - Fenton 115kV line	Under MISO DPP Study
J523	50.00	ITCM	ITCM Adams 161 kV Substation	Under MISO DPP Study
J524	100.00	MEC	Webster substation 161 kV bus	Under MISO DPP Study
J525	50.00	XEL	Lake Wilson 69kV	Under Study DPP-2016-FEB-West
J526	300.00	OTP	Tap Brookings - Big Stone 345kV	Under Study DPP-2016-FEB-West
J527	250.00	MEC	Booneville Cooper 345kV line	Under MISO DPP Study
J528	200.00	MEC	Rolling Hills - Madison 345kV Line	Under MISO DPP Study
J529	250.00	MEC	Obrien - Kossuth 345 kV line (J529_J590 POI)	Under MISO DPP Study
J530	250.00	MEC	Montezuma - Hills 345kV Line (J530 POI)	Under MISO DPP Study
J534	250.00	MEC	Kossuth â€“ Webster 345kV Line	Under MISO DPP Study
J535	210.00	MEC	J411 â€“ Lehigh 345kV Line (J535 POI)	Under MISO DPP Study
J541	400.00	ATC	Zachary-Ottumwa 345 kV line	Under MISO DPP Study
J555	140.00	MEC	Montezuma, IA 50171 345kV substation (J475-J555 POI)	Under MISO DPP Study
J569	100.00	NSP	NSP Rock County Substation	Under MISO DPP Study
J575	100.00	NSP	Brookings County Substation 345 kV	Under MISO DPP Study
J577	102.80	NSP	345kV Brookings County Sub	Under MISO DPP Study
J583	200.10	MEC	Fallow Avenue 345kV Substation. Zip Code 50002	Under MISO DPP Study
J587	200.00	NSP	J460 substation on the Brookings-H081 345kV line	Under MISO DPP Study
J590	90.00	MEC	Obrien - Kossuth 345 kV line (J529&J590 POI)	Under MISO DPP Study
J593	224.00	MDU	Tioga 4 230kV Substation (MDU)	Under MISO DPP Study
J594	150.00	ITCM	Jackson North 161kV (ITCM)	Under MISO DPP Study
J596	100.00	GRE	Morris -Moro 115kV Tap	Under MISO DPP Study
J597	300.00	NSP	Brookings County Substation 345	Under MISO DPP Study
J598	300.00	ATC	Zachary to Ottumawa 345kV tap	Under MISO DPP Study
J599	200.00	MDU	Glenham 230kV Substation	Under MISO DPP Study
J607	150.00	MDU	Wishek - Heskett 230kV line	Under MISO DPP Study
J611	110.00	MEC	Clarinda - Merryville 161kV tap	Under MISO DPP Study
J613	100.00	OTP	Jamestown Substation 115kV	Under MISO DPP Study
J614	66.00	SMMP	Rice 161kV Substation	Under MISO DPP Study
J615	70.00	MEC	Electric Farms- Shaulis 161kV (J615 POI)	Under MISO DPP Study
J637	98.00	OTP	Big Stone - Brookings 345 kV	Under MISO DPP Study
J638	104.00	OTP	Big Stone - Brookings 345 kV	Under MISO DPP Study
J638	100.00	OTP	Big Stone - Brookings 345 kV	Under MISO DPP Study
Llano Estacado (White Deer)	80.00	SPS	Llano Wind 115kV	On-Line
MPC01200	98.90	OTP	Maple River 230 kV	IA Pending
MPC02100	100.00	OTP	Center - Mandan 230 kV	On-Line
NPPD Distributed (Broken Bow)	8.30	NPPD	Broken Bow 115kV	On-Line
NPPD Distributed (Buffalo County Solar)	10.00	NPPD	Kearney Northeast	On-Line
NPPD Distributed (Burt County Wind)	12.00	NPPD	Tekamah & Oakland 115kV	On-Line
NPPD Distributed (Burwell)	3.00	NPPD	Ord 115kV	On-Line
NPPD Distributed (Columbus Hydro)	45.00	NPPD	Columbus 115kV	On-Line
NPPD Distributed (North Platte - Lexington)	54.00	NPPD	Multiple: Jeffrey 115kV, John_1 115kV, John_2 115kV	On-Line
NPPD Distributed (Ord)	11.90	NPPD	Ord 115kV	On-Line
NPPD Distributed (Stuart)	2.10	NPPD	Ainsworth 115kV	On-Line
SPS Distributed (Carson)	10.00	SPS	Martin 115kV	On-Line
SPS Distributed (Dumas 19th St)	20.00	SPS	Dumas 19th Street 115kV	On-Line

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
SPS Distributed (Etter)	20.00	SPS	Etter 115kV	On-Line
SPS Distributed (Hopi)	10.00	SPS	Hopi 115kV	On-Line
SPS Distributed (Jal)	10.00	SPS	S Jal 115kV	On-Line
SPS Distributed (Lea Road)	10.00	SPS	Lea Road 115kV	On-Line
SPS Distributed (Monument)	10.00	SPS	Monument 115kV	On-Line
SPS Distributed (Moore E)	25.00	SPS	Moore East 115kV	On-Line
SPS Distributed (Ocotillo)	10.00	SPS	S_Jal 115kV	On-Line
SPS Distributed (Sherman)	20.00	SPS	Sherman 115kV	On-Line
Total:	**57,365.7**			

11.3 C: STUDY GROUPINGS

C. Study Groups

GROUP 1: WOODWARD AREA			
Request	Capacity	Area	Proposed Point of Interconnection
GEN-2001-014	96.00	WFEC	Ft Supply 138kV
GEN-2001-037	100.00	OKGE	FPL Moreland Tap 138kV
GEN-2005-008	120.00	OKGE	Woodward 138kV
GEN-2006-024S	19.80	WFEC	Buffalo Bear Tap 69kV
GEN-2006-046	131.00	OKGE	Dewey 138kV
GEN-2007-021	201.00	OKGE	Tatonga 345kV
GEN-2007-043	200.00	OKGE	Minco 345kV
GEN-2007-044	300.00	OKGE	Tatonga 345kV
GEN-2007-050	170.00	OKGE	Woodward EHV 138kV
GEN-2007-062	425.00	OKGE	Woodward EHV 345kV
GEN-2008-003	101.00	OKGE	Woodward EHV 138kV
GEN-2008-044	197.80	OKGE	Tatonga 345kV
GEN-2010-011	29.70	OKGE	Tatonga 345kV
GEN-2010-040	300.00	OKGE	Cimarron 345kV
GEN-2011-010	100.80	OKGE	Minco 345kV
GEN-2011-019	175.00	OKGE	Woodward 345kV
GEN-2011-020	165.60	OKGE	Woodward 345kV
GEN-2011-054	300.00	OKGE	Cimarron 345kV
GEN-2014-002	10.50	OKGE	Tatonga 345kV (GEN-2007-021 POI)
GEN-2014-003	15.80	OKGE	Tatonga 345kV (GEN-2007-044 POI)
GEN-2014-005	5.70	OKGE	Minco 345kV (GEN-2011-010 POI)
GEN-2014-020	100.00	AEPW	Tuttle 138kV
GEN-2014-056	250.00	OKGE	Minco 345kV
GEN-2015-029	161.00	OKGE	Tatonga 345kV
GEN-2015-048	200.00	OKGE	Cleo Corner 138kV
GEN-2015-057	100.00	OKGE	Minco 345kV
GEN-2015-093	250.00	OKGE	Gracemont 345kV
GEN-2015-095	176.00	WFEC	DeGrasse 138kV
GEN-2016-003	248.40	OKGE	Tap Badger - Woodward 345kV
GEN-2016-020	150.00	WFEC	Mooreland 138kV
GEN-2016-045	499.10	OKGE	Mathewson 345kV
GEN-2016-047	24.00	OKGE	Mustang 69kV
GEN-2016-057	499.10	OKGE	Mathewson 345kV
PRIOR QUEUED SUBTOTAL	5,822.30		
GEN-2016-118	288.00	WFEC	Dover Switchyard 138kV
GEN-2016-131	2.50	OKGE	Minco Substation 345kV
CURRENT CLUSTER SUBTOTAL	290.50		
AREA TOTAL	6,112.80		

GROUP 2: HITCHLAND AREA Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2011-002	20.00	SPS	Herring 115kV
ASGI-2013-001	11.50	SPS	PanTex South 115kV
GEN-2002-008	240.00	SPS	Hitchland 345kV
GEN-2002-009	80.00	SPS	Hansford 115kV
GEN-2002-022	240.00	SPS	Bushland 230kV
GEN-2003-020	160.00	SPS	Martin 115kV
GEN-2006-020S	18.90	SPS	DWS Frisco 115kV
GEN-2006-044	370.00	SPS	Hitchland 345kV
GEN-2007-046	200.00	SPS	Hitchland 115kV
GEN-2008-047	300.00	OKGE	Beaver County 345kV
GEN-2008-051	322.00	SPS	Potter County 345kV
GEN-2010-001	300.00	OKGE	Beaver County 345kV
GEN-2010-014	358.80	SPS	Hitchland 345kV
GEN-2011-014	201.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (GEN-2011-014 Tap) 345kV
GEN-2011-022	299.00	SPS	Hitchland 345kV
GEN-2013-030	300.00	OKGE	Beaver County 345kV
GEN-2014-037	200.00	SPS	Tap Hitchland - Beaver County Dbl Ckt (Optima) 345kV
GEN-2015-082	200.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (GEN-2011-014 Tap) 345kV
GEN-2016-070	5.30	SPS	Martin 115kV
Llano Estacado (White Deer)	80.00	SPS	Llano Wind 115kV
SPS Distributed (Carson)	10.00	SPS	Martin 115kV
SPS Distributed (Dumas 19th St)	20.00	SPS	Dumas 19th Street 115kV
SPS Distributed (Etter)	20.00	SPS	Etter 115kV
SPS Distributed (Moore E)	25.00	SPS	Moore East 115kV
SPS Distributed (Sherman)	20.00	SPS	Sherman 115kV
PRIOR QUEUED SUBTOTAL	4,001.50		
ASGI-2016-010	90.00	SPS	Powell Corner 115kV
GEN-2016-161	3.00	SPS	Martin 115kV
CURRENT CLUSTER SUBTOTAL	93.00		
AREA TOTAL	4,094.50		

GROUP 3: SPEARVILLE AREA			
Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2012-006	22.50	SUNCMKEC	Tap Hugoton - Rolla 69kV
ASGI-2015-001	6.13	SUNCMKEC	Ninnescah 115kV
GEN-2001-039A	105.00	SUNCMKEC	Shooting Star Tap 115kV
GEN-2002-025A	150.00	SUNCMKEC	Spearville 230kV
GEN-2004-014	154.50	SUNCMKEC	Spearville 230kV
GEN-2005-012	250.00	SUNCMKEC	Ironwood 345kV
GEN-2006-021	101.00	SUNCMKEC	Flat Ridge Tap 138kV
GEN-2007-040	200.00	SUNCMKEC	Buckner 345kV
GEN-2008-018	250.00	SPS	Finney 345kV
GEN-2008-079	99.20	SUNCMKEC	Crooked Creek 115kV
GEN-2008-124	200.10	SUNCMKEC	Ironwood 345kV
GEN-2010-009	165.60	SUNCMKEC	Buckner 345kV
GEN-2011-008	600.00	SUNCMKEC	Clark County 345kV
GEN-2011-016	200.10	SUNCMKEC	Ironwood 345kV
GEN-2012-007	120.00	SUNCMKEC	Rubart 115kV
GEN-2012-024	180.00	SUNCMKEC	Clark County 345kV
GEN-2013-010	99.00	SUNCMKEC	Tap Spearville - Post Rock (North of GEN-2011-017 Tap) 345kV
GEN-2015-021	20.00	SUNCMKEC	Johnson Corner 115kV
GEN-2016-005	150.00	SUNCMKEC	Tap Clark County - Thistle 345kV
GEN-2016-016	78.20	MIDW	North Kinsley 115kV
GEN-2016-046	299.00	SUNCMKEC	Tap Clark County - Ironwood 345kV
Gray County Wind (Montezuma)	110.00	SUNCMKEC	Gray County Tap 115kV
PRIOR QUEUED SUBTOTAL	3,560.33		
AREA TOTAL	3,560.33		

GROUP 4: NORTHWEST KANSAS AREA			
Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2013-004	36.60	SUNCMKEC	Morris 115kV
GEN-2001-039M	100.00	SUNCMKEC	Central Plains Tap 115kV
GEN-2003-006A	200.00	SUNCMKEC	Elm Creek 230kV
GEN-2003-019	250.00	MIDW	Smoky Hills Tap 230kV
GEN-2006-031	75.00	MIDW	Knoll 115kV
GEN-2008-092	200.60	MIDW	Post Rock 230kV
GEN-2009-008	199.50	MIDW	South Hays 230kV
GEN-2009-020	48.30	MIDW	Walnut Creek 69kV
GEN-2010-057	201.00	MIDW	Rice County 230kV
GEN-2013-033	28.00	MIDW	Knoll 115kV
GEN-2014-025	2.40	MIDW	Walnut Creek 69kV
GEN-2015-064	197.80	SUNCMKEC	Mingo 115kV
GEN-2015-065	202.40	SUNCMKEC	Mingo 345kV
GEN-2016-067	73.60	SUNCMKEC	Mingo 345kV
PRIOR QUEUED SUBTOTAL	1,815.20		
GEN-2016-111	302.00	WERE	Tap Summit – Reno 345kV Line
GEN-2016-112	220.00	WERE	Tap Reno-Summit 345kV (proposed Cross-County Wind 1 345kV Substation GEN-2016-122)
GEN-2016-113	155.00	WERE	Tap Reno-Summit 345kV (proposed Cross-County Wind 1 345kV Substation GEN-2016-122)
GEN-2016-114	310.00	WERE	Tap Reno-Summit 345kV
GEN-2016-122	225.00	WERE	Tap Reno-Summit 345kV
GEN-2016-160	20.00	MIDW	Post Rock 230kV Substation (530584)
CURRENT CLUSTER SUBTOTAL	1,232.00		
AREA TOTAL	3,047.20		

GROUP 6: SOUTH TEXAS PANHANDLE/NEW MEXICO AREA			
Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2010-010	42.20	SPS	Lovington 115kV
ASGI-2010-020	30.00	SPS	Tap LE-Tatum - LE-Crossroads 69kV
ASGI-2010-021	15.00	SPS	Tap LE-Saunders Tap - LE-Anderson 69kV
ASGI-2011-001	27.30	SPS	Lovington 115kV
ASGI-2011-003	10.00	SPS	Hendricks 69kV
ASGI-2011-004	20.00	SPS	Pleasant Hill 69kV
ASGI-2012-002	18.15	SPS	FE-Clovis Interchange 115kV
ASGI-2013-002	18.40	SPS	FE Tucumcari 115kV
ASGI-2013-003	18.40	SPS	FE Clovis 115kV
ASGI-2013-005	1.65	SPS	FE Clovis 115kV
ASGI-2015-002	2.00	SPS	SP-Yuma 69kV
ASGI-2016-002	0.35	SPS	SP-Yuma 115kV
ASGI-2016-004	9.60	SPS	Palo Duro 115kV
GEN-2001-033	180.00	SPS	San Juan Tap 230kV
GEN-2001-036	80.00	SPS	Norton 115kV
GEN-2006-018	170.00	SPS	TUCO Interchange 230kV
GEN-2006-026	502.00	SPS	Hobbs 230kV & Hobbs 115kV
GEN-2008-022	300.00	SPS	Crossroads 345kV
GEN-2010-006	205.00	SPS	Jones 230kV
GEN-2010-046	56.00	SPS	TUCO Interchange 230kV
GEN-2011-025	80.00	SPS	Tap Floyd County - Crosby County 115kV
GEN-2011-045	205.00	SPS	Jones 230kV
GEN-2011-046	27.00	SPS	Lopez 115kV
GEN-2011-048	175.00	SPS	Mustang 230kV
GEN-2012-001	61.20	SPS	Cirrus Tap 230kV
GEN-2012-020	478.00	SPS	TUCO 230kV
GEN-2012-034	7.00	SPS	Mustang 230kV
GEN-2012-035	7.00	SPS	Mustang 230kV
GEN-2012-036	7.00	SPS	Mustang 230kV
GEN-2012-037	203.00	SPS	TUCO 345kV
GEN-2013-016	203.00	SPS	TUCO 345kV
GEN-2013-022	25.00	SPS	Norton 115kV
GEN-2013-027	150.00	SPS	Tap Tolk - Yoakum 230kV
GEN-2014-012	225.00	SPS	Tap Hobbs Interchange - Andrews 230kV
GEN-2014-033	70.00	SPS	Chaves County 115kV
GEN-2014-034	70.00	SPS	Chaves County 115kV
GEN-2014-035	30.00	SPS	Chaves County 115kV
GEN-2014-040	320.40	SPS	Castro 115kV
GEN-2014-047	40.00	SPS	Crossroads 345kV
GEN-2015-014	150.00	SPS	Tap Cochran - Lehman 115kV
GEN-2015-020	100.00	SPS	Oasis 115kV
GEN-2015-022	112.00	SPS	Swisher 115kV
GEN-2015-031	150.50	SPS	Tap Amarillo South - Swisher 230kV
GEN-2015-041	5.00	SPS	TUCO Interchange 345kV
GEN-2015-056	101.20	SPS	Crossroads 345kV
GEN-2015-058	50.00	SPS	Atoka 115kV
GEN-2015-068	300.00	SPS	TUCO Interchange 345kV
GEN-2015-075	51.50	SPS	Carlisle 69kV
GEN-2015-079	129.20	SPS	Tap Yoakum - Hobbs Interchange 230kV

GEN-2015-080	129.20	SPS	Tap Yoakum - Hobbs Interchange 230kV
GEN-2016-015	100.00	SPS	Andrews 230kV
GEN-2016-056	200.00	SPS	Carlisle 230kV
GEN-2016-062	250.70	SPS	Andrews 230kV
GEN-2016-069	31.40	SPS	Chaves County 115kV
SPS Distributed (Hopi)	10.00	SPS	Hopi 115kV
SPS Distributed (Jal)	10.00	SPS	S Jal 115kV
SPS Distributed (Lea Road)	10.00	SPS	Lea Road 115kV
SPS Distributed (Monument)	10.00	SPS	Monument 115kV
SPS Distributed (Ocotillo)	10.00	SPS	S_Jal 115kV
Sunray	49.50	SPS	Valero 115kV
PRIOR QUEUED SUBTOTAL	6,049.85		
ASGI-2016-009	3.00	SPS	Wolfforth 115kV
GEN-2015-039	50.10	SPS	Tap Deaf Smith - Plant X 230kV
GEN-2015-040	50.10	SPS	Mustang 230kV
GEN-2015-078	50.10	SPS	Mustang 115kV
GEN-2015-099	73.30	SPS	Maddox 115kV
GEN-2016-039	112.00	SPS	Swisher 115kV
GEN-2016-077	54.00	SPS	Ozark Mahoning #1 69kV (526770)
GEN-2016-078	108.00	SPS	Bailey County 115kV (525028)
GEN-2016-120	400.00	SPS	Tap Tuco-Border 345kV Line
GEN-2016-121	110.00	SPS	Roadrunner 115kV Sub (528028 "RDRUNNER")
GEN-2016-123	298.00	SPS	Crossroads 345kV
GEN-2016-124	150.00	SPS	Crossroads 345kV
GEN-2016-125	74.00	SPS	Crossroads 345kV
GEN-2016-169	260.00	SPS	Hobbs Interchange 345kV
GEN-2016-171	64.00	SPS	Tap Hobbs –Yoakum 230kV Line
GEN-2016-172	231.00	SPS	Newhart 115kV
GEN-2016-175	150.00	SPS	Tap Tuco-Border 345kV Line
GEN-2016-177	17.00	SPS	Tap Ink Basin - Denver City 115kV
CURRENT CLUSTER SUBTOTAL	2,254.60		
AREA TOTAL	8,304.45		

GROUP 7: SOUTHWEST OKLAHOMA AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2001-026	74.30	WFEC	Washita 138kV
GEN-2002-005	120.00	WFEC	Red Hills Tap 138kV
GEN-2003-004	100.00	WFEC	Washita 138kV
GEN-2003-005	100.00	WFEC	Anadarko - Paradise (Blue Canyon) 138kV
GEN-2003-022	120.00	AEPW	Weatherford 138kV
GEN-2004-020	27.00	AEPW	Weatherford 138kV
GEN-2004-023	20.60	WFEC	Washita 138kV
GEN-2005-003	30.60	WFEC	Washita 138kV
GEN-2006-002	101.00	AEPW	Sweetwater 230kV
GEN-2006-035	225.00	AEPW	Sweetwater 230kV
GEN-2006-043	99.00	AEPW	Sweetwater 230kV
GEN-2007-052	150.00	WFEC	Anadarko 138kV
GEN-2008-023	150.00	AEPW	Hobart Junction 138kV
GEN-2008-037	101.00	WFEC	Slick Hills 138kV
GEN-2011-037	7.00	WFEC	Blue Canyon 5 138kV
GEN-2011-049	250.70	OKGE	Border 345kV
GEN-2012-028	74.80	WFEC	Gotebo 69kV
GEN-2015-004	52.90	OKGE	Border 345kV
GEN-2015-013	120.00	WFEC	Synder 138kV
GEN-2015-055	40.00	WFEC	Erick 138kV
GEN-2015-071	200.00	AEPW	Chisholm 345kV
GEN-2015-084	51.30	AEPW	Hollis 138kV
GEN-2015-085	122.40	AEPW	Altus Junction 138kV
GEN-2016-037	300.00	AEPW	Tap Chisholm - Gracemont 345kV
GEN-2016-051	9.80	AEPW	Tap Clinton Junction - Weatherford Southeast 138kV
PRIOR QUEUED SUBTOTAL	2,647.40		
GEN-2016-091	303.60	AEPW	New tap on PSE&G (AEP) 345kV Gracemont-Lawton
GEN-2016-095	200.00	AEPW	Tap Gracemont - Lawton 345kV
GEN-2016-097	100.00	AEPW	Tap Southwestern-Fletcher Tap 138kV
GEN-2016-132	6.10	AEPW	Sweetwater 230kV
CURRENT CLUSTER SUBTOTAL	609.70		
AREA TOTAL	3,257.10		

GROUP 8: NORTH OKLAHOMA/SOUTH CENTRAL KANSAS AREA

Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2010-006	150.00	AECI	Remington 138kV
ASGI-2014-014	56.40	GRDA	Ferguson 69kV
ASGI-2015-004	56.36	GRDA	Coffeyville City 69kV
ASGI-2017-008	158.60	AECI	Remington to Shidler 138 kV
GEN-2002-004	200.00	WERE	Latham 345kV
GEN-2005-013	201.00	WERE	Caney River 345kV
GEN-2007-025	300.00	WERE	Viola 345kV
GEN-2008-013	300.00	OKGE	Hunter 345kV
GEN-2008-021	42.00	WERE	Wolf Creek 345kV
GEN-2008-098	100.80	WERE	Waverly 345kV
GEN-2009-025	59.80	OKGE	Nardins 69kV
GEN-2010-003	100.80	WERE	Waverly 345kV
GEN-2010-005	299.20	WERE	Viola 345kV
GEN-2010-055	4.50	AEPW	Wekiwa 138kV
GEN-2011-057	150.40	WERE	Creswell 138kV

GEN-2012-032	300.00	OKGE	Open Sky 345kV
GEN-2012-033	98.10	OKGE	Tap and Tie South 4th - Bunch Creek & Enid Tap - Fairmont (GEN-2012-033T) 138kV
GEN-2012-041	121.50	OKGE	Ranch Road 345kV
GEN-2013-012	147.00	OKGE	Redbud 345kV
GEN-2013-028	559.50	GRDA	Tap N Tulsa - GRDA 1 345kV
GEN-2013-029	300.00	OKGE	Renfrow 345kV
GEN-2014-001	200.60	WERE	Tap Wichita - Emporia Energy Center (GEN-2014-001 Tap) 345kV
GEN-2014-028	35.00	EMDE	Riverton 161kV
GEN-2014-064	248.40	OKGE	Otter 138kV
GEN-2015-001	200.00	OKGE	Ranch Road 345kV
GEN-2015-015	154.60	OKGE	Road Runner 138kV
GEN-2015-016	200.00	KCPL	Tap Marmaton - Centerville 161kV
GEN-2015-024	220.00	WERE	Tap Thistle - Wichita 345kV Dbl CKT
GEN-2015-025	220.00	WERE	Tap Thistle - Wichita 345kV Dbl CKT
GEN-2015-030	200.10	OKGE	Sooner 345kV
GEN-2015-034	200.00	OKGE	Ranch Road 345kV
GEN-2015-047	300.00	OKGE	Sooner 345kV
GEN-2015-052	300.00	WERE	Tap Open Sky - Rose Hill 345kV
GEN-2015-062	4.50	OKGE	Tap and Tie South 4th - Bunch Creek & Enid Tap - Fairmont (GEN-2012-033T) 138kV
GEN-2015-063	300.00	OKGE	Tap Woodring - Mathewson 345kV
GEN-2015-066	248.40	OKGE	Tap Cleveland - Sooner 345kV
GEN-2015-069	300.00	WERE	Union Ridge 230kV
GEN-2015-073	200.10	WERE	Emporia Energy Center 345kV
GEN-2015-083	125.00	WERE	Belle Plain 138kV
GEN-2015-090	220.00	WERE	Tap Thistle - Wichita 345kV Dbl CKT
GEN-2016-009	29.00	OKGE	Osage 69kV
GEN-2016-022	151.80	OKGE	Ranch Road 345kV
GEN-2016-031	1.50	OKGE	Ranch Road 345kV
GEN-2016-032	200.00	OKGE	Tap Marshall - Cottonwood Creek 138kV
GEN-2016-060	25.30	WERE	Belle Plain 138kV
GEN-2016-061	250.70	OKGE	Tap Woodring - Sooner 345kV
GEN-2016-068	250.00	OKGE	Woodring 345kV
GEN-2016-071	200.10	WFEC	Chilocco 138kV
GEN-2016-073	220.00	WERE	Tap Thistle – Wichita 345kV Dbl CKT
PRIOR QUEUED SUBTOTAL	8,911.06		
GEN-2016-024	55.90	WERE	Midian 138kV
GEN-2016-072	300.00	OKGE	Renfrow 345kV
GEN-2016-100	100.00	OKGE	Tap Sooner-Spring Creek 345kV
GEN-2016-101	195.00	OKGE	Tap Sooner-Spring Creek 345kV
GEN-2016-119	600.00	OKGE	Tap Spring Creek-Sooner 345 kV
GEN-2016-127	200.10	AEPW	Shidler 138kV Substation
GEN-2016-128	176.00	OKGE	Woodring 345kV Substation
GEN-2016-133	187.50	AEPW	Tulsa North 345kV Substation
GEN-2016-134	187.50	AEPW	Tulsa North 345kV Substation
GEN-2016-135	100.00	AEPW	Tulsa North 345kV Substation
GEN-2016-136	75.00	AEPW	Tulsa North 345kV Substation
GEN-2016-137	187.50	AEPW	Tulsa North 345kV Substation
GEN-2016-138	187.50	AEPW	Tulsa North 345kV Substation
GEN-2016-139	100.00	AEPW	Tulsa North 345kV Substation
GEN-2016-140	75.00	AEPW	Tulsa North 345kV Substation
GEN-2016-141	350.00	AEPW	Tulsa North 345kV Substation
GEN-2016-142	350.00	AEPW	Tulsa North 345kV Substation

GEN-2016-143	175.00	AEPW	Tulsa North 345kV Substation
GEN-2016-144	175.00	AEPW	Tulsa North 345kV Substation
GEN-2016-145	175.00	AEPW	Tulsa North 345kV Substation
GEN-2016-146	175.00	AEPW	Tulsa North 345kV Substation
GEN-2016-148	150.00	WFEC	Hardy 138kV Substation
GEN-2016-153	134.00	WERE	Viola 345kV Substation
GEN-2016-162	252.00	WERE	Benton 345kV
GEN-2016-163	252.00	WERE	Benton 345kV
GEN-2016-173	42.00	WERE	Creswell 69kV Sub
CURRENT CLUSTER SUBTOTAL	4,957.00		
AREA TOTAL	13,868.06		

GROUP 9: NEBRASKA AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2002-023N	0.80	NPPD	Harmony 115kV
GEN-2003-021N	75.00	NPPD	Ainsworth Wind Tap 115kV
GEN-2004-023N	75.00	NPPD	Columbus Co 115kV
GEN-2006-020N	42.00	NPPD	Bloomfield 115kV
GEN-2006-037N1	75.00	NPPD	Broken Bow 115kV
GEN-2006-038N005	80.00	NPPD	Broken Bow 115kV
GEN-2006-038N019	80.00	NPPD	Petersburg North 115kV
GEN-2006-044N	40.50	NPPD	North Petersburg 115kV
GEN-2007-011N08	81.00	NPPD	Bloomfield 115kV
GEN-2007-017IS	166.00	WAPA	Ft Thompson-Grand Island 345kV
GEN-2007-018IS	234.00	WAPA	Ft Thompson-Grand Island 345kV
GEN-2008-086N02	201.00	NPPD	Meadow Grove 230kV
GEN-2008-119O	60.00	OPPD	S1399 161kV
GEN-2008-123N	89.70	NPPD	Tap Pauline - Guide Rock (Rosemont) 115kV
GEN-2009-040	73.80	WERE	Marshall 115kV
GEN-2010-041	10.50	OPPD	S1399 161kV
GEN-2010-051	200.00	NPPD	Tap Hoskins - Twin Church (Dixon County) 230kV
GEN-2011-018	73.60	NPPD	Steele City 115kV
GEN-2011-027	120.00	NPPD	Tap Hoskins - Twin Church (Dixon County) 230kV
GEN-2011-056	3.60	NPPD	Jeffrey 115kV
GEN-2011-056A	3.60	NPPD	John 1 115kV
GEN-2011-056B	4.50	NPPD	John 2 115kV
GEN-2012-021	4.80	LES	Terry Bundy Generating Station 115kV
GEN-2013-002	50.60	LES	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2
GEN-2013-008	1.20	NPPD	Steele City 115kV
GEN-2013-019	73.60	LES	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2
GEN-2013-032	204.00	NPPD	Antelope 115kV
GEN-2014-004	4.00	NPPD	Steele City 115kV (GEN-2011-018 POI)
GEN-2014-013	73.50	NPPD	Meadow Grove (GEN-2008-086N2 Sub) 230kV
GEN-2014-031	35.80	NPPD	Meadow Grove 230kV
GEN-2014-032	10.20	NPPD	Meadow Grove 230kV
GEN-2014-039	73.40	NPPD	Friend 115kV
GEN-2015-007	160.00	NPPD	Hoskins 345kV
GEN-2015-023	300.70	NPPD	Holt County 345kV
GEN-2015-053	50.00	NPPD	Antelope 115kV
GEN-2015-076	158.40	NPPD	Belden 115kV
GEN-2015-087	66.00	NPPD	Tap Fairbury - Hebron 115kV
GEN-2015-088	300.00	NPPD	Tap Moore - Pauline 345kV

GEN-2015-089	200.00	WAPA	Utica 230kV
GEN-2016-021	300.00	NPPD	Hoskins 345kV
GEN-2016-023	150.50	WAPA	Tap Laramie River – Sidney 345kV
GEN-2016-029	150.00	WAPA	Tap Laramie River – Sidney 345kV
GEN-2016-043	230.00	NPPD	Hoskins 345kV
GEN-2016-050	250.70	NPPD	Tap Axtell - Post Rock 345kV
GEN-2016-075	50.00	WAPA	Grand Prairie 345kV
J233-J514	232.00	ITCM	Existing ITC Midwest Marshalltown substation (M-Town 161 kV POI #631081)
J475	200.00	MEC	Existing 345 kV Montezuma Substation
J495	200.00	ITCM	Ledyard-Colby 345kV line
J498	340.00	MEC	MEC 345 kV Grimes-Lehigh line (18 miles south of Leigh substation)
J499	340.00	MEC	MEC 345 kV Fallow-Grimes line (18 miles east of Fallow substation)
J500	500.00	MEC	New substation at intersection of MEC 345 kV Boone-Atchison and MEC 345 kV Rolling Hills-Madison County substation
J504	50.00	ITCM	J505
J506	200.00	MEC	Raun-Lakefield Jct 345 kV line tap (T-19N, R-43W)
J524	100.00	MEC	Webster substation 161 kV bus
J527	250.00	MEC	Booneville Cooper 345kV line
J528	200.00	MEC	Rolling Hills - Madison 345kV Line
J529	250.00	MEC	Obrien - Kossuth 345 kV line (J529_J590 POI)
J530	250.00	MEC	Montezuma - Hills 345kV Line (J530 POI)
J534	250.00	MEC	Kossuth â€“ Webster 345kV Line
J535	210.00	MEC	J411 â€“ Lehigh 345kV Line (J535 POI)
J555	140.00	MEC	Montezuma, IA 50171 345kV substation (J475-J555 POI)
J583	200.10	MEC	Fallow Avenue 345kV Substation. Zip Code 50002
J615	70.00	MEC	Electric Farms- Shaulis 161kV (J615 POI)
NPPD Distributed (Broken Bow)	8.30	NPPD	Broken Bow 115kV
NPPD Distributed (Buffalo County Solar)	10.00	NPPD	Kearney Northeast
NPPD Distributed (Burt County Wind)	12.00	NPPD	Tekamah & Oakland 115kV
NPPD Distributed (Burwell)	3.00	NPPD	Ord 115kV
NPPD Distributed (Columbus Hydro)	45.00	NPPD	Columbus 115kV
NPPD Distributed (North Platte - Lexington)	54.00	NPPD	Multiple: Jeffrey 115kV, John_1 115kV, John_2 115kV
NPPD Distributed (Ord)	11.90	NPPD	Ord 115kV
NPPD Distributed (Stuart)	2.10	NPPD	Ainsworth 115kV
PRIOR QUEUED SUBTOTAL	8,815.40		
GEN-2016-034	90.00	WAPA	Tap Laramie River – Sidney 345kV
GEN-2016-074	200.00	NPPD	Sweetwater 345kV
GEN-2016-096	227.70	NPPD	Tap Pauline-Moore 345kV
GEN-2016-106	400.00	NPPD	Gentleman Substation 345kV
GEN-2016-110	152.00	WAPA	Tap Laramie River-Stegall 345kV Line
GEN-2016-147	40.00	NPPD	Sidney 115kV Sub
GEN-2016-159	427.80	NPPD	Hoskins 345kV Substation
GEN-2016-165	202.00	WAPA	Tap Fort Thompson - Grand Island 345kV
CURRENT CLUSTER SUBTOTAL	1,739.50		
AREA TOTAL	10,554.90		

GROUP 10: SOUTHEAST OKLAHOMA/NORTHEAST TEXAS AREA			
Request	Capacity	Area	Proposed Point of Interconnection
GEN-2016-167	73.50	AEPW	Tap Lieberman - North Benton 138kV
CURRENT CLUSTER SUBTOTAL	73.50		
AREA TOTAL	73.50		

GROUP 12: NORTHWEST ARKANSAS AREA			
Request	Capacity	Area	Proposed Point of Interconnection
GEN-2013-011	30.00	AEPW	Turk 138kV
GEN-2016-013	10.00	EMDE	La Russell 161kV
GEN-2016-014	10.00	EMDE	La Russell 161kV
PRIOR QUEUED SUBTOTAL	50.00		
GEN-2016-166	35.00	AEPW	Prairie Grove 69kV Substation
CURRENT CLUSTER SUBTOTAL	35.00		
AREA TOTAL	85.00		

GROUP 13: NORTHWEST MISSOURI AREA			
Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2016-003	6.00	KCPL	Paola 161kV
ASGI-2017-006	238.00	AECI	Maryville 161 kV
GEN-2008-129	80.00	KCPL	Pleasant Hill 161kV
GEN-2010-036	4.60	WERE	6th Street 115kV
GEN-2011-011	50.00	KCPL	Iatan 345kV
GEN-2014-021	300.00	KCPL	Tap Nebraska City - Mullin Creek (Holt) 345kV
GEN-2015-005	200.10	KCPL	Tap Nebraska City - Sibley (Ketchem) 345kV
J476	246.00	MEC	Atchison County to Booneville 345 kV Line Tap
J541	400.00	ATC	Zachary-Ottumwa 345 kV line
J598	300.00	ATC	Zachary to Ottumawa 345kV tap
J611	110.00	MEC	Clarinda - Merryville 161kV tap
PRIOR QUEUED SUBTOTAL	1,934.70		
GEN-2016-088	151.20	KCPL	Transource Ketchem 345kV Station
GEN-2016-115	300.00	KCPL	Holt County Switching Station 345kV
GEN-2016-149	302.00	WERE	Stranger Creek 345kV Sub
GEN-2016-150	302.00	WERE	Stranger Creek 345kV Sub
GEN-2016-157	252.00	KCPL	West Gardner 345kV Sub
GEN-2016-158	252.00	KCPL	West Gardner 345kV Sub
GEN-2016-168	20.00	KCPL	Higginsville 69kV Sub
GEN-2016-174	302.00	WERE	Stranger Creek 345kV Sub
GEN-2016-176	302.00	WERE	Stranger Creek 345kV Sub
CURRENT CLUSTER SUBTOTAL	2,183.20		
AREA TOTAL	4,117.90		

GROUP 14: SOUTH CENTRAL OKLAHOMA AREA Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2015-006	9.00	SWPA	Tupelo 138kV
ASGI-2016-011	7.41	SWPA	Allen 138 kV
ASGI-2016-012	61.73	SWPA	Tupelo 138 kV
ASGI-2016-013	4.94	WFEC	Ashland 138 kV
GEN-2011-040	111.00	OKGE	Carter County 138kV
GEN-2011-050	109.80	AEPW	Santa Fe Tap 138kV
GEN-2012-004	41.40	OKGE	Carter County 138kV
GEN-2013-007	100.30	OKGE	Tap Prices Falls - Carter 138kV
GEN-2014-057	250.00	AEPW	Tap Lawton - Sunnyside (Terry Road) 345kV
GEN-2015-036	303.60	OKGE	Johnston County 345kV
GEN-2015-045	20.00	AEPW	Tap Lawton - Sunnyside (Terry Road) 345kV
GEN-2015-092	250.00	AEPW	Tap Lawton - Sunnyside (Terry Road) 345kV
GEN-2016-028	100.00	AEPW	Clayton 138kV
GEN-2016-030	100.00	OKGE	Brown 138kV
GEN-2016-063	200.00	OKGE	Tap Sunnyside – Hugo 345kV
PRIOR QUEUED SUBTOTAL	1,669.17		
GEN-2016-102	150.90	OKGE	Blue River 138kV Substation
GEN-2016-126	172.50	OKGE	Tap Arbuckle - Blue River 138kV
GEN-2016-129	132.00	AEPW	Valliant 345kV substation
CURRENT CLUSTER SUBTOTAL	455.40		
AREA TOTAL	2,124.57		

GROUP 15: E-SOUTH DAKOTA AREA Request	Capacity	Area	Proposed Point of Interconnection
SGI-2016-005	20.00	WAPA	Tap White Lake - Stickeny 69kV
ASGI-2016-006	20.00	WAPA	Mitchall
ASGI-2016-007	20.00	WAPA	Kimball 69kV
G176	100.00	XEL	Yankee 115kV
G255	100.00	XEL	Yankee 115kV
G586	30.00	XEL	Yankee 115kV
G736	200.00	OTP	Big Stone South 230kV
GEN-2002-009IS	40.00	WAPA	Ft Thompson 69kV [Hyde 69kV]
GEN-2007-013IS	50.00	WAPA	Wessington Springs 230kV
GEN-2007-014IS	100.00	WAPA	Wessington Springs 230kV
GEN-2007-023IS	50.00	WAPA	Formit-Summit 115kV
GEN-2009-001IS	200.00	WAPA	Groton-Watertown 345kV
GEN-2009-018IS	99.50	WAPA	Groton 115kV
GEN-2010-001IS	99.00	WAPA	Bismarck-Glenham 230kV
GEN-2010-003IS	34.00	WAPA	Wessington Springs 230kV
GEN-2012-014IS	99.50	WAPA	Groton 115kV
GEN-2013-001IS	90.00	WAPA	Summit-Watertown 115kV
GEN-2013-009IS	19.50	WAPA	Redfield NW 115kV
GEN-2014-001IS	103.70	WAPA	Newell-Maurine 115kV
GEN-2016-017	250.70	WAPA	Tap Fort Thompson - Leland Olds 345kV
H081	200.00	XEL	Tap Brookings - Lyons County 345kV
J414	120.00	ITCM	Freeborn 161kV Substation on the Hayword - Freeborn - Winnebago 161kV line
J415	188.50	MEC	New 345 kV Switchyard on the ROW of the proposed 345 kV Emery - Blackhawk line (MVP4)
J432	98.00	XEL	Brookings 345kV
J436	150.00	OTP	Big Stone South 345kV

J437	150.00	OTP	Big Stone South 345kV
J439	500.00	MEC	Dickens, IA 51333 at O'Brien to Kossuth 345 kV (J439 POI)
J442	200.00	OTP	Big Stone 230 kV
J459	200.00	OTP	Big Stone - Brookings 345kV (J459 POI)
J460	200.00	XEL	Tap Brookings - Lyons County 345kV
J485	46.85	RPU	West Side Substation - 5846 19th Street NW, Rochester, MN
J488	151.80	OTP	Tap Big Stone - Ellendale 345kV
J489	151.80	OTP	Tap Big Stone - Ellendale 345kV
J493	150.00	OTP	Burr 115kV
J510	326.90	OTP	Tap Brookings - Big Stone 345kV
J512	250.00	NSP	Nobles - Fenton 115kV line
J523	50.00	ITCM	ITCM Adams 161 kV Substation
J525	50.00	XEL	Lake Wilson 69kV
J526	300.00	OTP	Tap Brookings - Big Stone 345kV
J569	100.00	NSP	NSP Rock County Substation
J575	100.00	NSP	Brookings County Substation 345 kV
J577	102.80	NSP	345kV Brookings County Sub
J587	200.00	NSP	J460 substation on the Brookings-H081 345kV line
J590	90.00	MEC	Obrien - Kossuth 345 kV line (J529&J590 POI)
J594	150.00	ITCM	Jackson North 161kV (ITCM)
J596	100.00	GRE	Morris -Moro 115kV Tap
J597	300.00	NSP	Brookings County Substation 345
J614	66.00	SMMP	Rice 161kV Substation
J637	98.00	OTP	Big Stone - Brookings 345 kV
J638	104.00	OTP	Big Stone - Brookings 345 kV
J638	100.00	OTP	Big Stone - Brookings 345 kV
PRIOR QUEUED SUBTOTAL	6,720.55		
GEN-2016-036	44.60	WAPA	Granite Falls 115kV Sub
GEN-2016-087	98.90	WAPA	Bismarck-Glenham 230kV
GEN-2016-092	250.70	WAPA	Tap Leland Olds-Ft Thompson 345kV
GEN-2016-103	250.70	WAPA	Tap Leland Olds- Ft Thompson 345kV
GEN-2016-164	7.90	WAPA	Groton 115kV substation
CURRENT CLUSTER SUBTOTAL	652.80		
AREA TOTAL	7,373.35		

GROUP 16: W-NORTH DAKOTA AREA

Request	Capacity	Area	Proposed Point of Interconnection
G380	150.00	OTP	Rugby 115kV
G408	12.00	XEL	Tap McHenry - Souris 115kV
G502	50.60	MP	Milton Young 230kV
G645	50.00	GRE	Ladish 115kV
G723	10.00	MDU	Haskett 115kV
G752	150.00	MDU	Tap Bison - Hettinger 230kV
G788	49.00	GRE	Ladish 115kV
G830	99.00	GRE	GRE McHenry 115kV
GEN-2005-008IS	50.00	WAPA	Hilken 230kV [Ecklund 230kV]
GEN-2006-015IS	50.00	WAPA	Hilken 230kV [Ecklund 230kV]
GEN-2007-015IS	100.00	WAPA	Hilken 230kV [Ecklund 230kV]
GEN-2009-026IS	110.00	WAPA	Dickenson-Heskett 230kV
GEN-2010-007IS	172.50	WAPA	Antelope Valley 345kV
GEN-2012-012IS	75.00	WAPA	Wolf Point-Circle 115kV
GEN-2014-003IS	91.00	WAPA	Culbertson 115kV
GEN-2014-004IS	384.20	WAPA	Charlie Creek 345kV
GEN-2014-006IS	125.00	WAPA	Williston 115kV
GEN-2014-010IS	150.00	WAPA	Neset 115kV
GEN-2014-014IS	151.50	WAPA	Belfield-Rhame 230kV
GEN-2015-046	300.00	WAPA	Tande 345kV
GEN-2015-096	150.00	WAPA	Tap Belfied - Rhame 230kV
GEN-2015-098	100.00	WAPA	Mingusville 230kV
GEN-2016-004	202.00	WAPA	Leland Olds 230kV
GEN-2016-052	3.30	WAPA	Hilken 230kV
GEN-2016-053	3.30	WAPA	Hilken 230kV
J003	20.00	MDU	Baker 115kV
J249	180.00	MDU	MDU Tatanka 230kV
J262	100.00	OTP	Jamestown 345
J263	100.00	OTP	Jamestown 345
J290	150.00	XEL	Tap Glenboro South - Rugby 230kV
J316	150.00	MDU	MDU 230 kV Tatanka-Ellendale line
J511	200.00	GRE	GRE Stanton Substation 230 kV bus, Stanton ND
J593	224.00	MDU	Tioga 4 230kV Substation (MDU)
MPC01300	455.00	GRE	Square Butte 230 kV
MPC02100	100.00	OTP	Center - Mandan 230 kV
PRIOR QUEUED SUBTOTAL	4,467.40		
GEN-2016-108	200.00	WAPA	Tap Antelope Valley Substation (AVS)-Charlie Creek 345kV
GEN-2016-130	202.00	WAPA	Leland Olds 345kV
GEN-2016-151	202.00	WAPA	Tande 345kV Sub
GEN-2016-152	102.00	WAPA	Tande 345kV Sub
GEN-2016-155	1.30	WAPA	Hilken 230kV switching station
CURRENT CLUSTER SUBTOTAL	707.30		
AREA TOTAL	0.00		

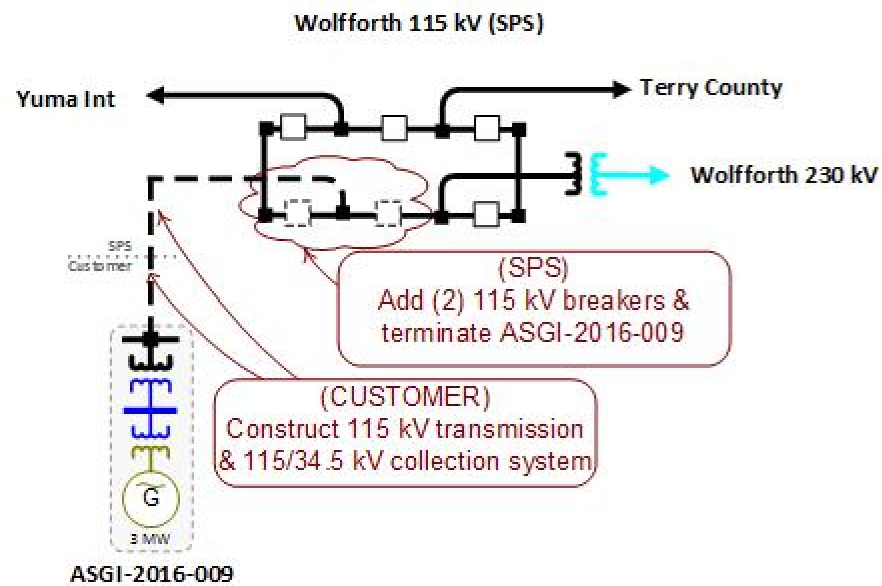
GROUP 17: W-SOUTH DAKOTA AREA Request	Capacity	Area	Proposed Point of Interconnection
GEN-2006-002IS	51.00	WAPA	Wessington Springs 230kV
GEN-2009-006IS	90.00	WAPA	Mission 115kV
GEN-2009-007IS	100.00	WAPA	Mission 115kV
GEN-2009-020AIS	130.50	WAPA	Tripp Junction 115kV
GEN-2012-009IS	99.00	WAPA	Fort Randall 115kV
GEN-2016-054	3.40	WAPA	Wessington Springs 230kV
J599	200.00	MDU	Glenham 230kV Substation
PRIOR QUEUED SUBTOTAL	673.90		
GEN-2016-094	200.00	WAPA	Tap Ft Thompson-Oahe 230kV
CURRENT CLUSTER SUBTOTAL	200.00		
AREA TOTAL	0.00		

GROUP 18: E-NORTH DAKOTA AREA Request	Capacity	Area	Proposed Point of Interconnection
GEN-2002-008IS	40.50	WAPA	Edgeley 115kV [Pomona 115kV]
GEN-2005-003IS	100.00	WAPA	Nelson 115kV
GEN-2006-001IS	10.00	XEL	Marshall 115kV
GEN-2006-006IS	10.00	XEL	Marshall 115kV
GEN-2007-020IS	16.00	WAPA	Nelson 115kV
GEN-2008-008IS	5.00	WAPA	Nelson 115kV
GEN-2016-007	100.00	WAPA	Valley City 115kV
J302	101.00	MDU	230kV Heskett-Wishek
J457	150.00	MDU	Merricourt Substation
J503	100.00	MDU	230 kV Heskett-Wishek, 20 miles NW of Wishek
J607	150.00	MDU	Wishek - Heskett 230kV line
J613	100.00	OTP	Jamestown Substation 115kV
MPC00100	99.00	OTP	Langdon 115 kV
MPC00200	60.00	OTP	Langdon 115 kV
MPC00300	40.50	OTP	Langdon 115 kV
MPC00500	378.80	OTP	Maple River 230 kV
MPC01200	98.90	OTP	Maple River 230 kV
PRIOR QUEUED SUBTOTAL	1,559.70		
AREA TOTAL	0.00		

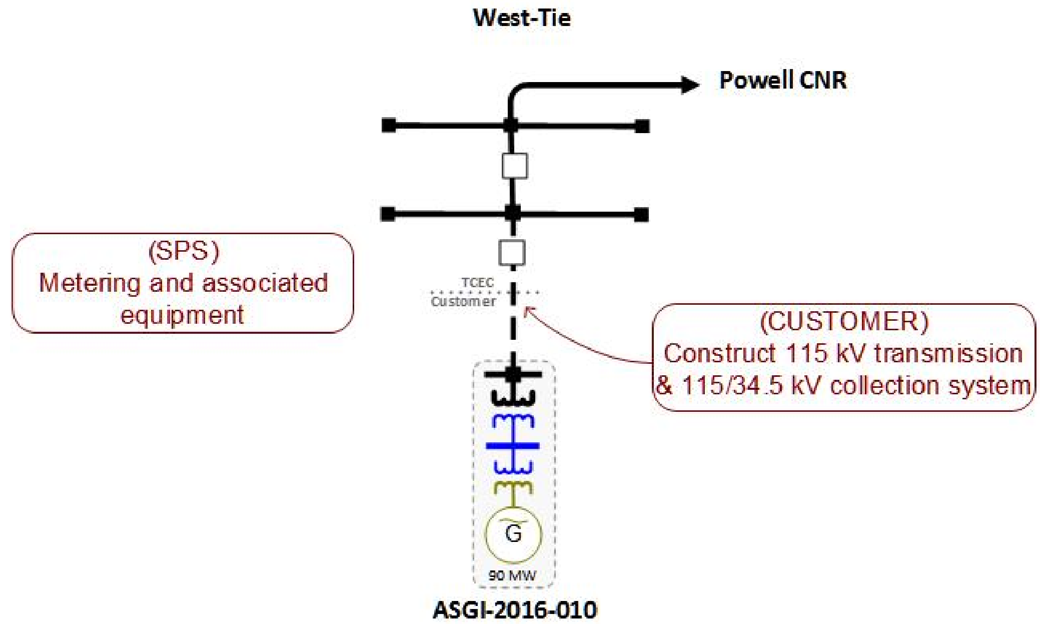
CLUSTER TOTAL (CURRENT STUDY)	15,483.5	MW
	57,365.7	MW
CLUSTER TOTAL (INCLUDING PRIOR QUEUED)	72,849.2	MW

11.4 D: PROPOSED POINT OF INTERCONNECTION ONE-LINE DIAGRAMS

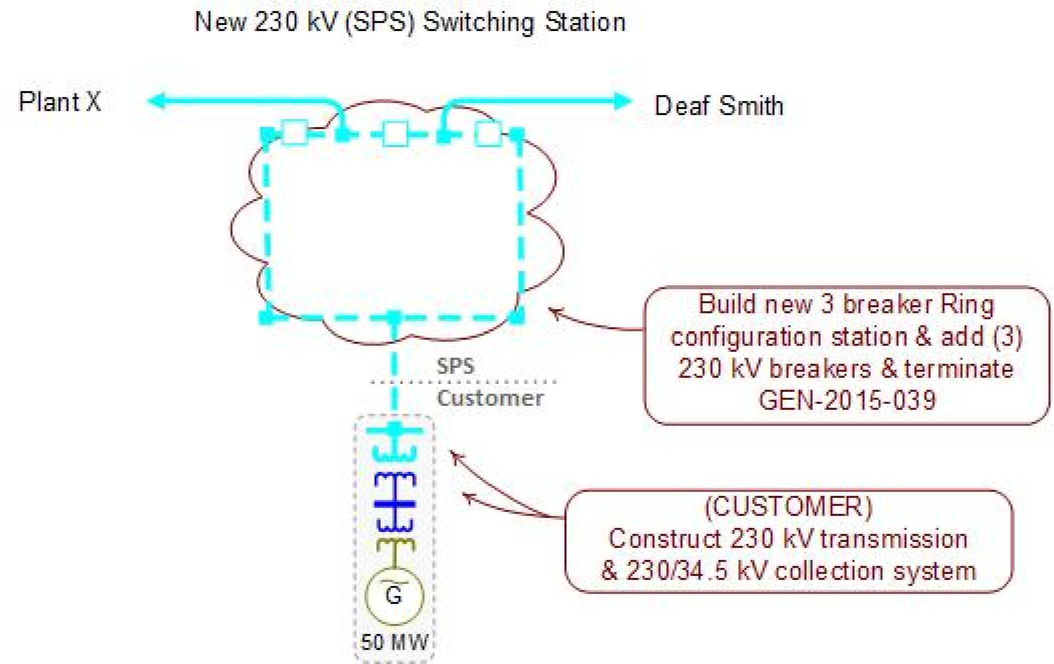
Interconnection Request: ASGI-2016-009
Cluster Interconnection Costs: $TBD



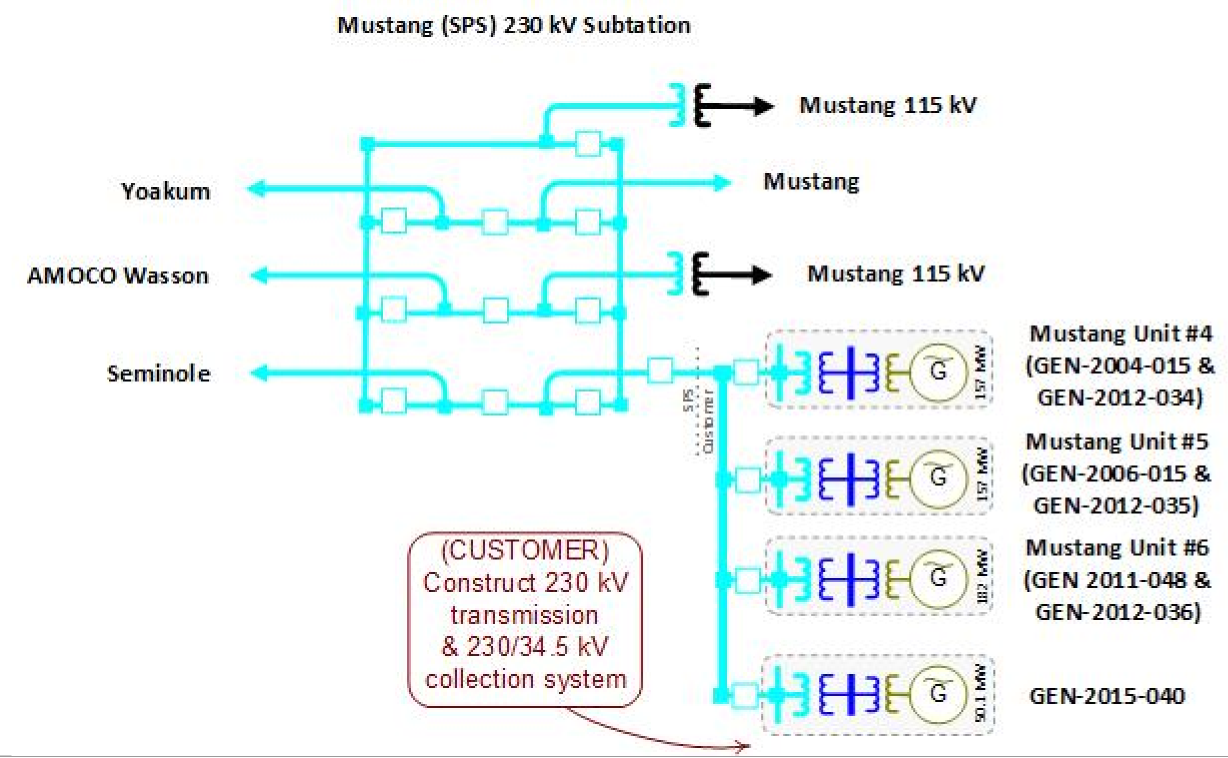
Interconnection Request: ASGI-2016-010
Cluster Interconnection Costs: $TBD



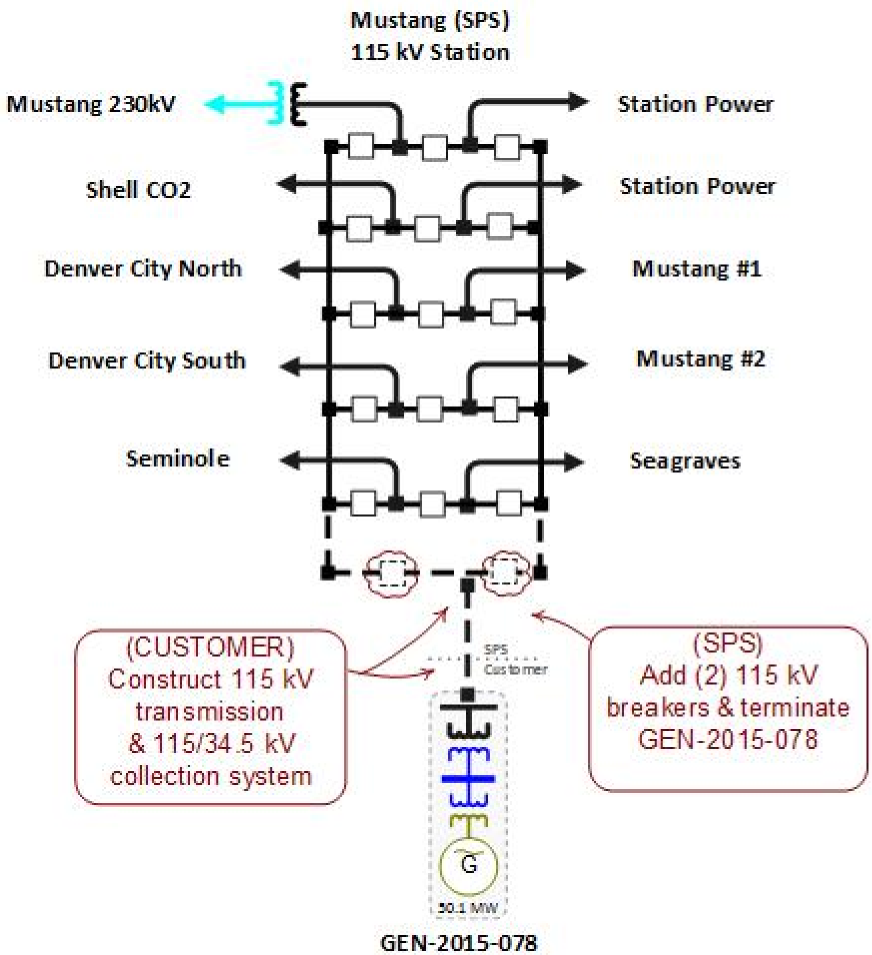
Interconnection Request: GEN-2015-039
Cluster Interconnection Costs: $8,609,632



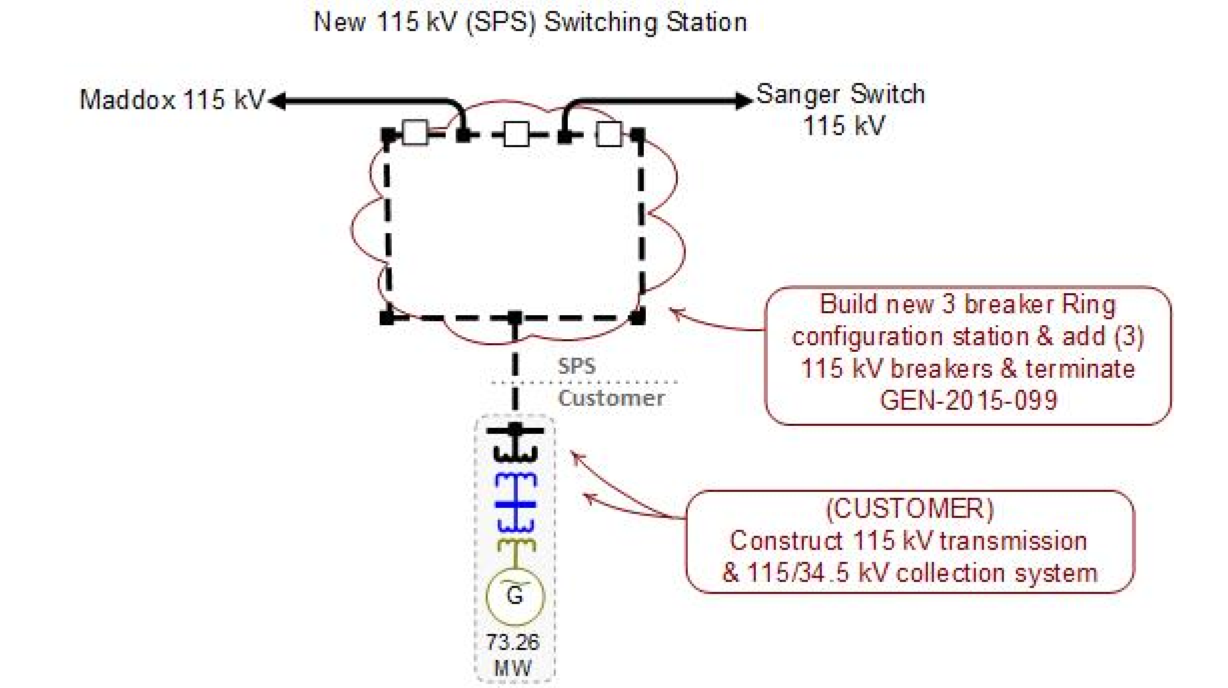
Interconnection Request: GEN-2015-040
Cluster Interconnection Costs: $1,237,460



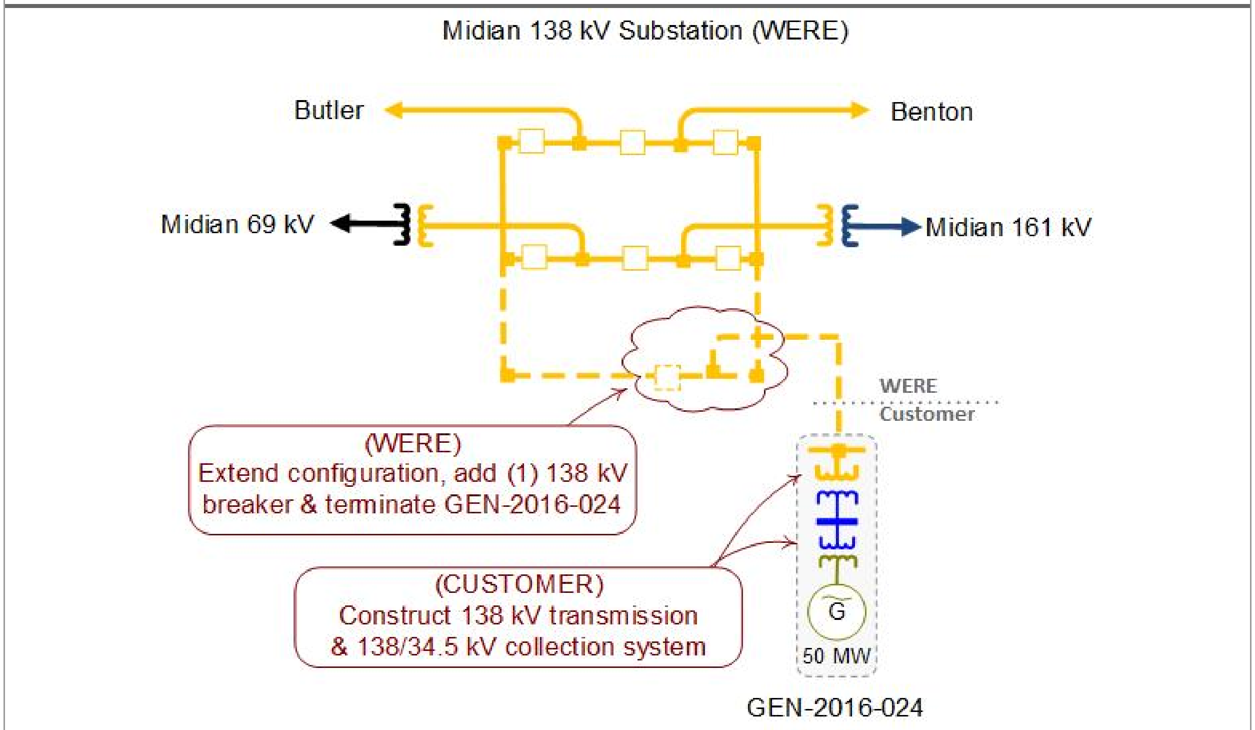
Interconnection Request: GEN-2015-078
Cluster Interconnection Costs: $3,562,000



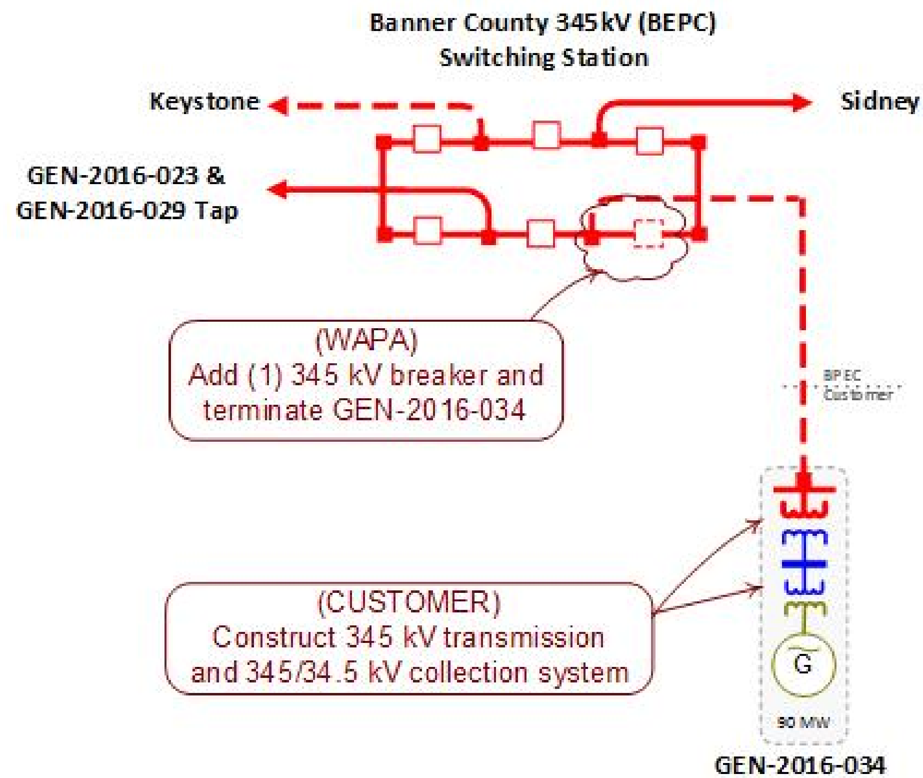
Interconnection Request: GEN-2015-099
Cluster Interconnection Costs: $4,688,000



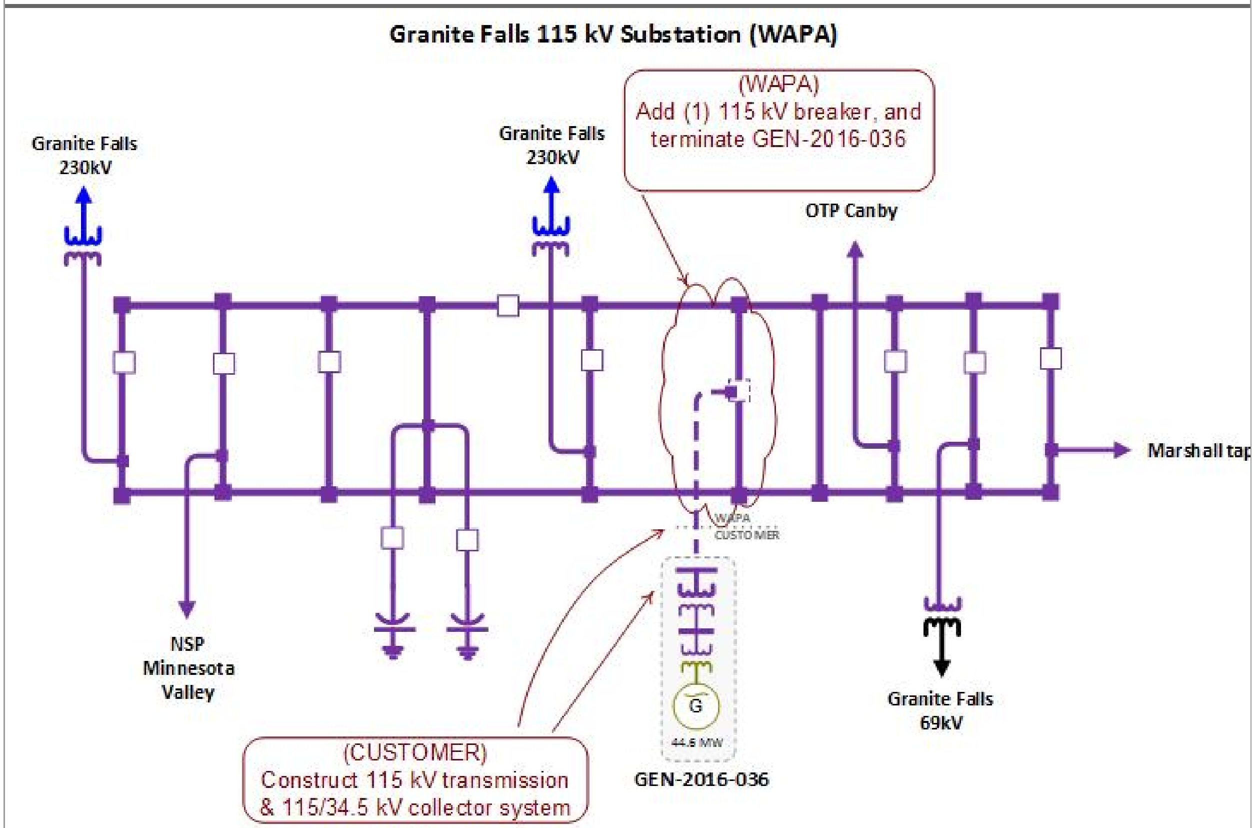
Interconnection Request: GEN-2016-024
Cluster Interconnection Costs: $1,929,855



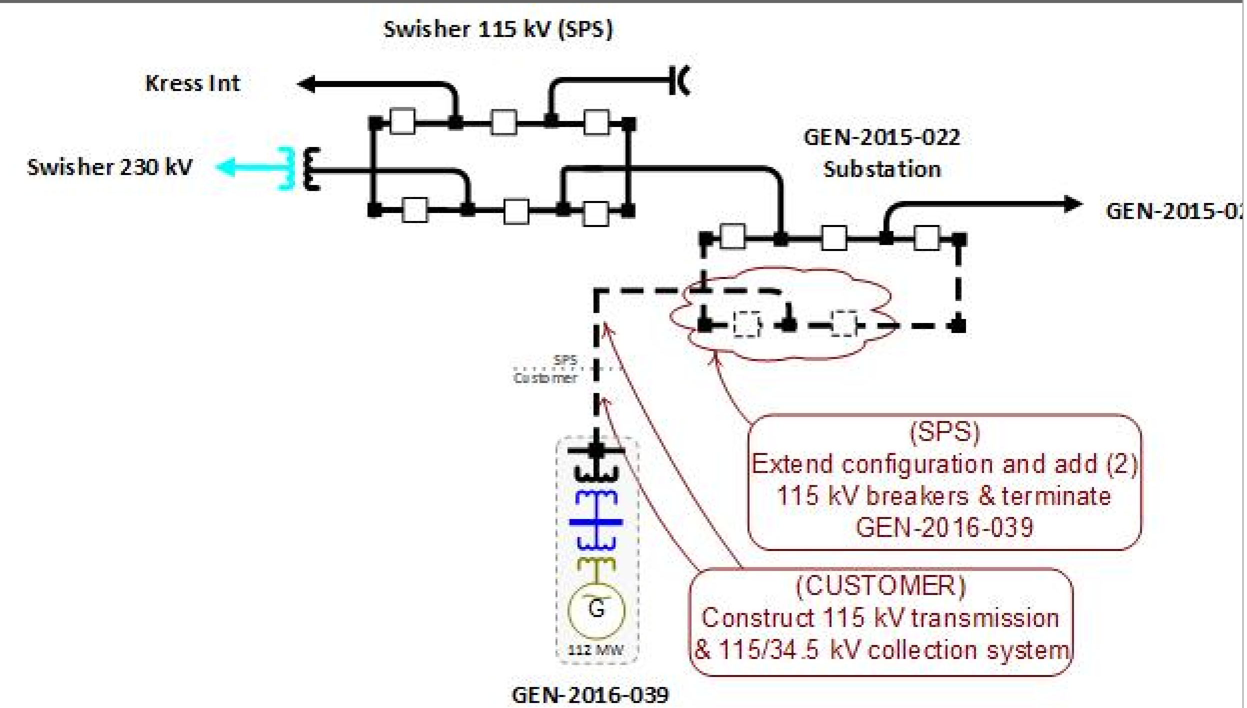
Interconnection Request: GEN-2016-034
Cluster Interconnection Costs: $2,531,976



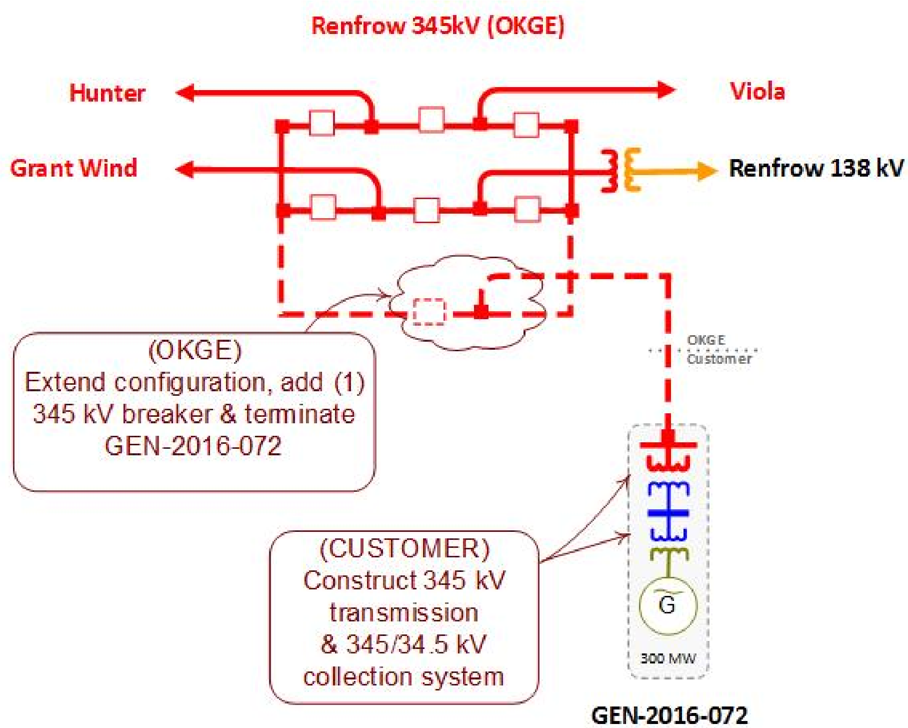
Interconnection Request: GEN-2016-036
Cluster Interconnection Costs: $1,340,000



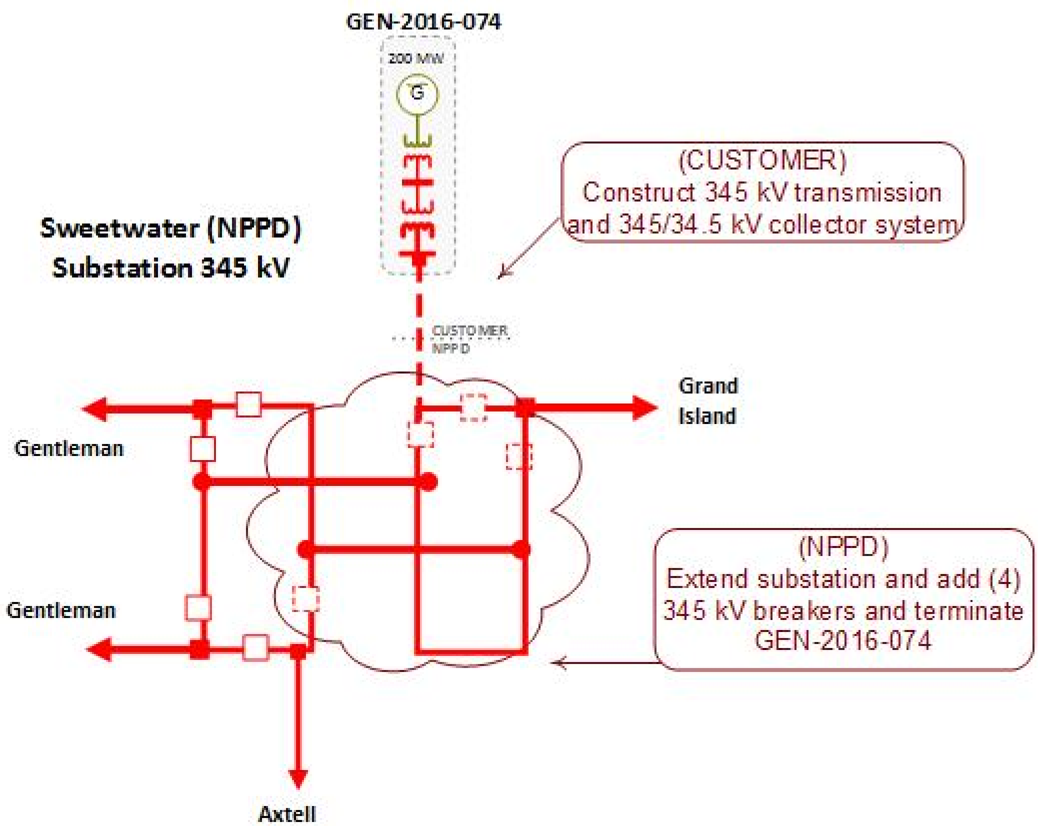
Interconnection Request: GEN-2016-039
Cluster Interconnection Costs: $210,000



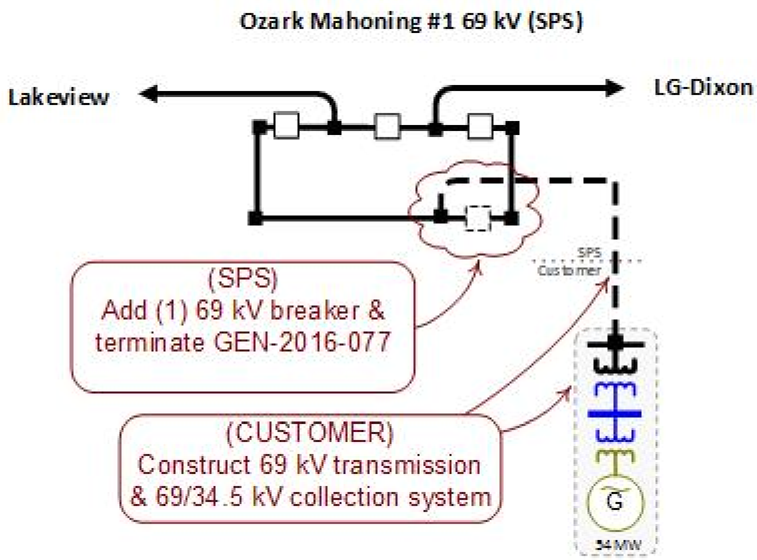
Interconnection Request: GEN-2016-072
Cluster Interconnection Costs: $1,940,000



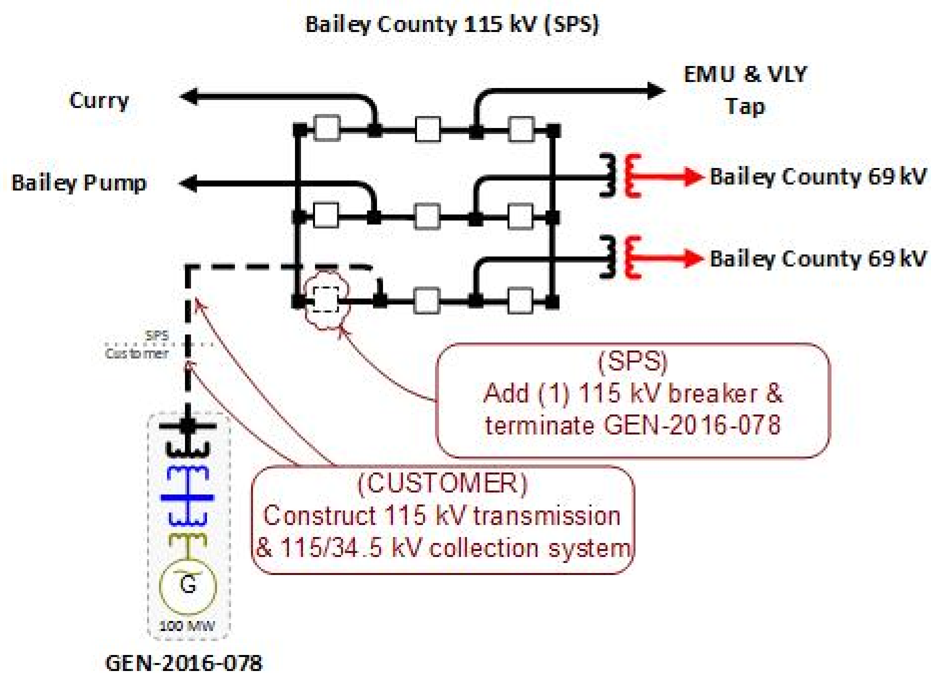
Interconnection Request: GEN-2016-074
Cluster Interconnection Costs: $7,500,000



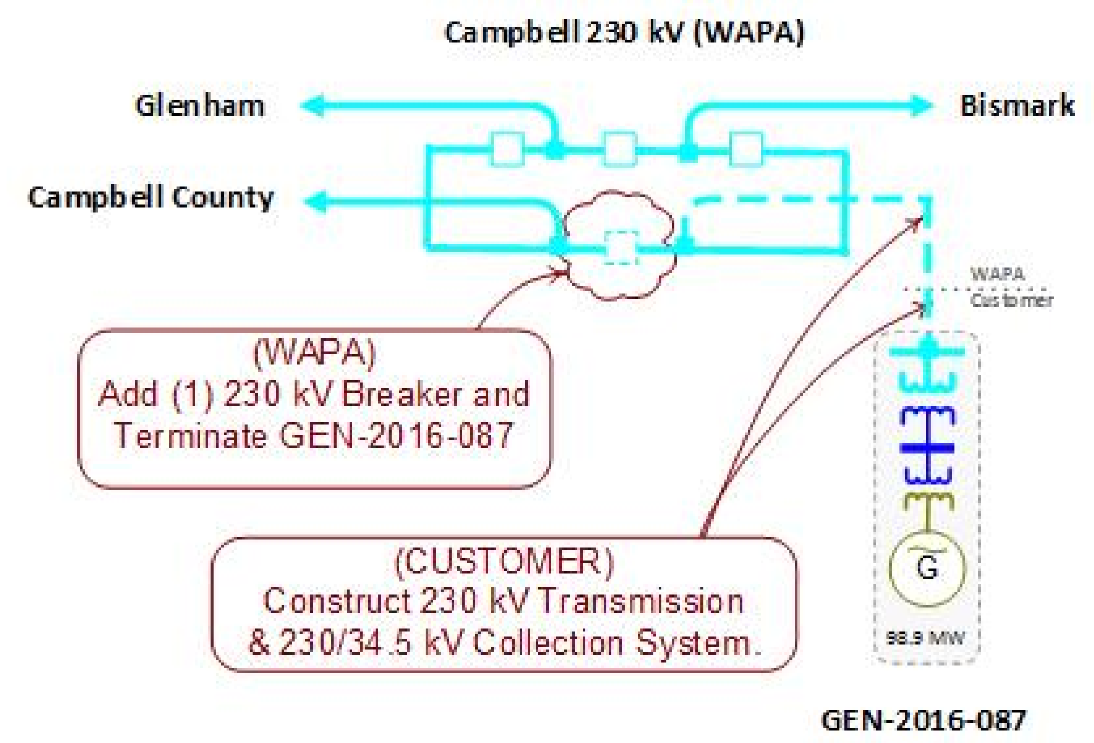
Interconnection Request: GEN-2016-077
Cluster Interconnection Costs: $1,700,000
(The cost is for new 69 kV substation with one breaker and 3-way switch)



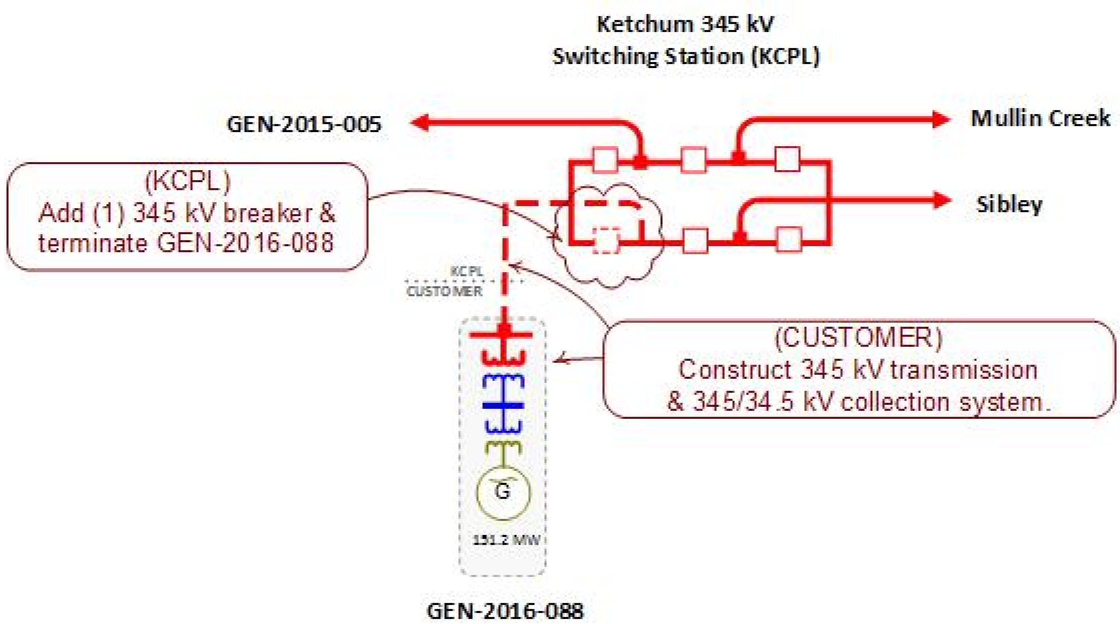
Interconnection Request: GEN-2016-078
Cluster Interconnection Costs: $1,282,250



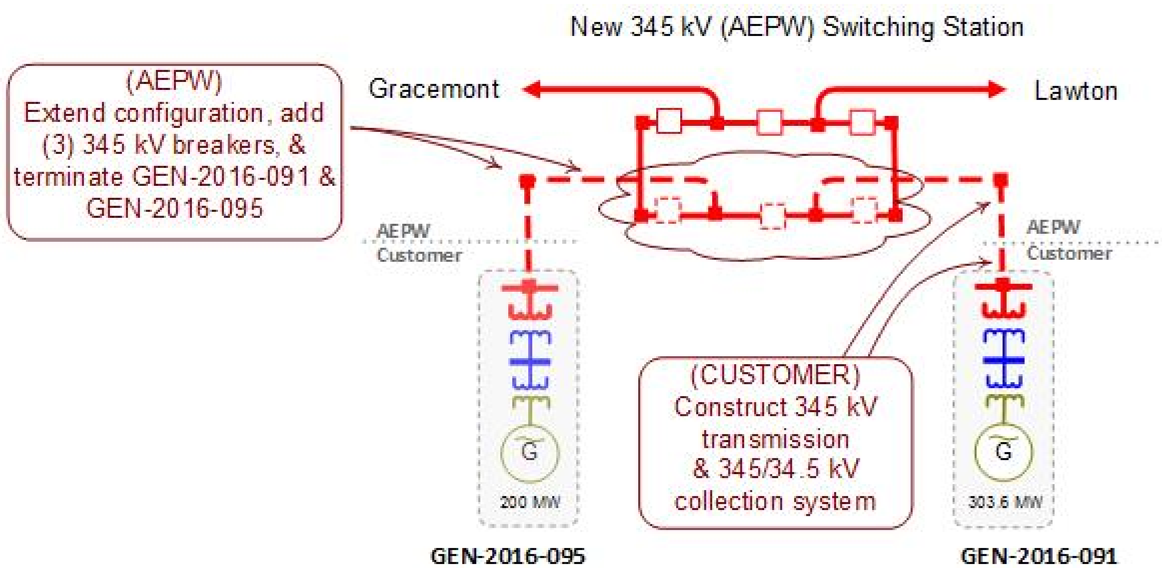
Interconnection Request: GEN-2016-087
Cluster Interconnection Costs: $1,565,000



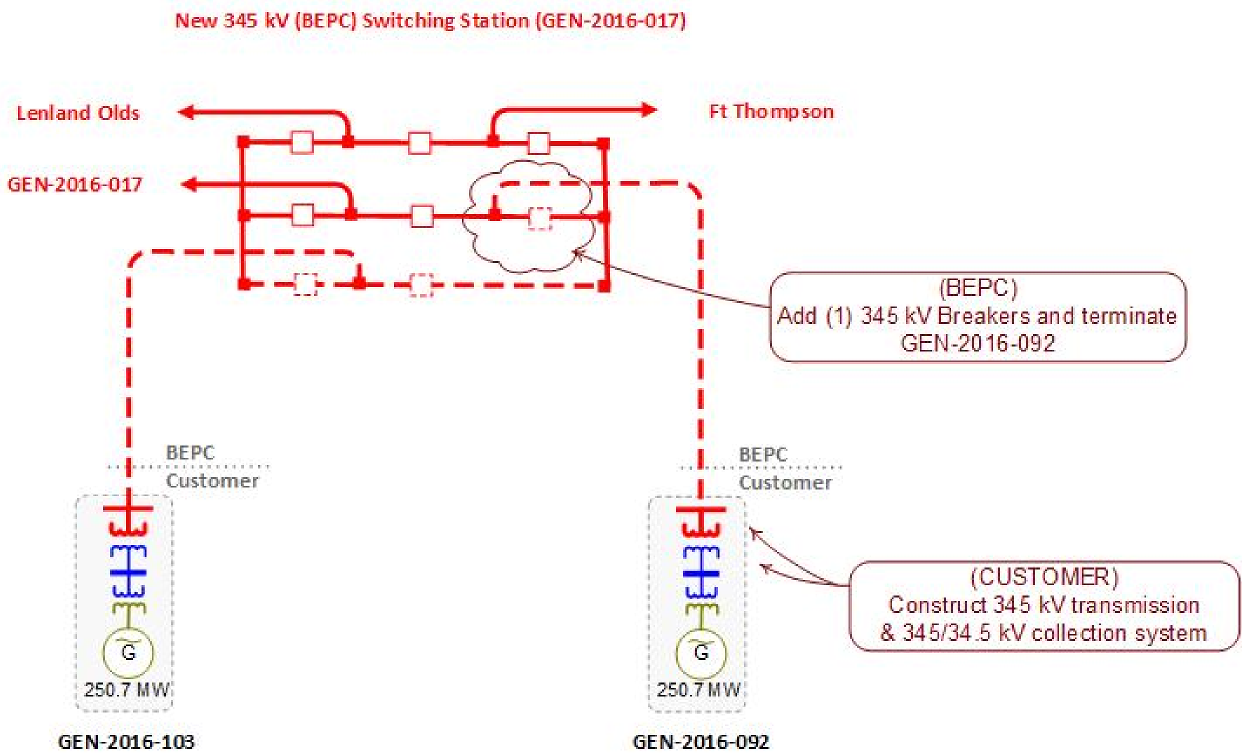
Interconnection Request: GEN-2016-088
Cluster Interconnection Costs: $1,532,553



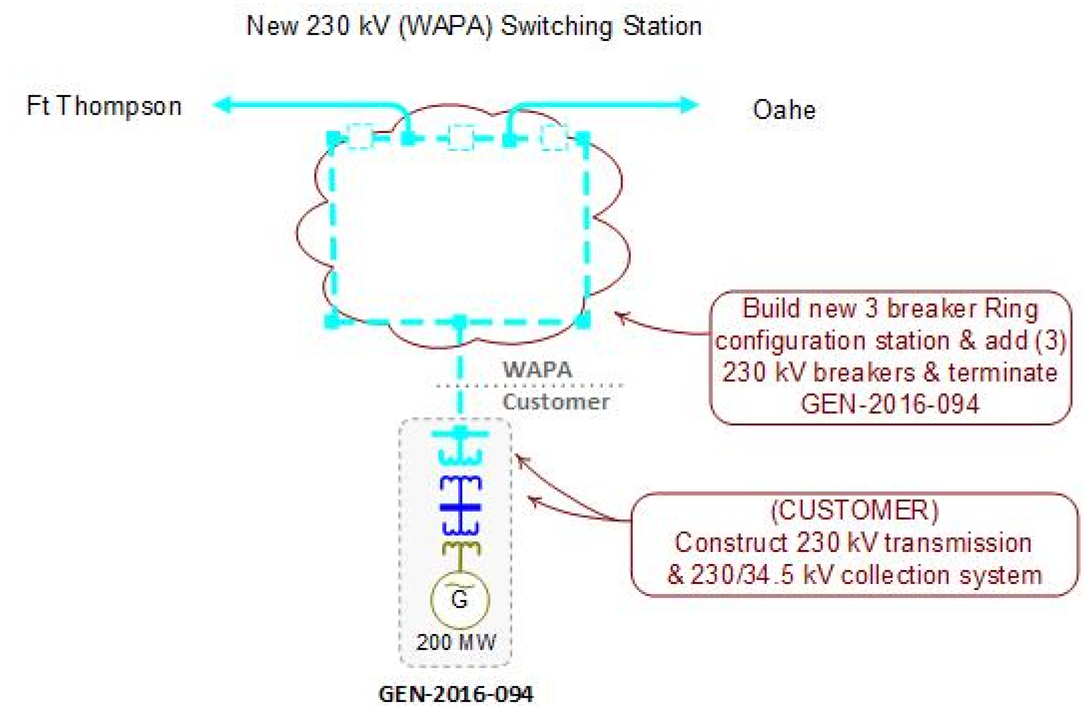
Interconnection Request: GEN-2016-091
Cluster Interconnection Costs: $10,343,736
(Total of $20,687,472 shared with GEN-2016-095)



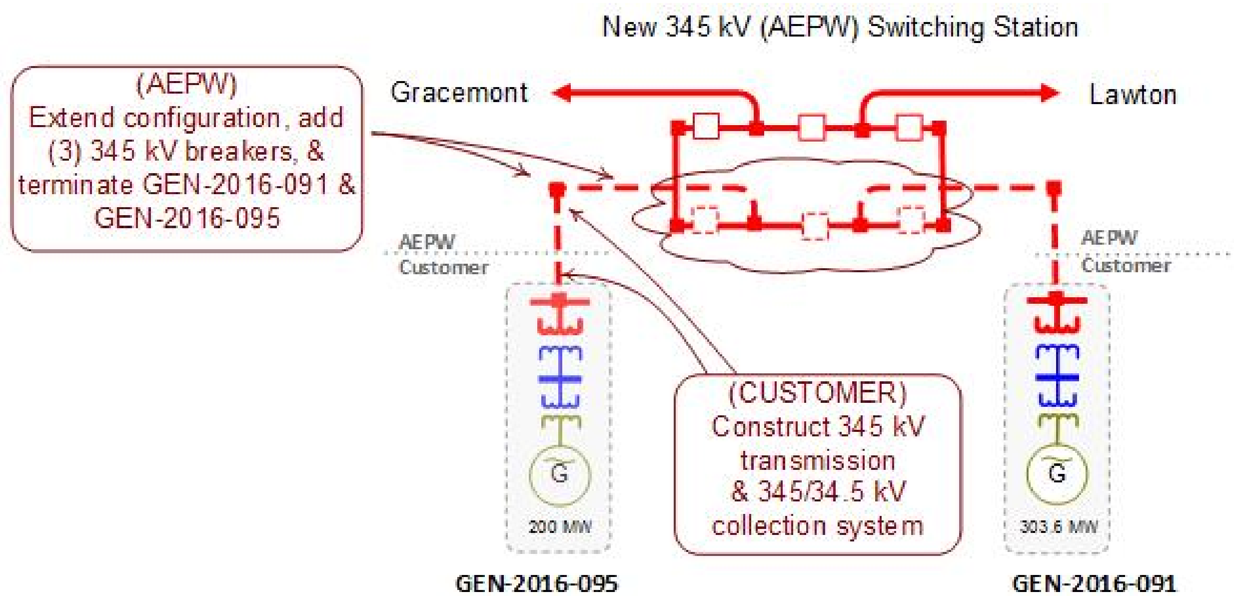
Interconnection Request: GEN-2016-092
Cluster Interconnection Costs: $3,404,096
(Total of $6,808,192 shared with GEN-2016-103)



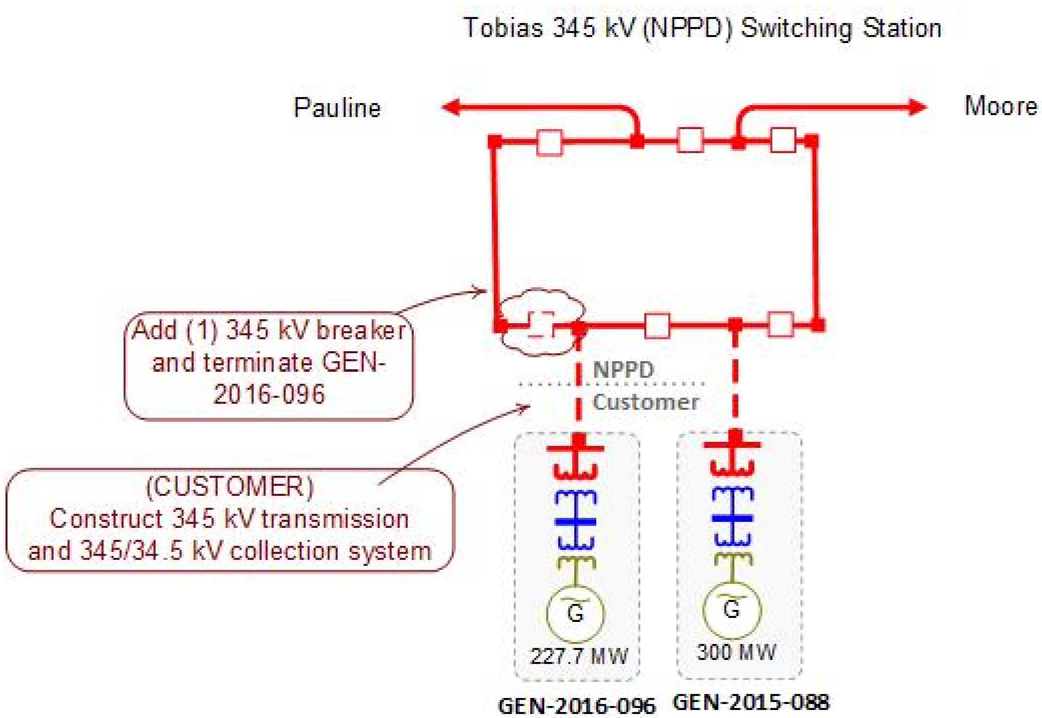
Interconnection Request: GEN-2016-094
Cluster Interconnection Costs: $1,960,000
(The cost is for a 230 kV interconnection at Ft. Thompson)



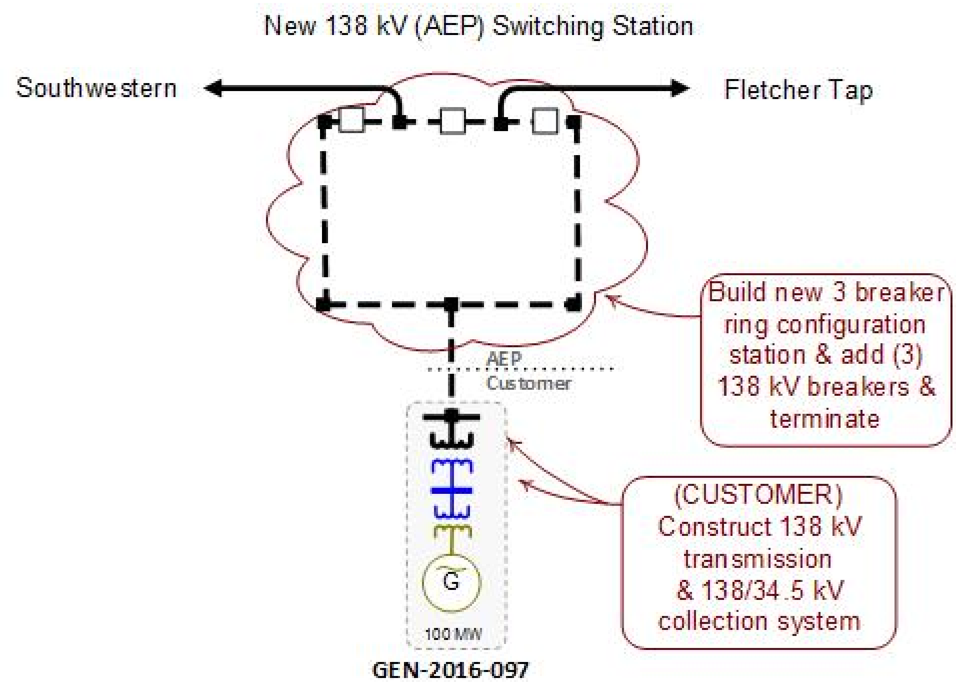
Interconnection Request: GEN-2016-095
Cluster Interconnection Costs: $10,343,736
(Total of $20,687,472 shared with GEN-2016-091)



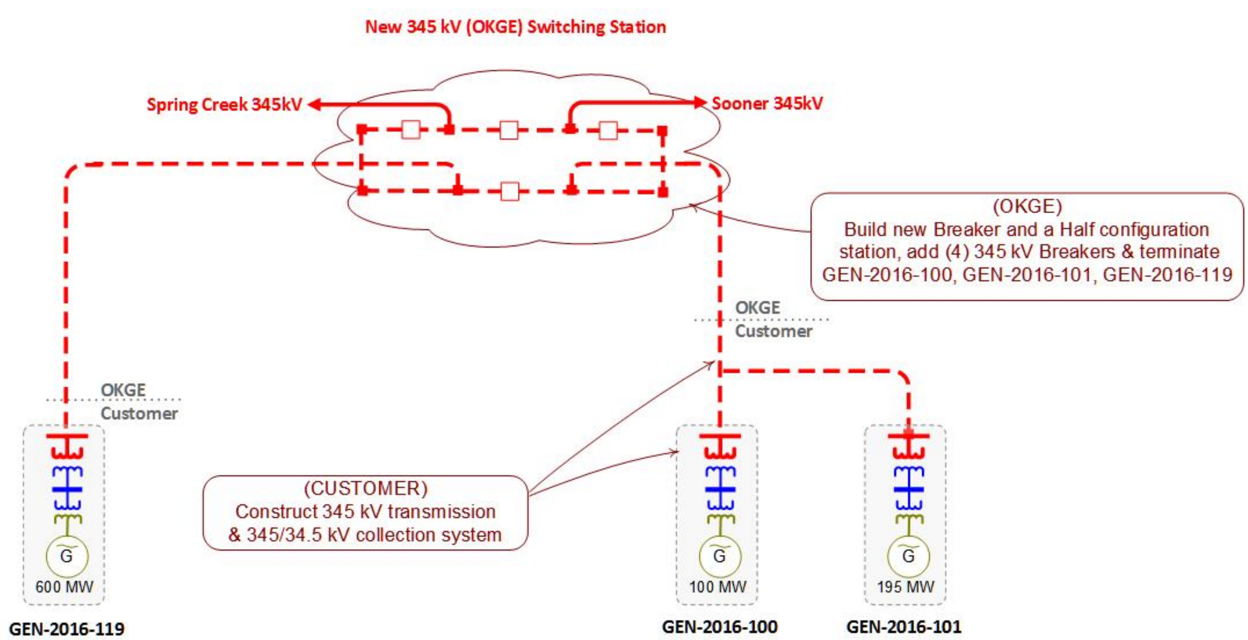
Interconnection Request: GEN-2016-096
Cluster Interconnection Costs: $1,700,000

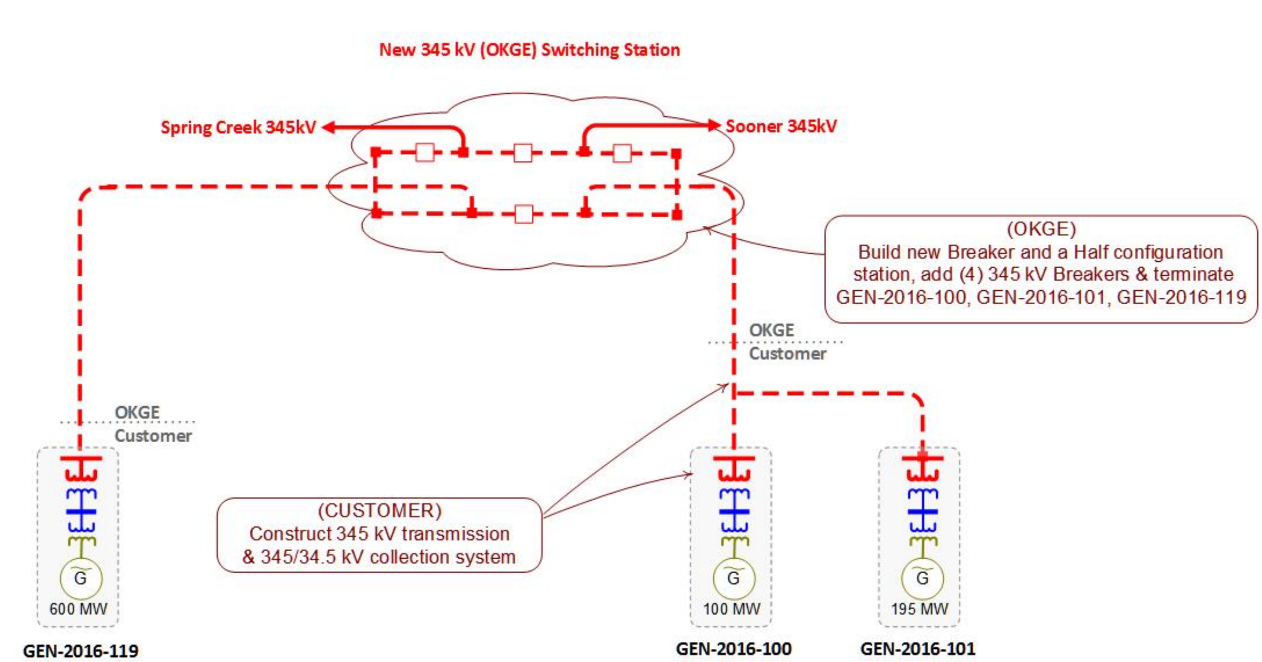


Interconnection Request: GEN-2016-097
Cluster Interconnection Costs: $7,778,750

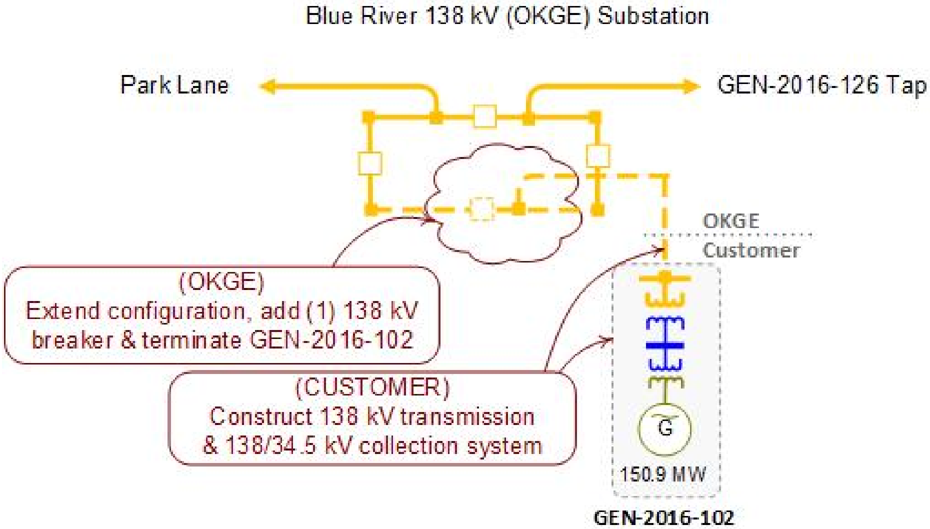


Interconnection Request: GEN-2016-100
Cluster Interconnection Costs: $6,465,000
(Total of $12,930,000 shared with GEN-2016-119)

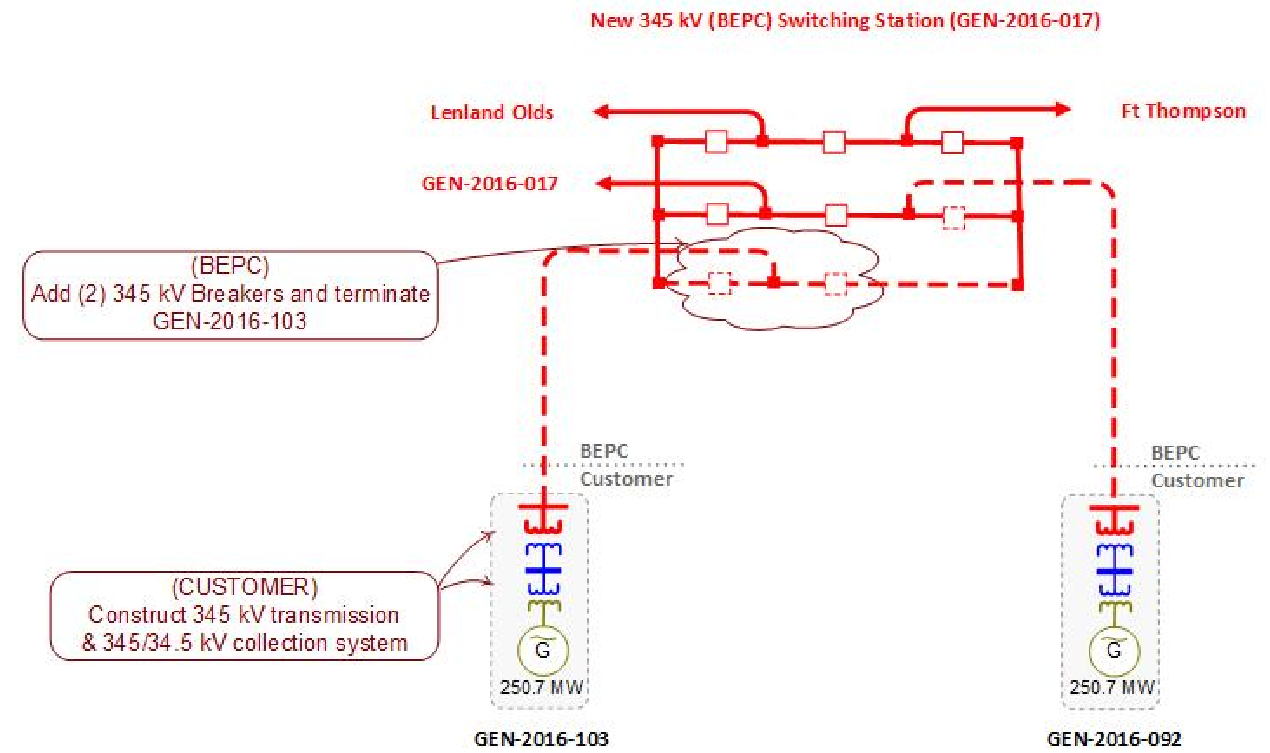


Interconnection Request: GEN-2016-101 **Cluster Interconnection Costs: $20,000*** ***Please note if GEN-2016-101 withdraws, GEN-2016-101 could be response for GEN-2016-100's interconnection costs.**


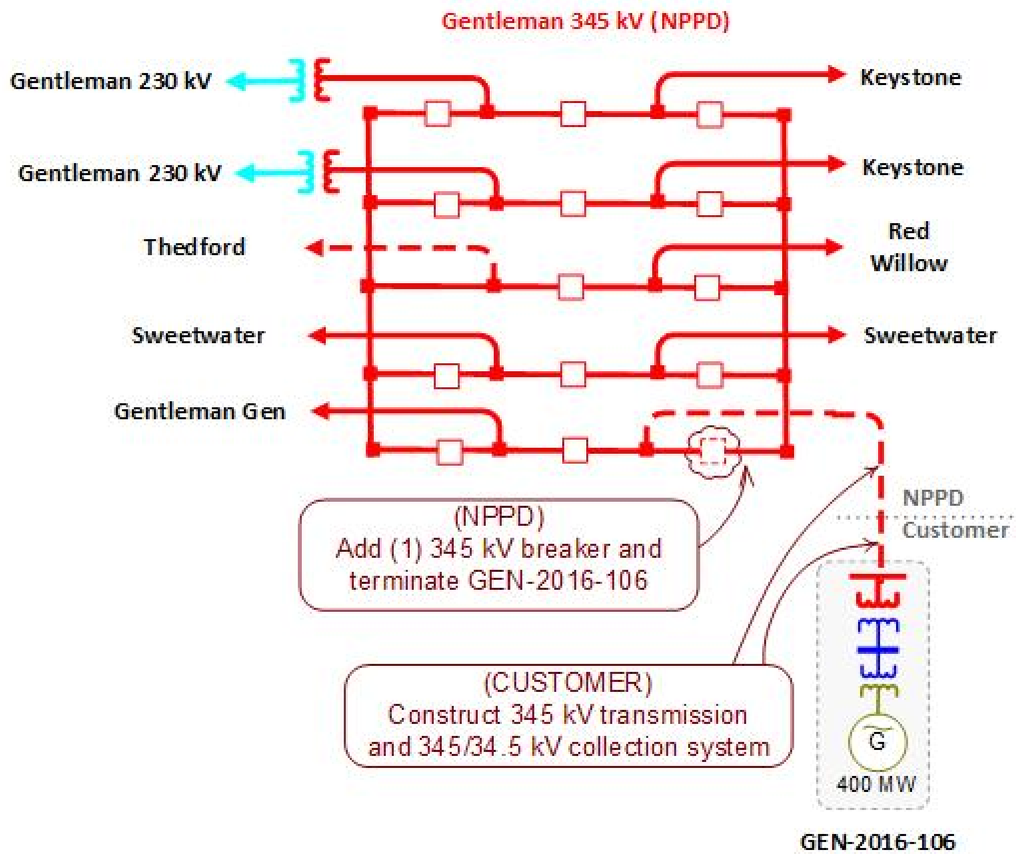
Interconnection Request: GEN-2016-102
Cluster Interconnection Costs: $3,405,000



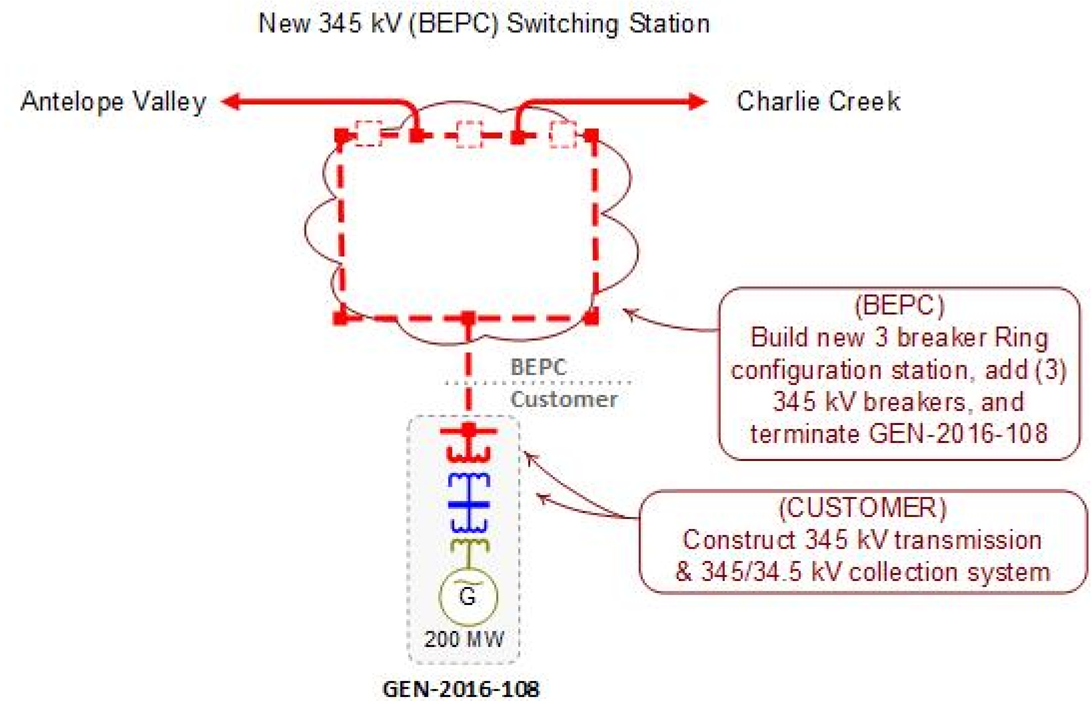
Interconnection Request: GEN-2016-103
Cluster Interconnection Costs: $3,404,096
(Total of $6,808,192 shared with GEN-2016-092)



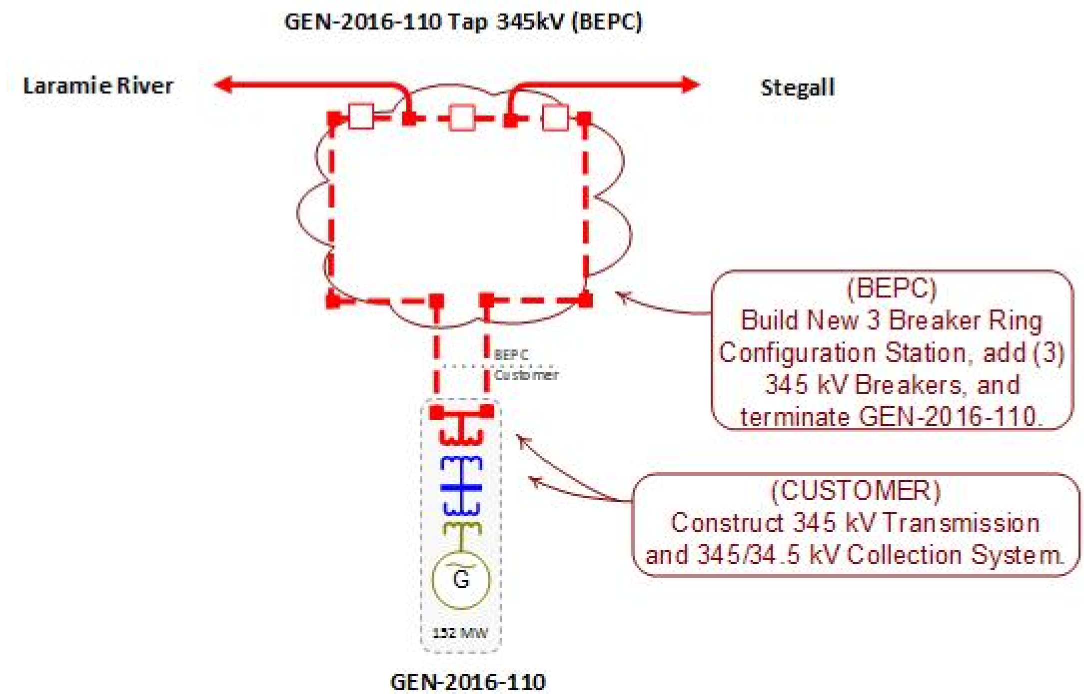
Interconnection Request: GEN-2016-106
Cluster Interconnection Costs: $1,700,000



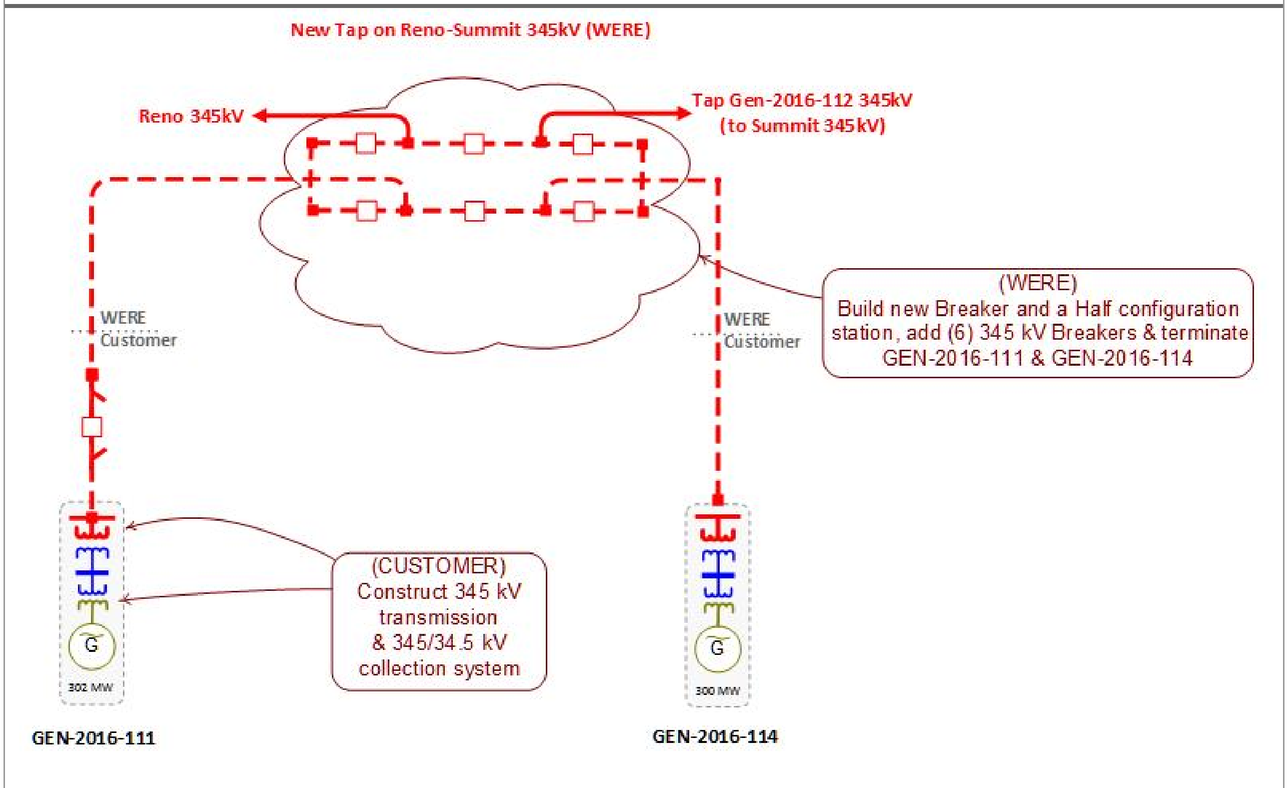
Interconnection Request: GEN-2016-108
Cluster Interconnection Costs: $23,074,093



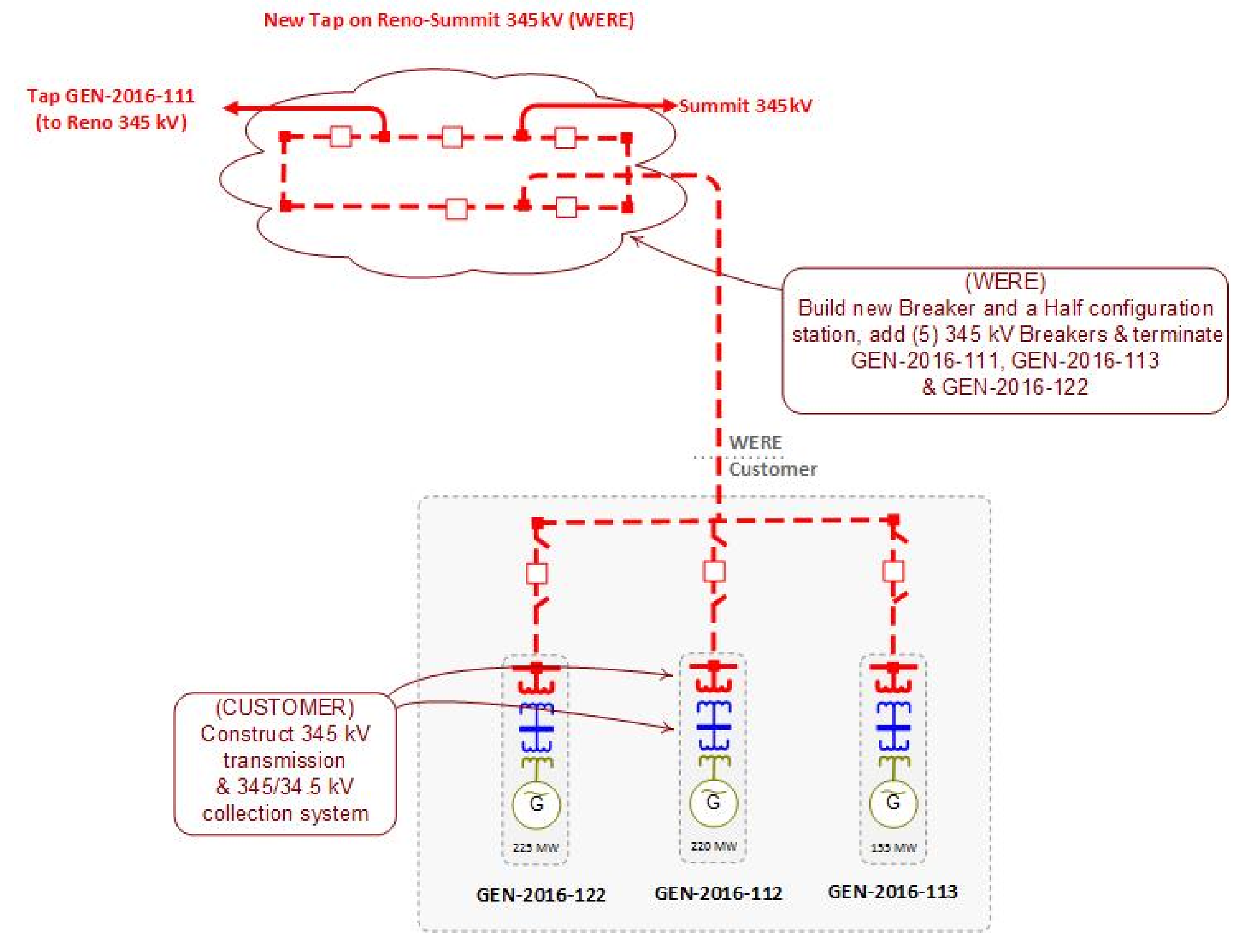
Interconnection Request: GEN-2016-110
Cluster Interconnection Costs: $23,052,493



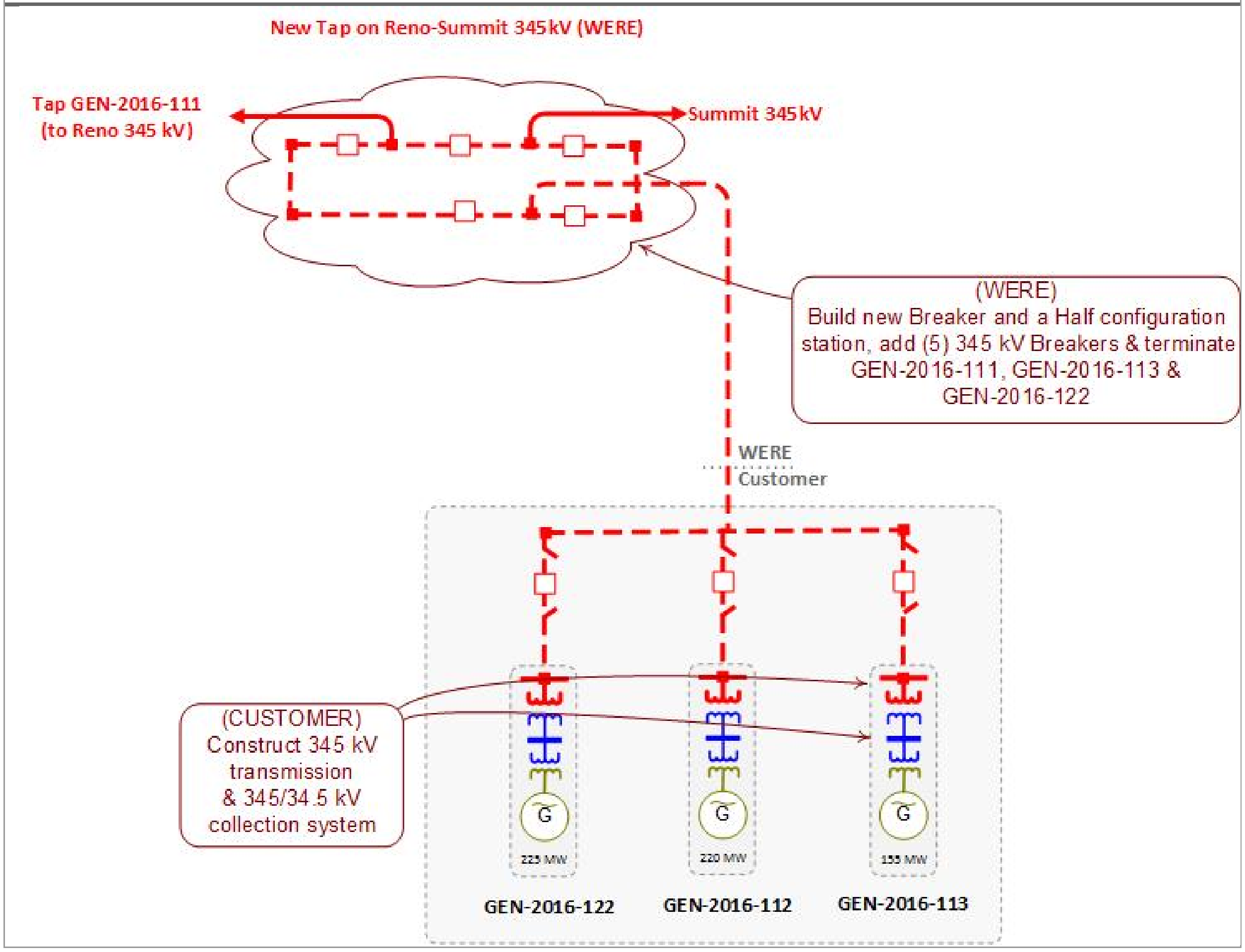
Interconnection Request: GEN-2016-111
Cluster Interconnection Costs: $8,792,574
(Total of $17,585,147 shared with GEN-2016-114)



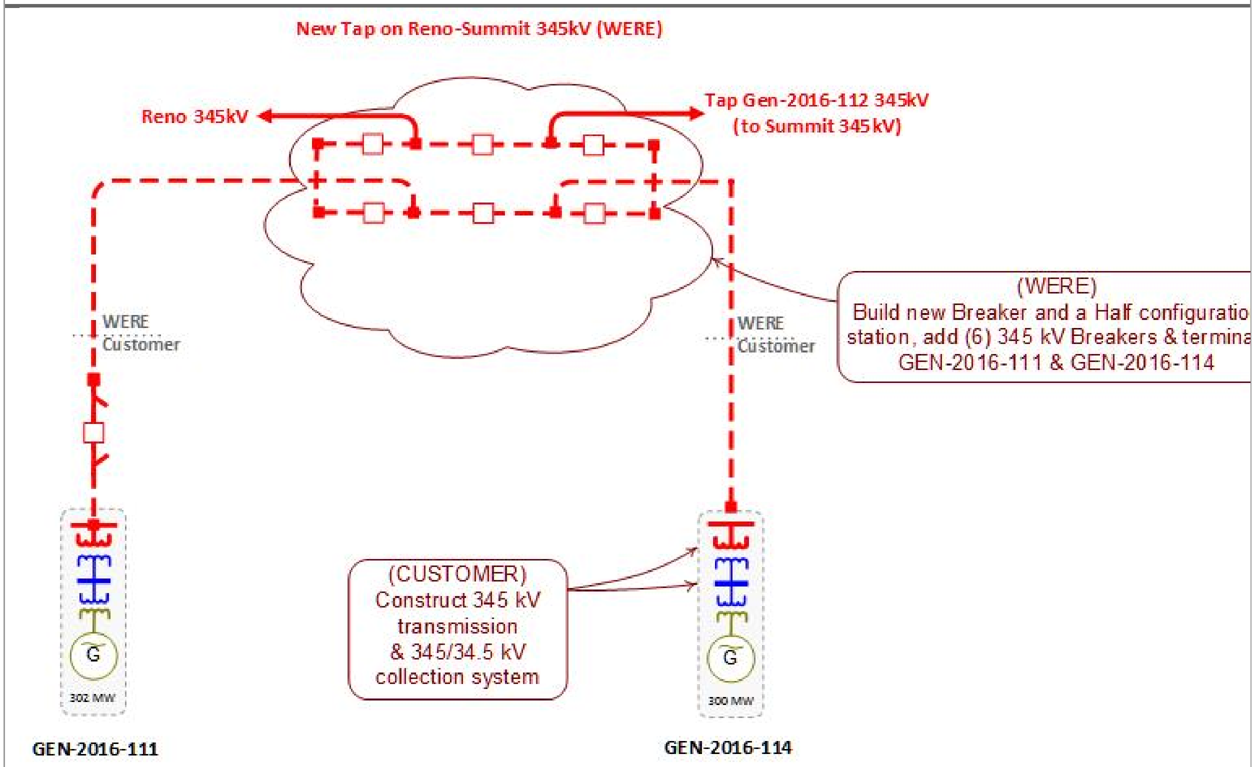
Interconnection Request: GEN-2016-112
Cluster Interconnection Costs: $5,371,860
(Total of $16,115,580 shared with GEN-2016-113 and GEN-2016-122)



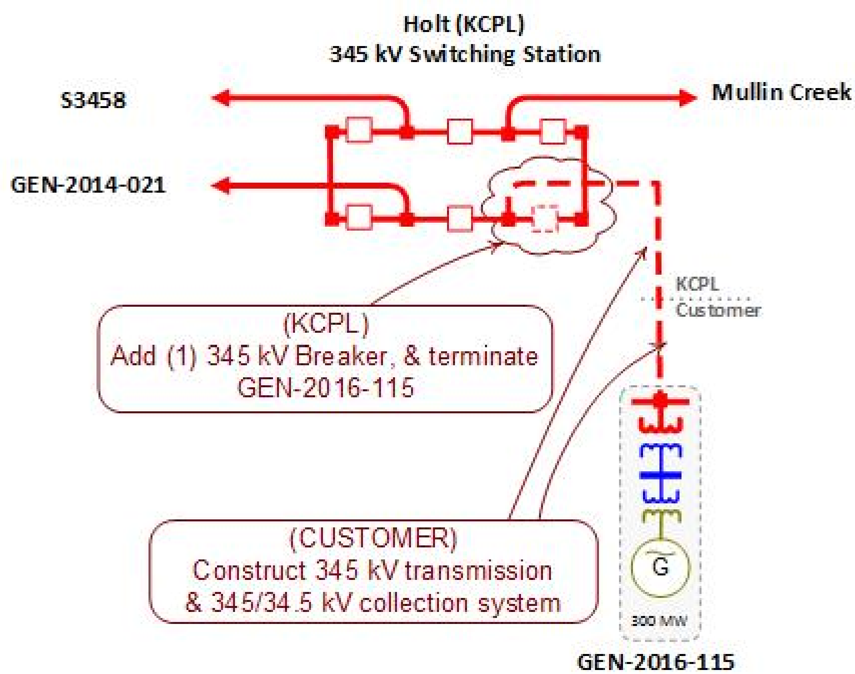
Interconnection Request: GEN-2016-113
Cluster Interconnection Costs: $5,371,860
(Total of $16,115,580 shared with GEN-2016-112 and GEN-2016-122)



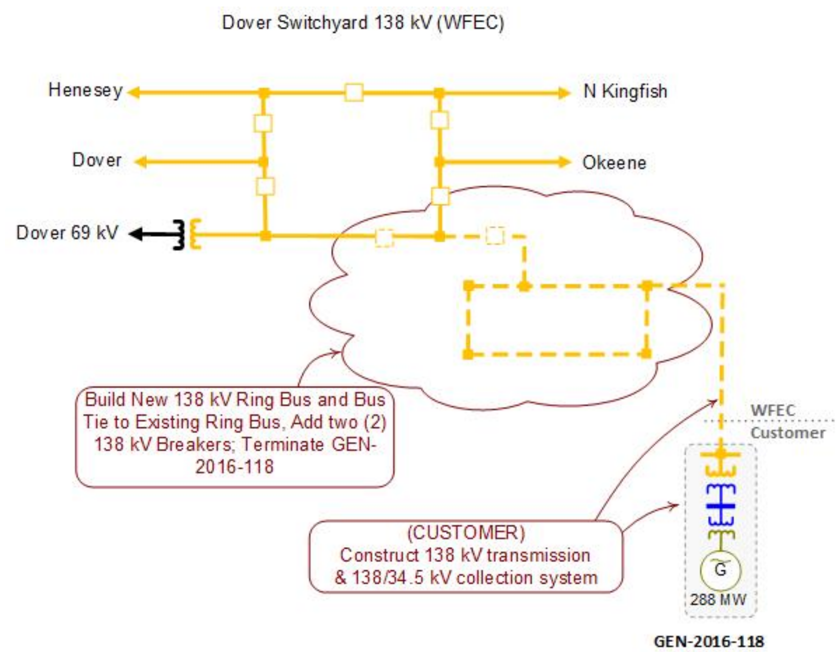
Interconnection Request: GEN-2016-114
Cluster Interconnection Costs: $8,792,574
(Total of $17,585,147 shared with GEN-2016-111)



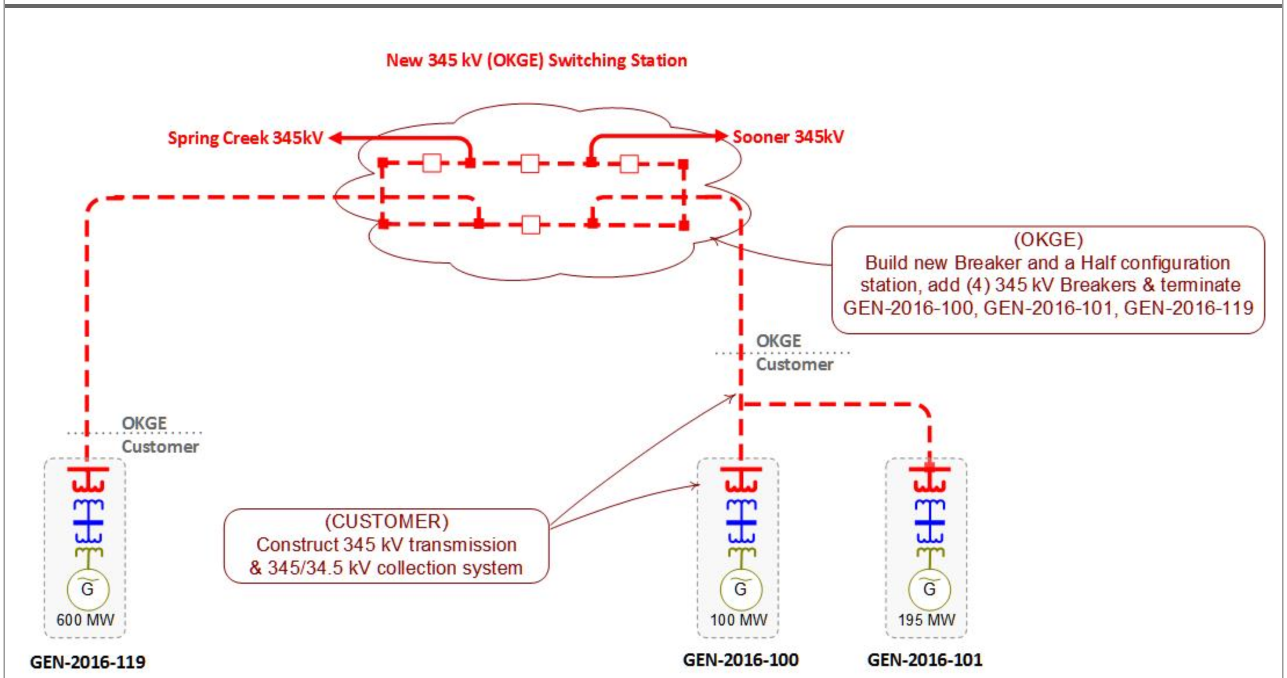
Interconnection Request: GEN-2016-115
Cluster Interconnection Costs: $1,532,553



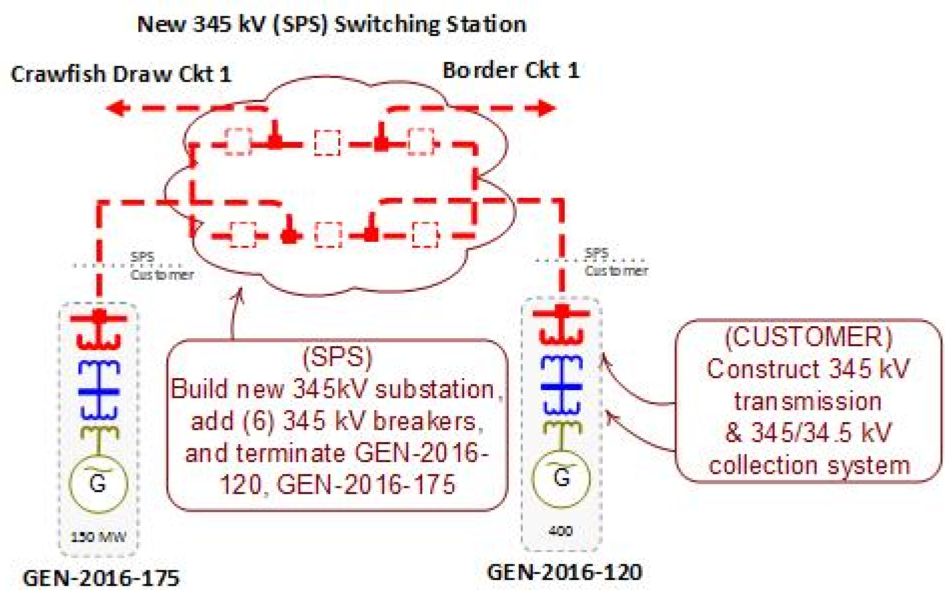
Interconnection Request: GEN-2016-118
Cluster Interconnection Costs: $5,010,000



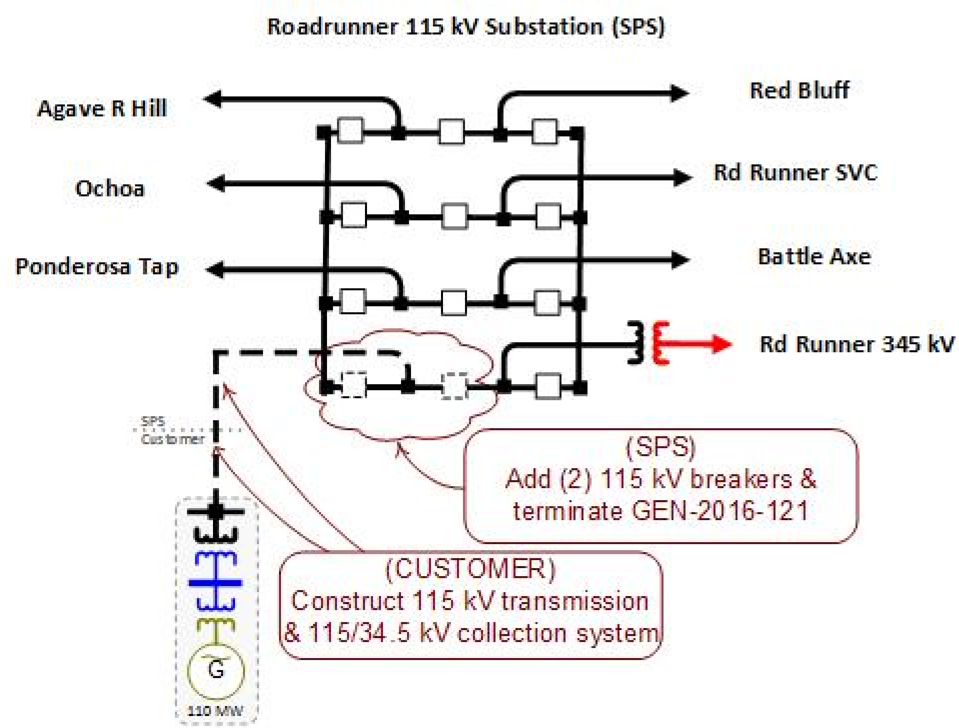
Interconnection Request: GEN-2016-119
Cluster Interconnection Costs: $6,465,000
(Total of $12,930,000 shared with GEN-2016-100)



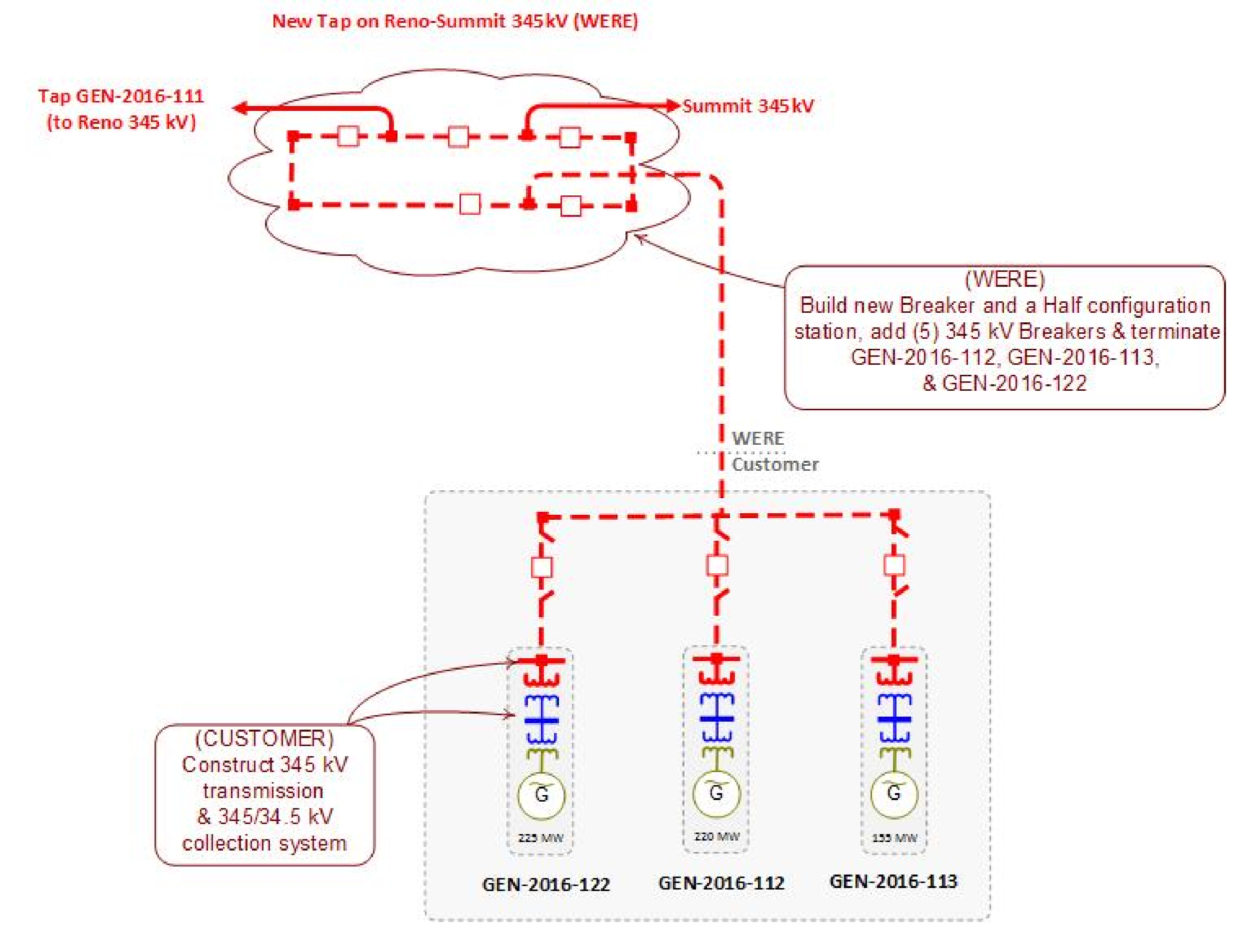
Interconnection Request: GEN-2016-120
Cluster Interconnection Costs: $16,546,802
(Total of $33,093,604 shared with GEN-2016-175)



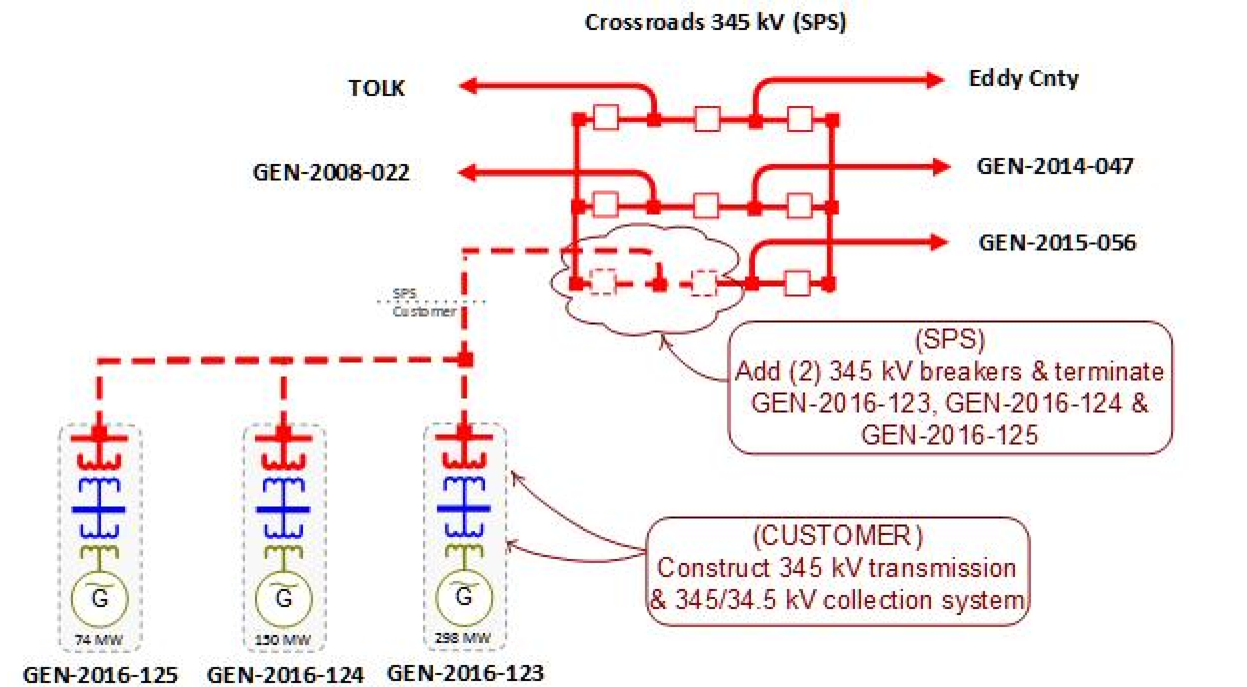
Interconnection Request: GEN-2016-121
Cluster Interconnection Costs: $2,799,536



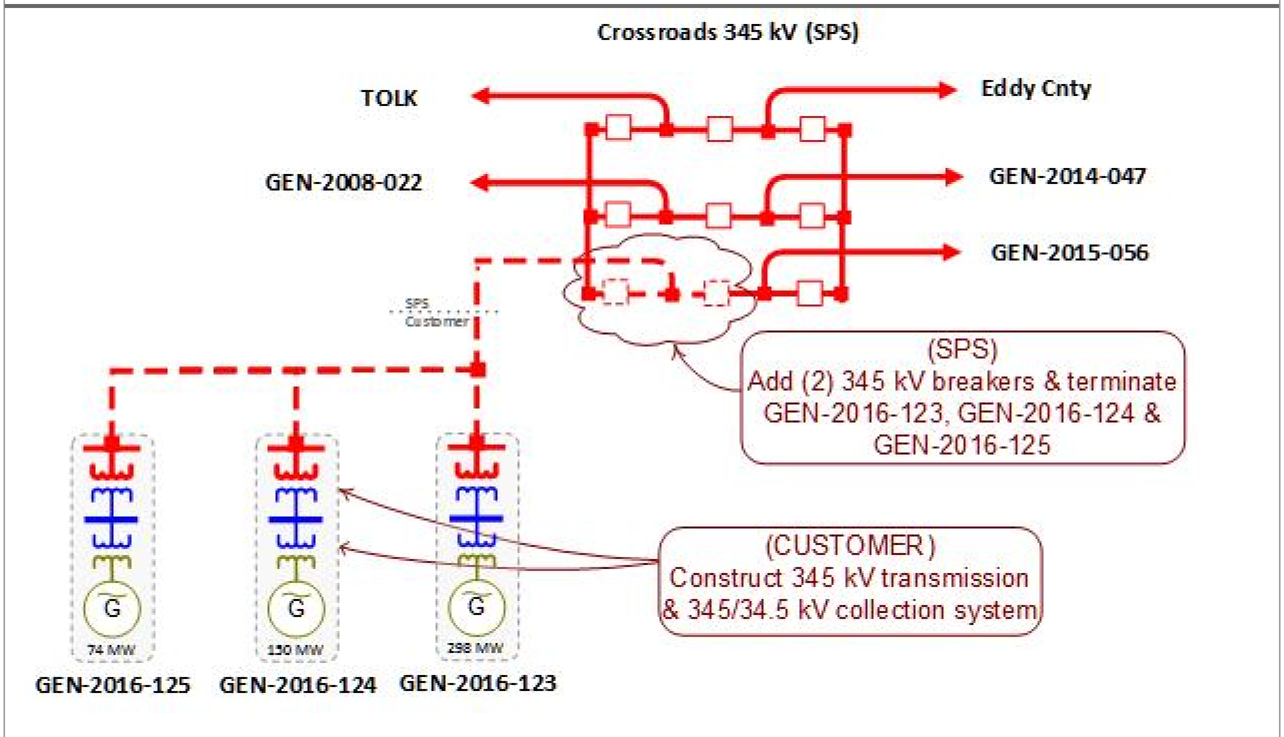
Interconnection Request: GEN-2016-122
Cluster Interconnection Costs: $5,371,860
(Total of $16,115,580 shared with GEN-2016-112 and GEN-2016-113)



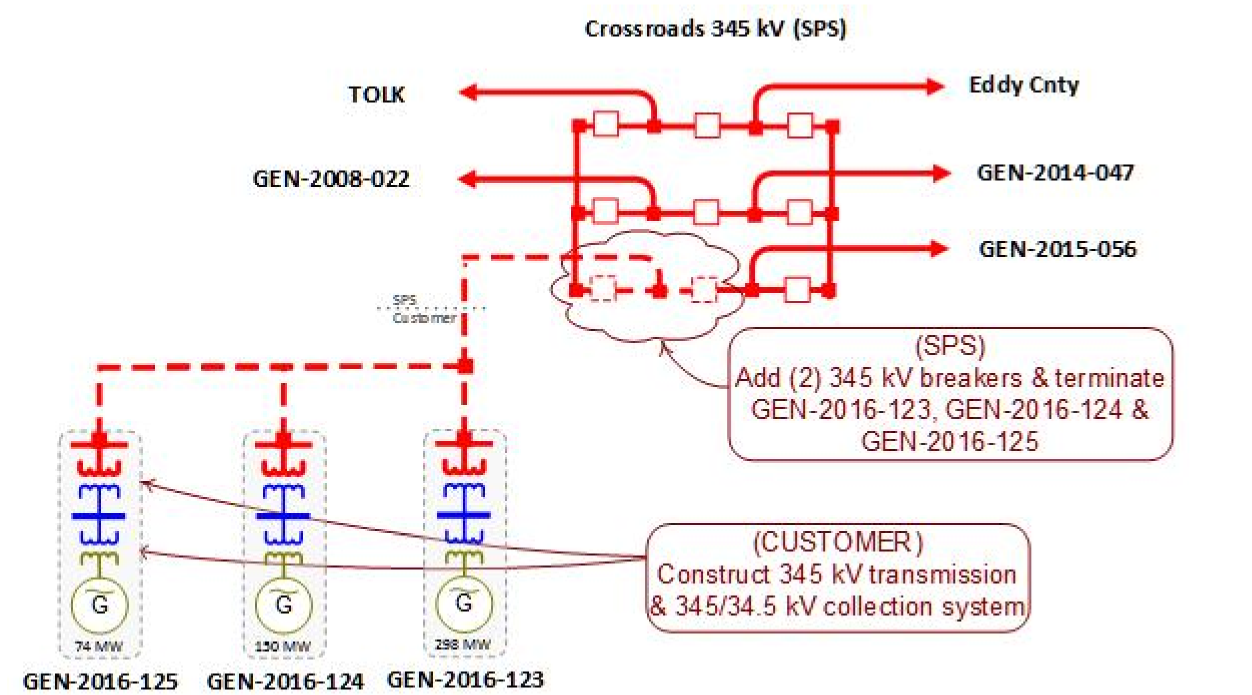
Interconnection Request: GEN-2016-123
Cluster Interconnection Costs: $1,585,403



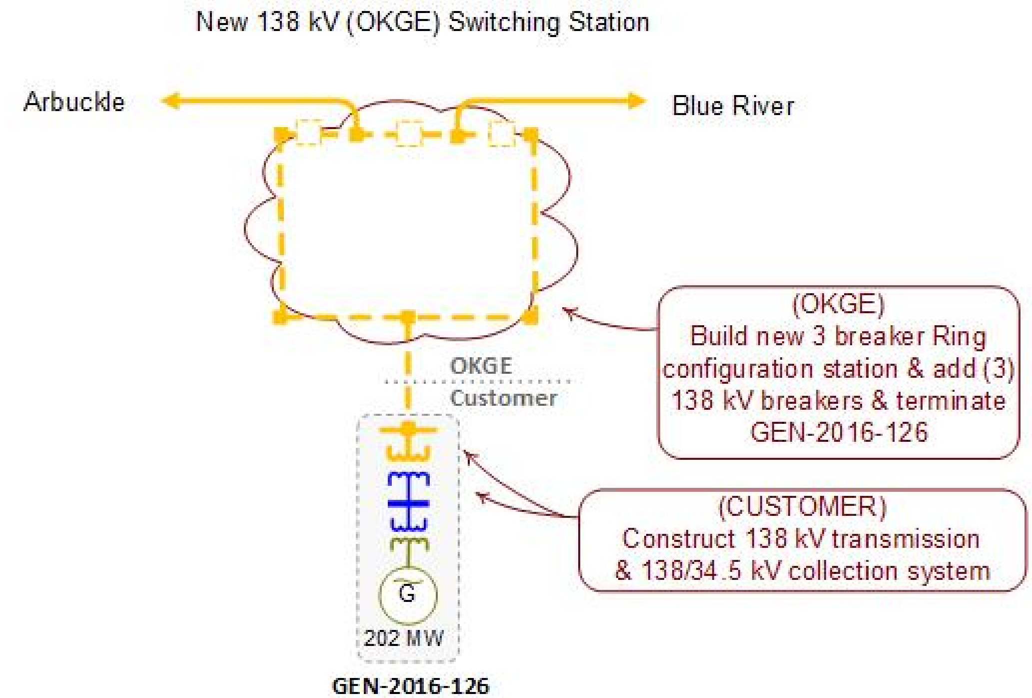
Interconnection Request: GEN-2016-124
Cluster Interconnection Costs: $1,585,403



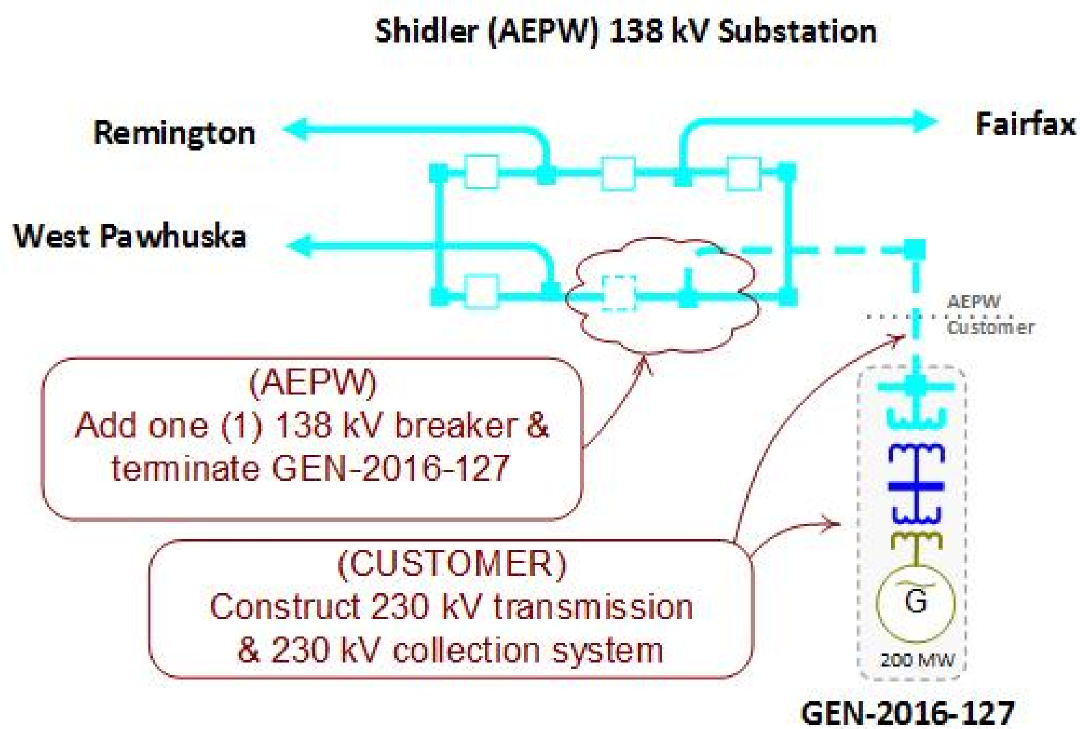
Interconnection Request: GEN-2016-125
Cluster Interconnection Costs: $1,585,403



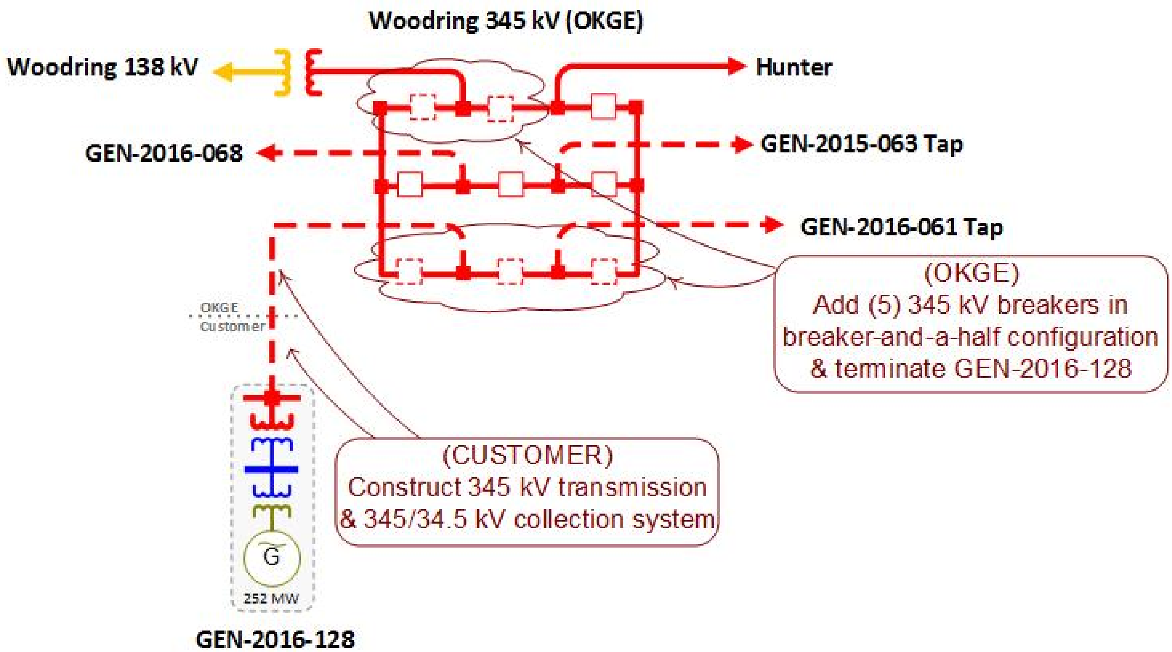
Interconnection Request: GEN-2016-126
Cluster Interconnection Costs: $4,000,000



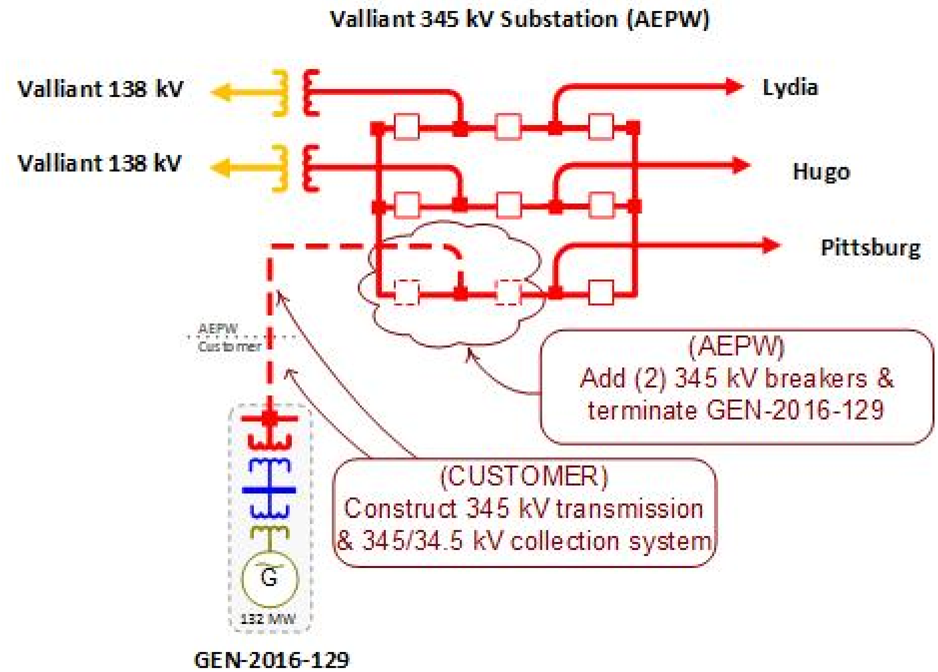
Interconnection Request: GEN-2016-127
Cluster Interconnection Costs: $1,653,750



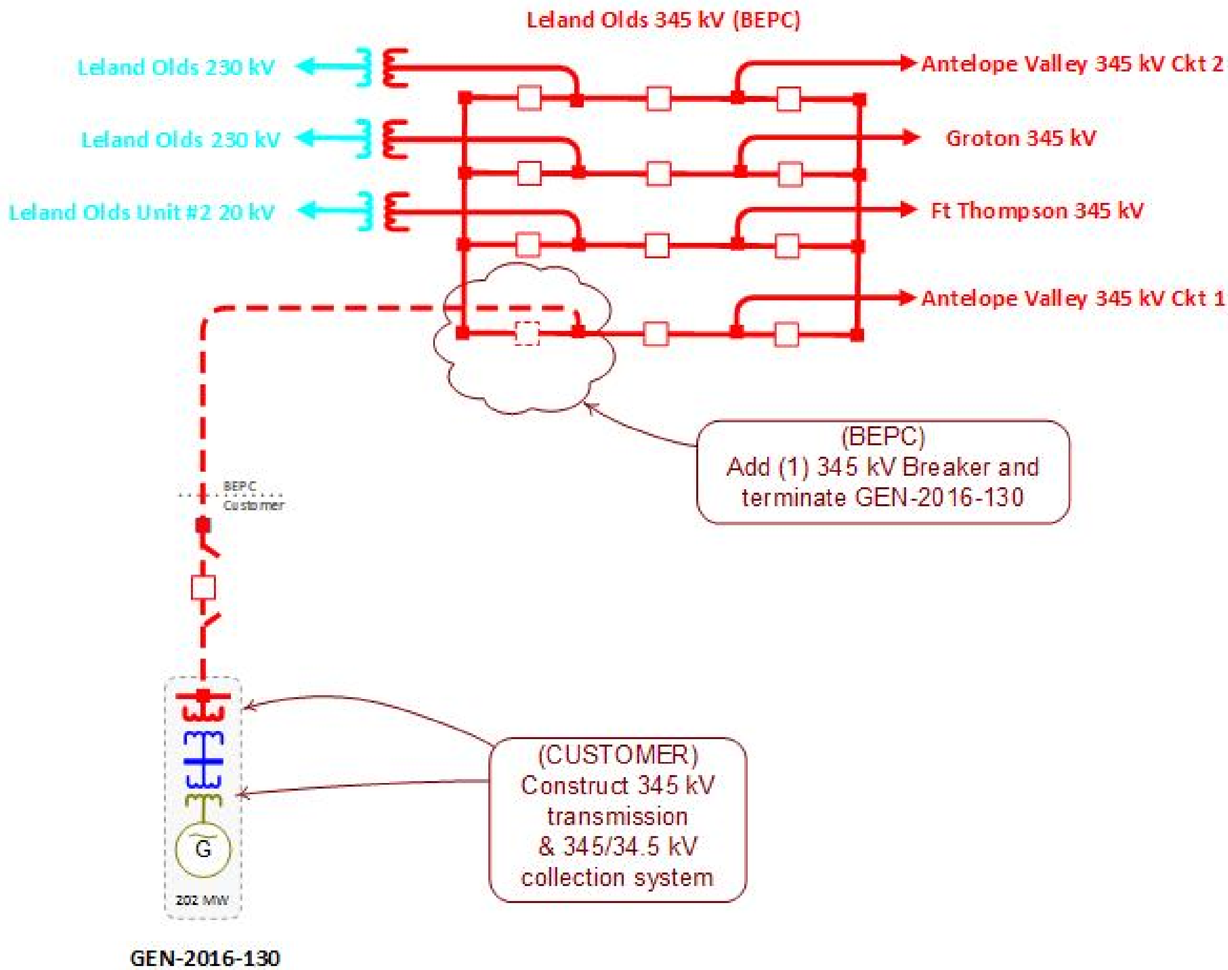
Interconnection Request: GEN-2016-128
Cluster Interconnection Costs: $5,052,000



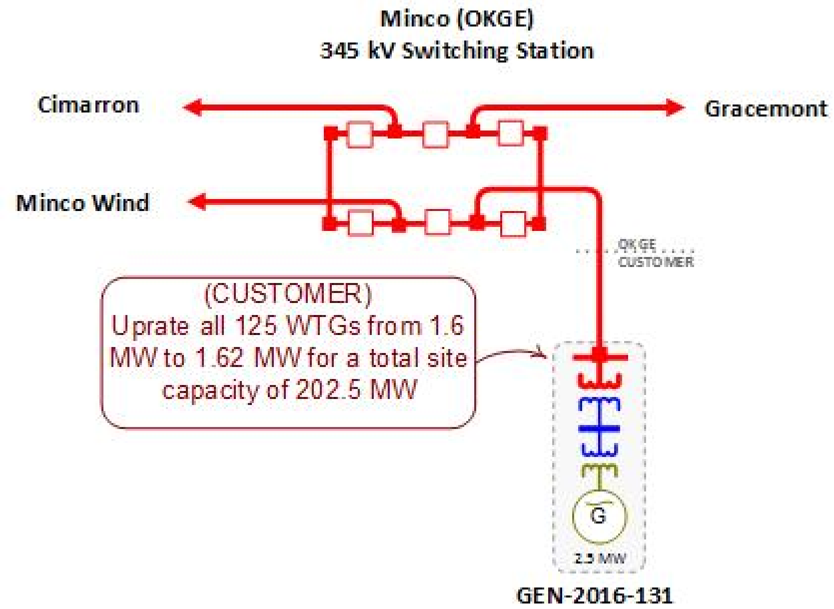
Interconnection Request: GEN-2016-129
Cluster Interconnection Costs: $5,367,500



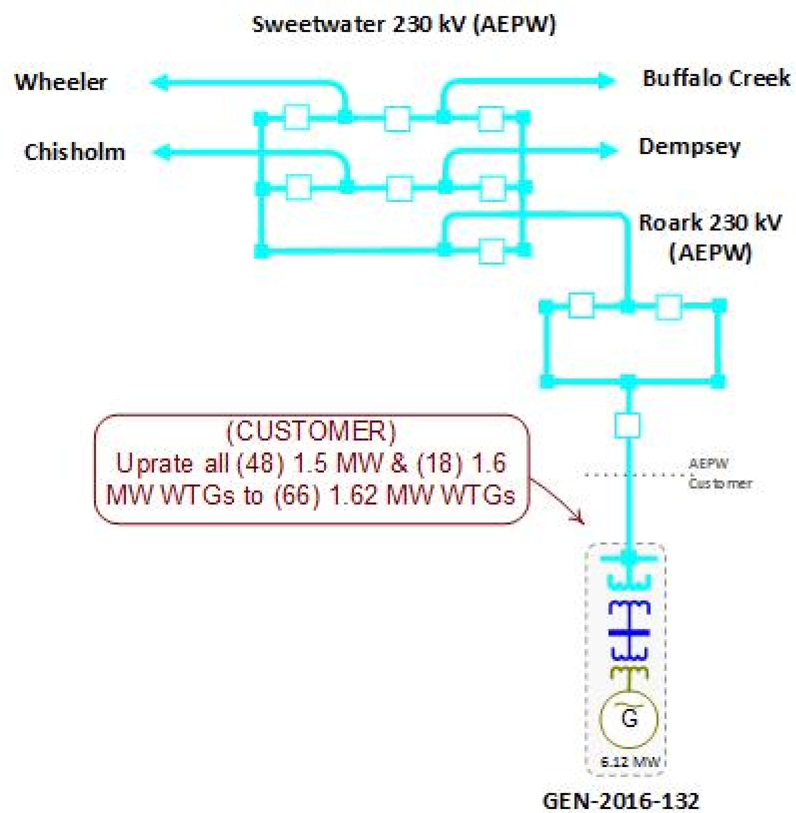
Interconnection Request: GEN-2016-130
Cluster Interconnection Costs: $2,853,562



Interconnection Request: GEN-2016-131
Cluster Interconnection Costs: $0

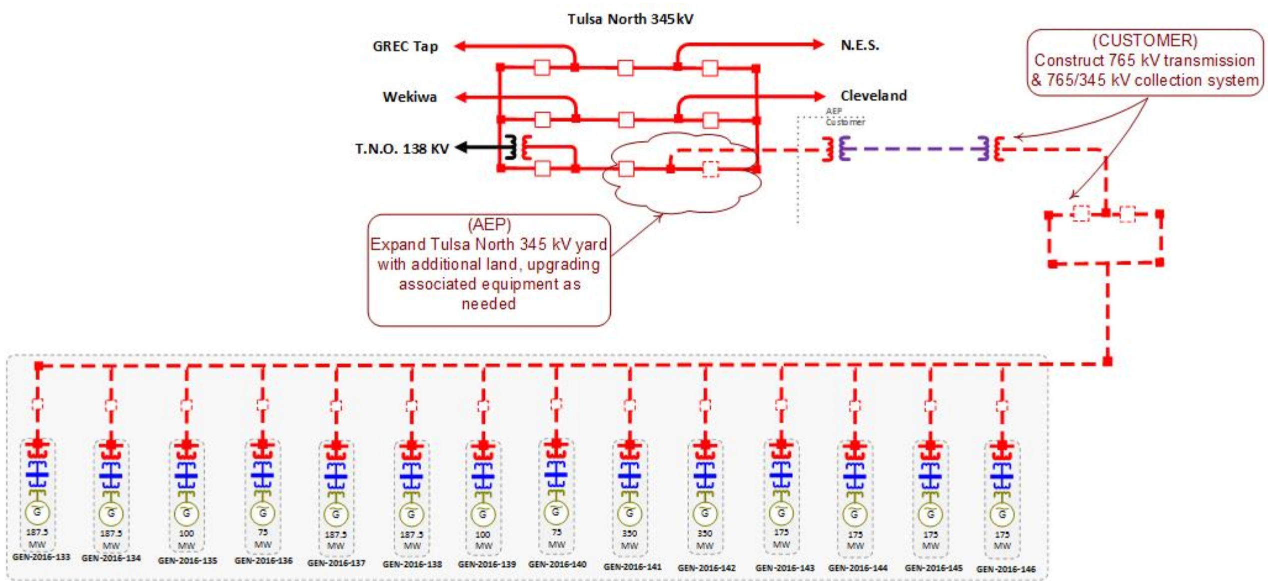


Interconnection Request: GEN-2016-132
Cluster Interconnection Costs: $210,000

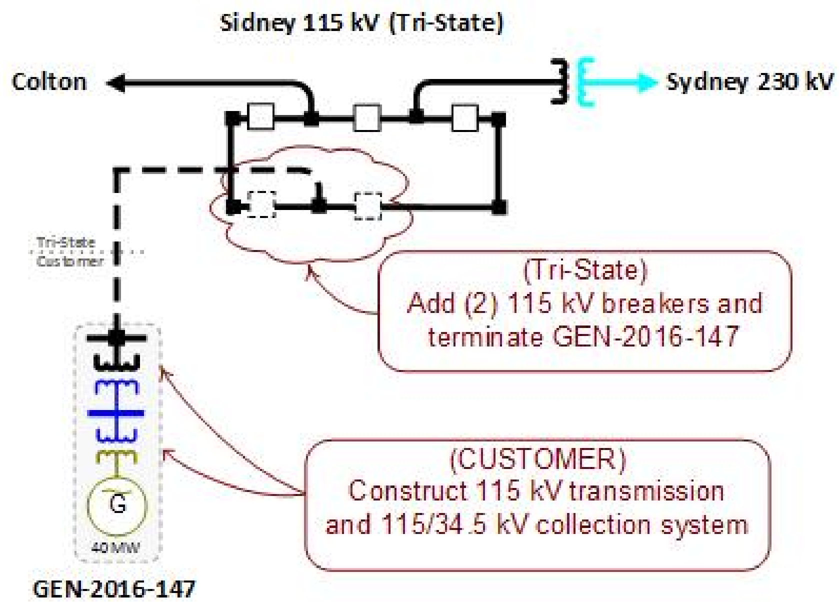


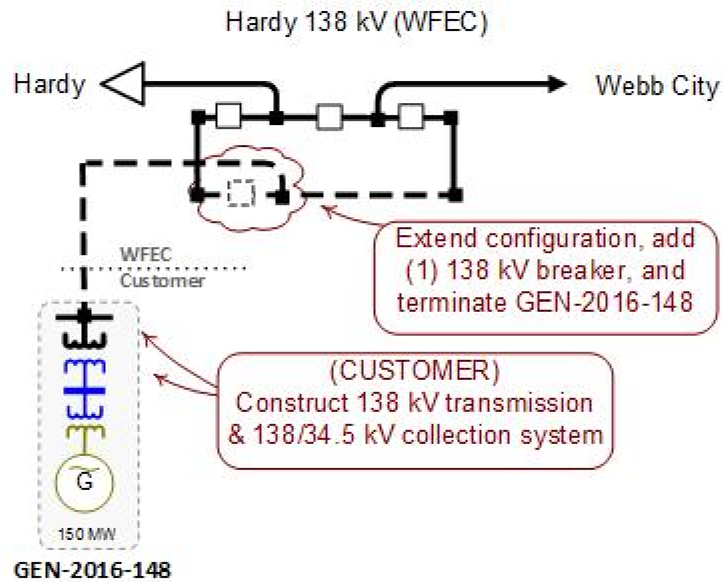
Interconnection Requests: GEN-2016-133, GEN-2016-134, GEN-2016-135, GEN-2016-136, GEN-2016-137, GEN-2016-138, GEN-2016-139, GEN-2016-140, GEN-2016-141, GEN-2016-142, GEN-2016-143, GEN-2016-144, GEN-2016-145, and GEN-2016-146

Cluster Interconnection Costs: Total of $31,786,454 shared among all 14 requests

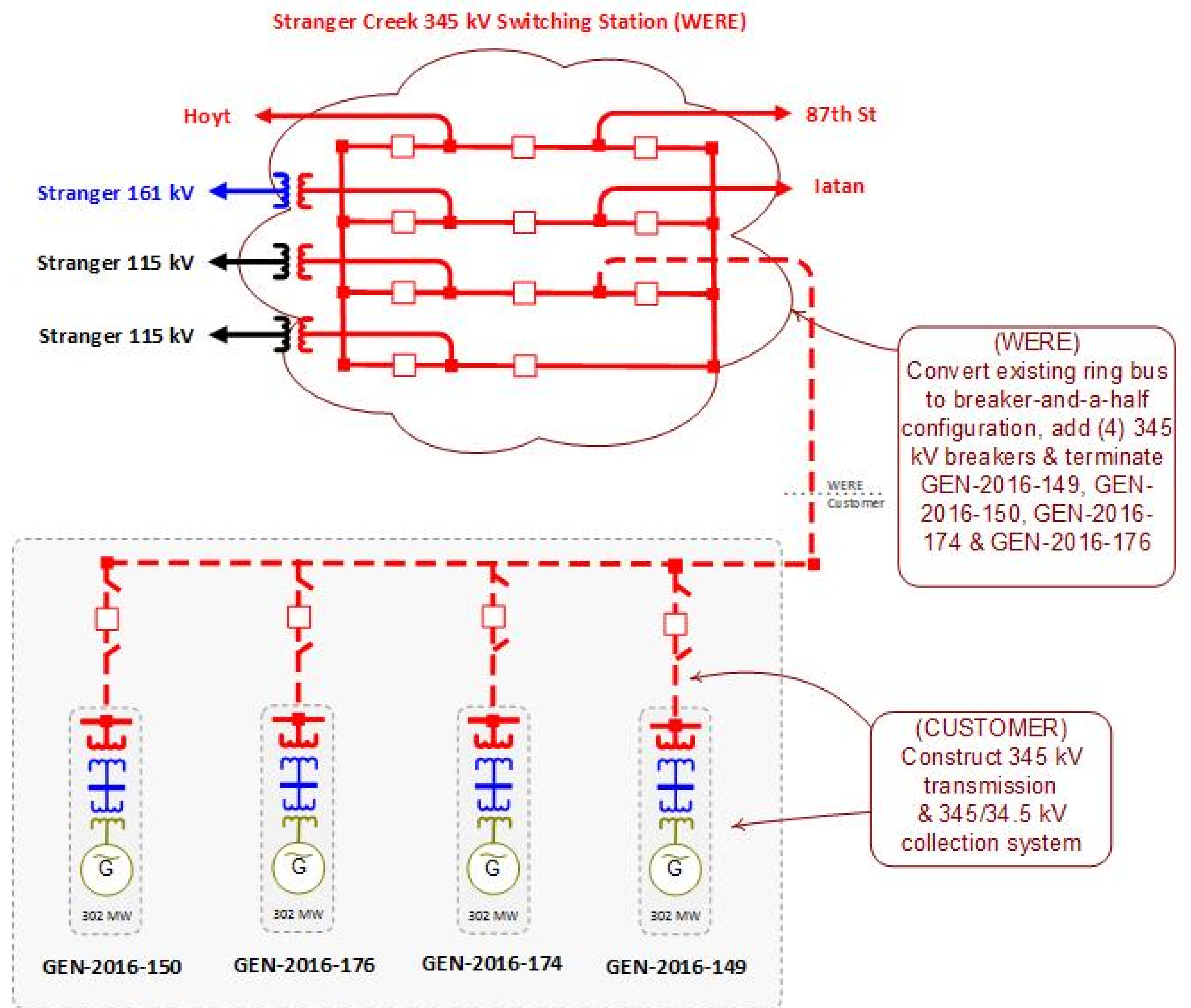


Interconnection Request: GEN-2016-147
Cluster Interconnection Costs: $3,521,000 (*This cost estimate was generated by SPP and is subject to verification by the TO)

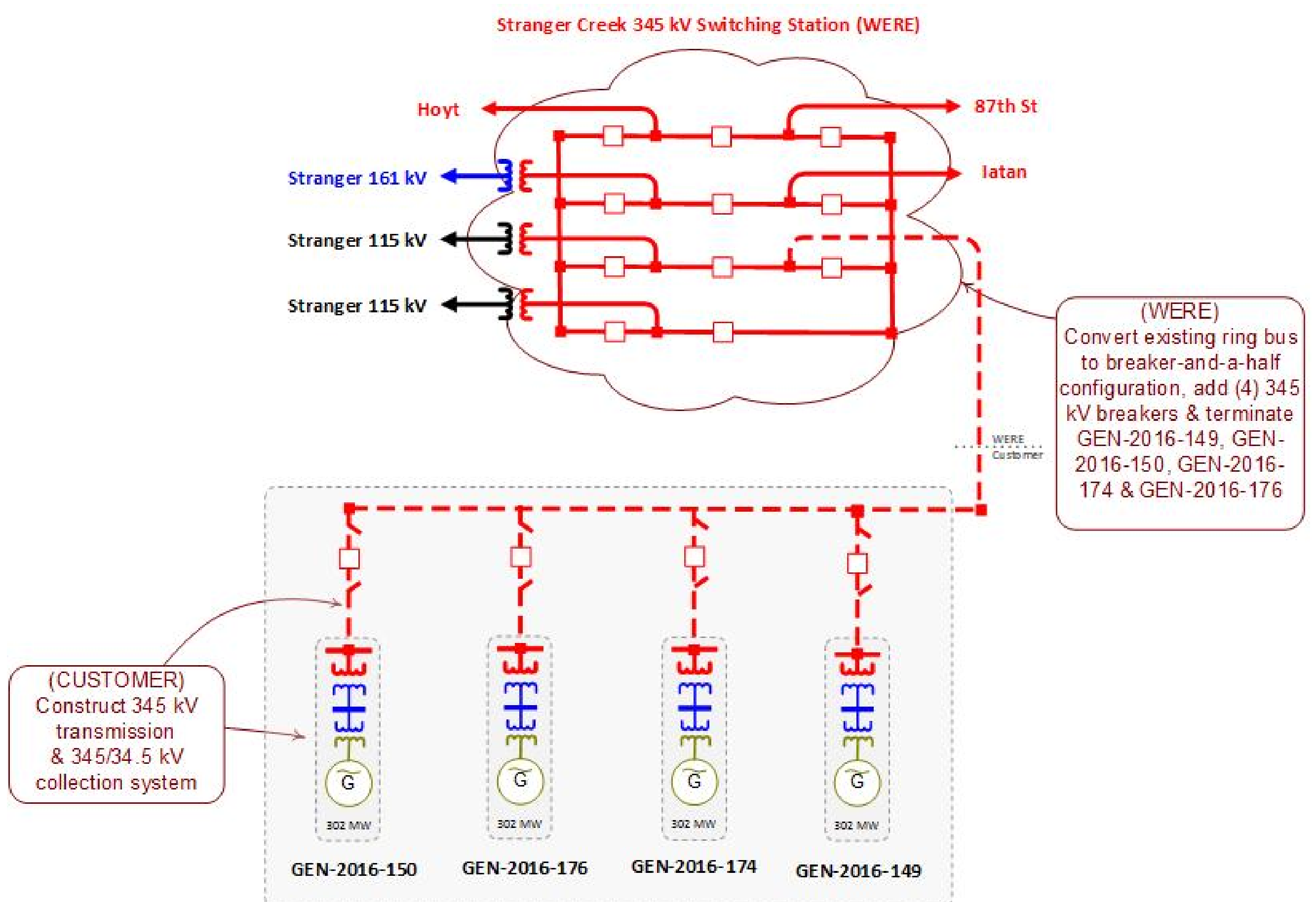


Interconnection Request: GEN-2016-148 **Cluster Interconnection Costs: $635,000**


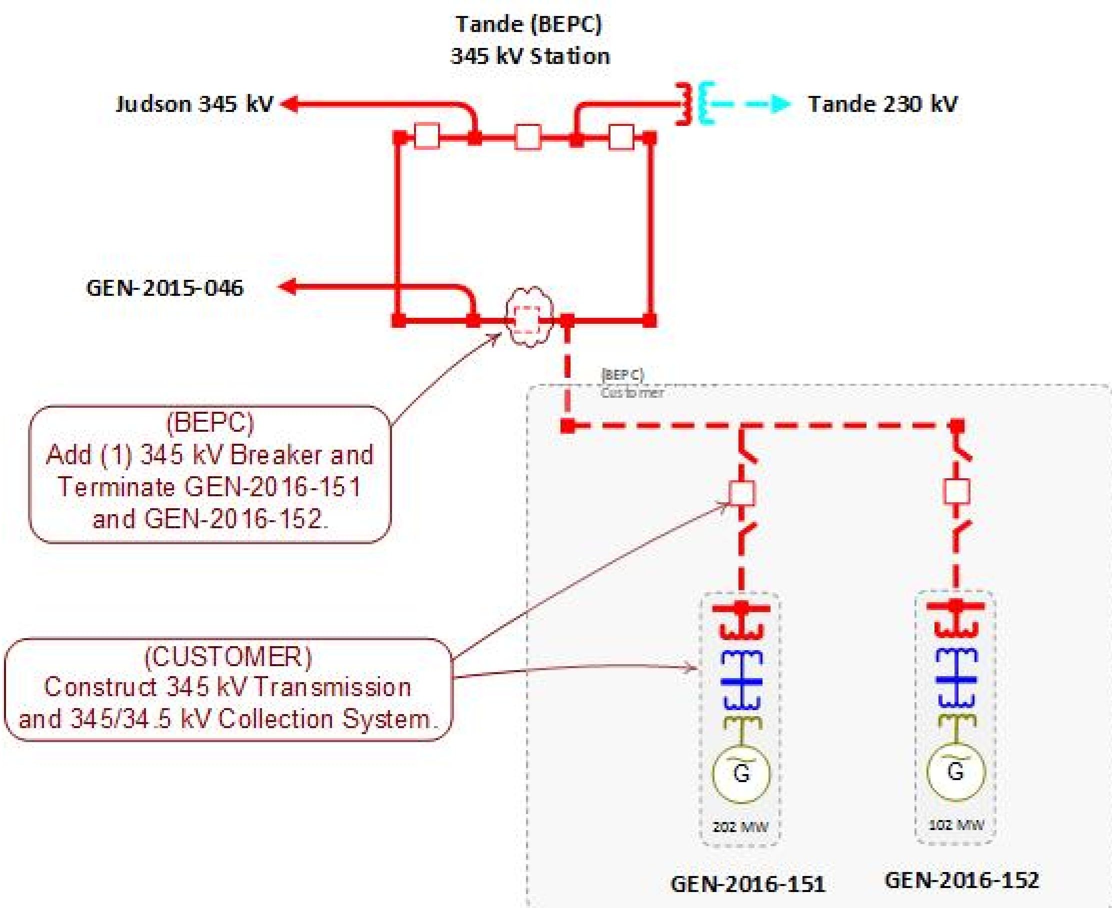
Interconnection Request: GEN-2016-149
Cluster Interconnection Costs: $7,298,094
(Total of $29,192,376 shared among GEN-2016-150, GEN-2016-174, and GEN-2016-176)



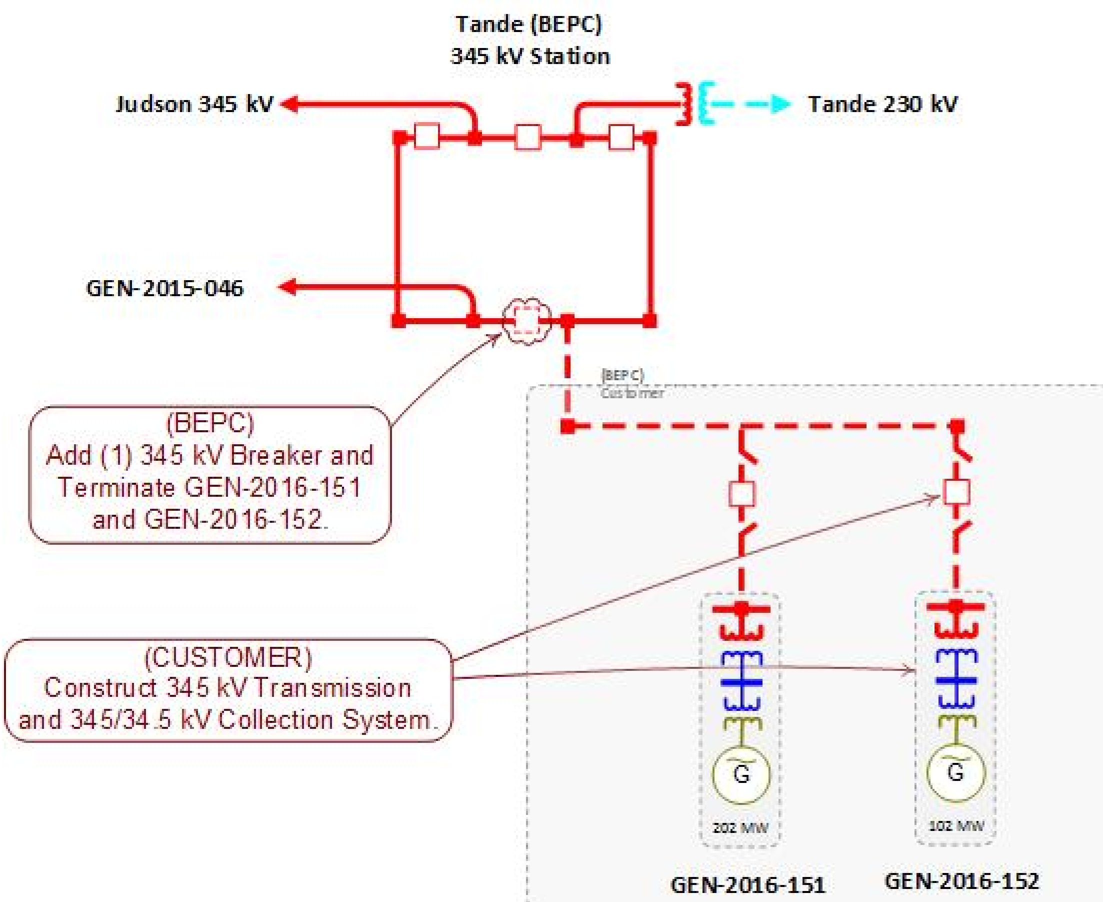
Interconnection Request: GEN-2016-150
Cluster Interconnection Costs: $7,298,094
(Total of $29,192,376 shared among GEN-2016-149, GEN-2016-174, and GEN-2016-176)



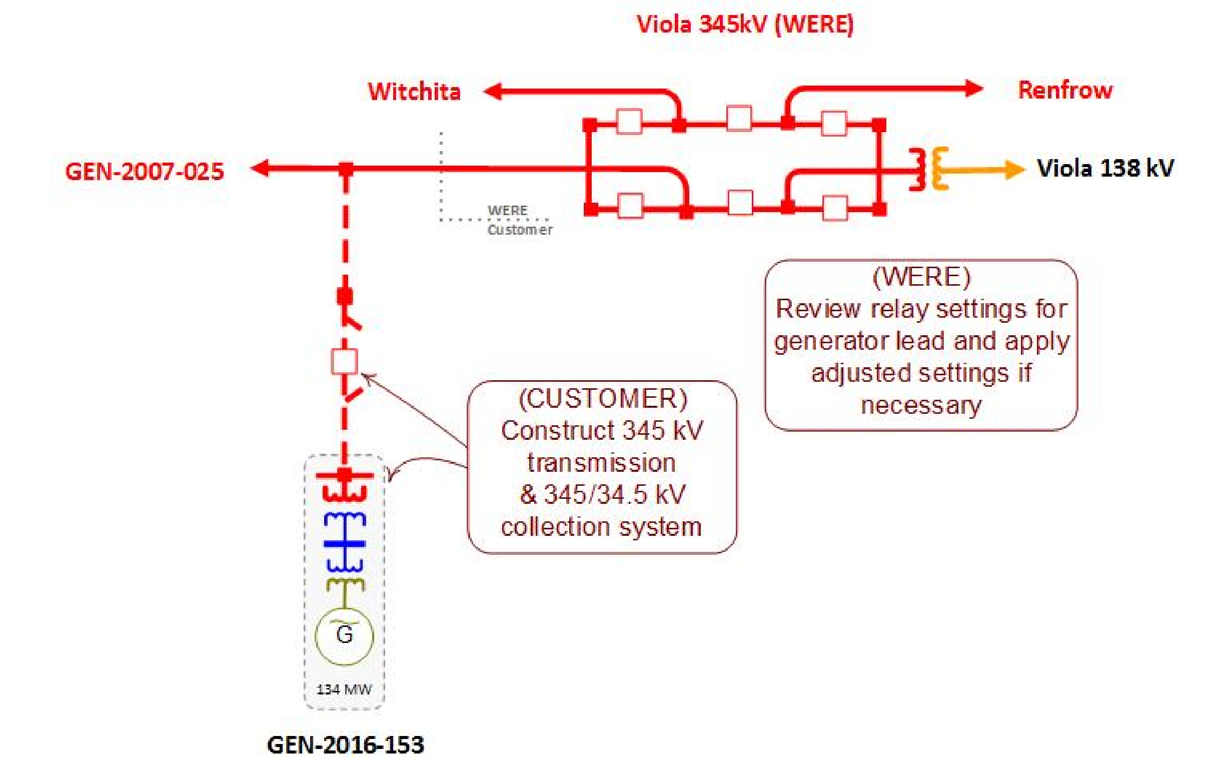
Interconnection Request: GEN-2016-151
Cluster Interconnection Costs: $1,298,460.5
(Total of $2,596,921 shared with GEN-2016-152)



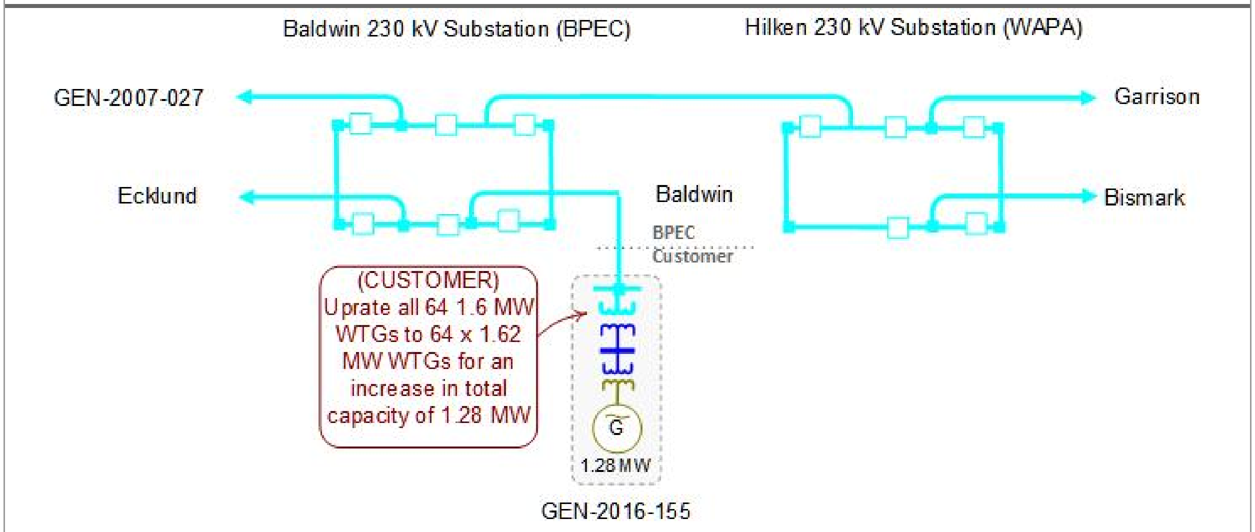
Interconnection Request: GEN-2016-152
Cluster Interconnection Costs: $1,298,460.5
(Total of $2,596,921 shared with GEN-2016-151)



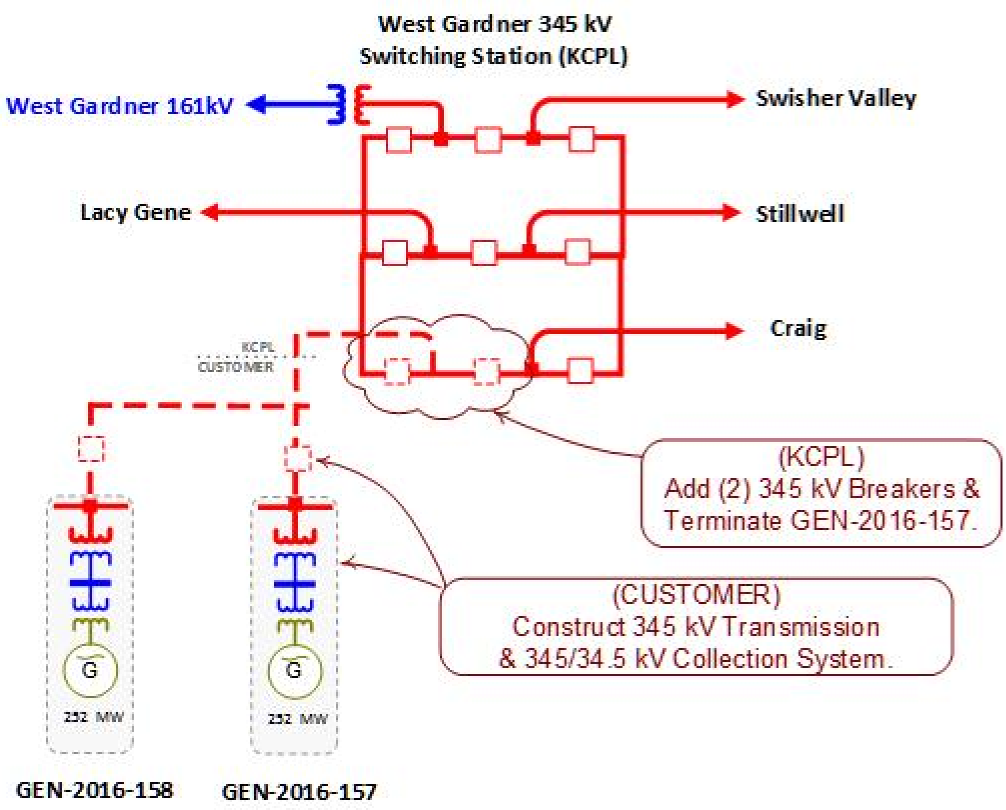
Interconnection Request: GEN-2016-153
Cluster Interconnection Costs: $10,000



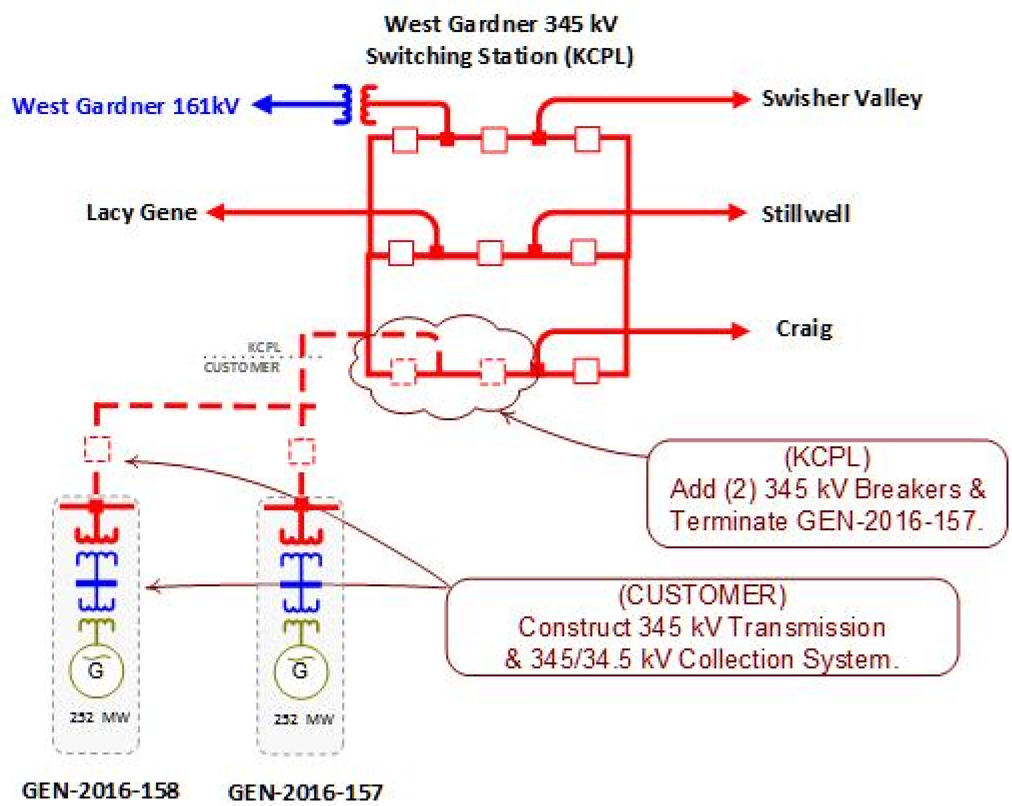
Interconnection Request: GEN-2016-155
Cluster Interconnection Costs: $0



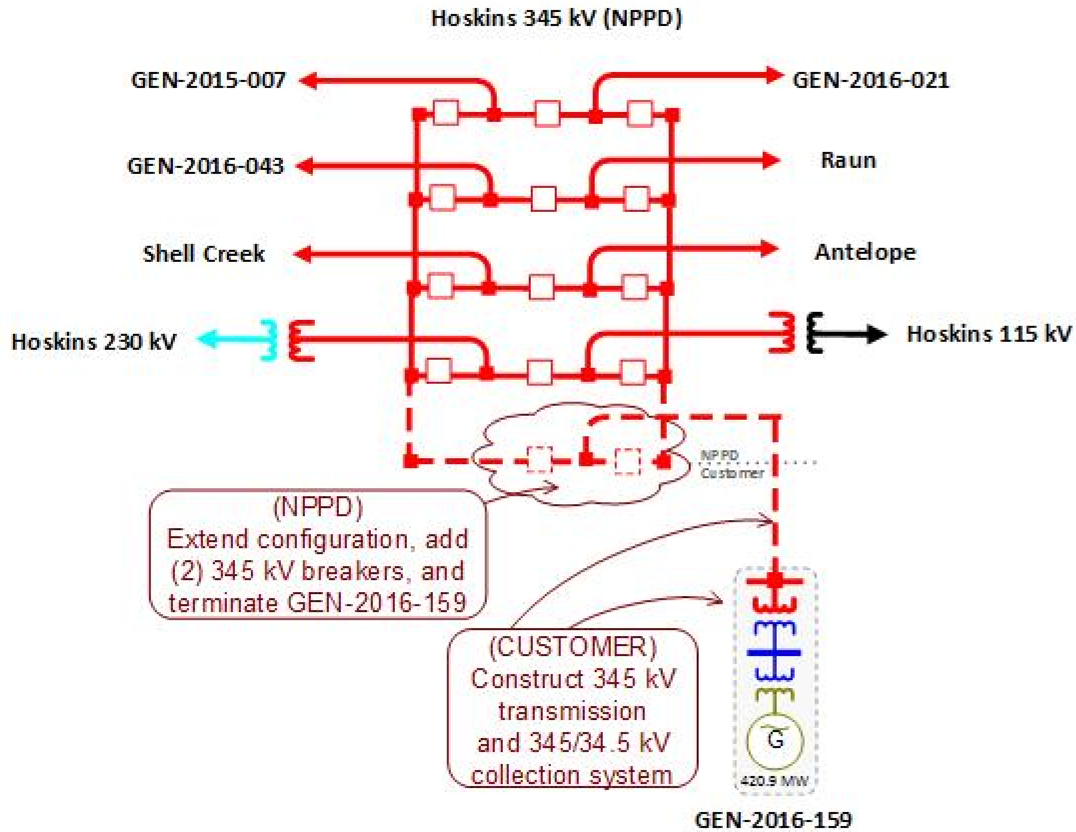
Interconnection Request: GEN-2016-157
Cluster Interconnection Costs: $14,992,000+$187,500



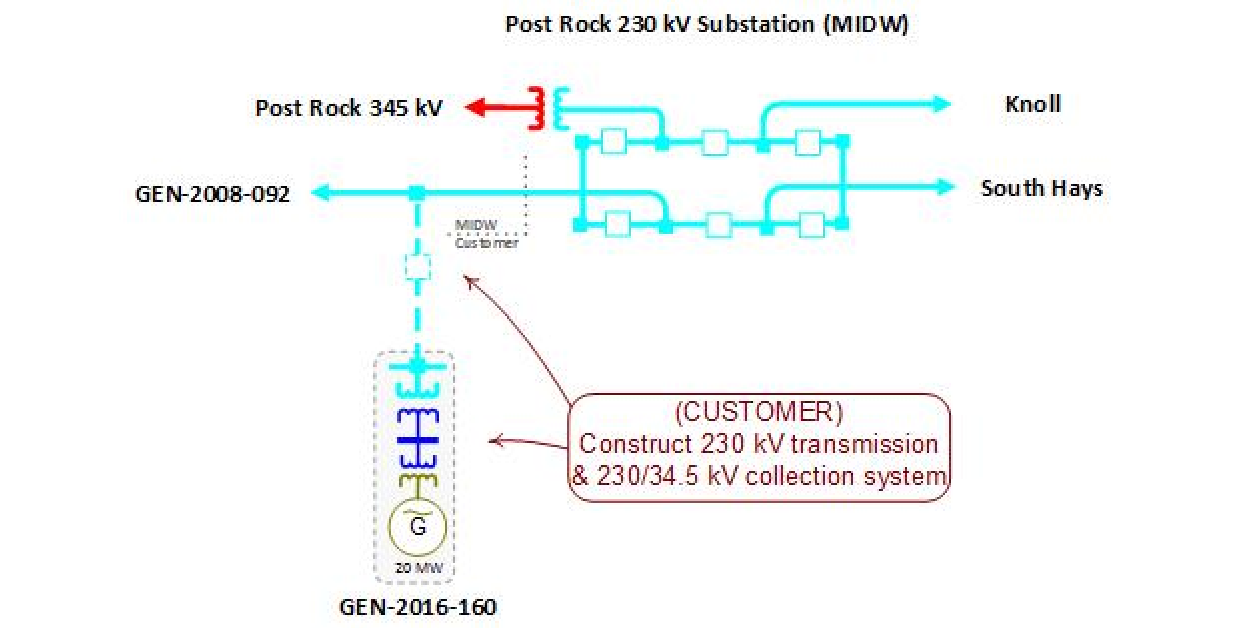
Interconnection Request: GEN-2016-158
Cluster Interconnection Costs: $14,992,000+$187,500



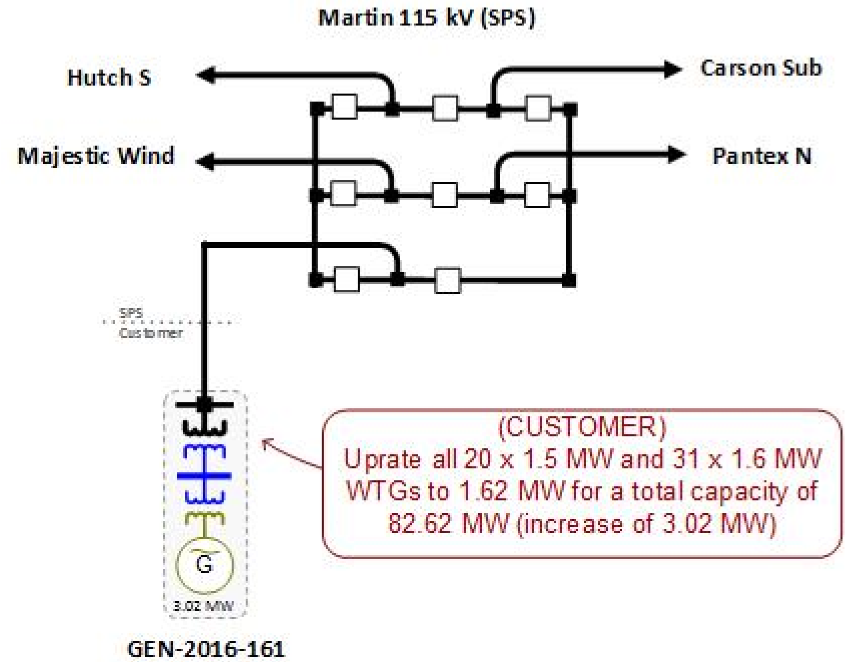
Interconnection Request: GEN-2016-159
Cluster Interconnection Costs: $6,200,000
(The cost is for an expansion of the Hoskins satellite substation)



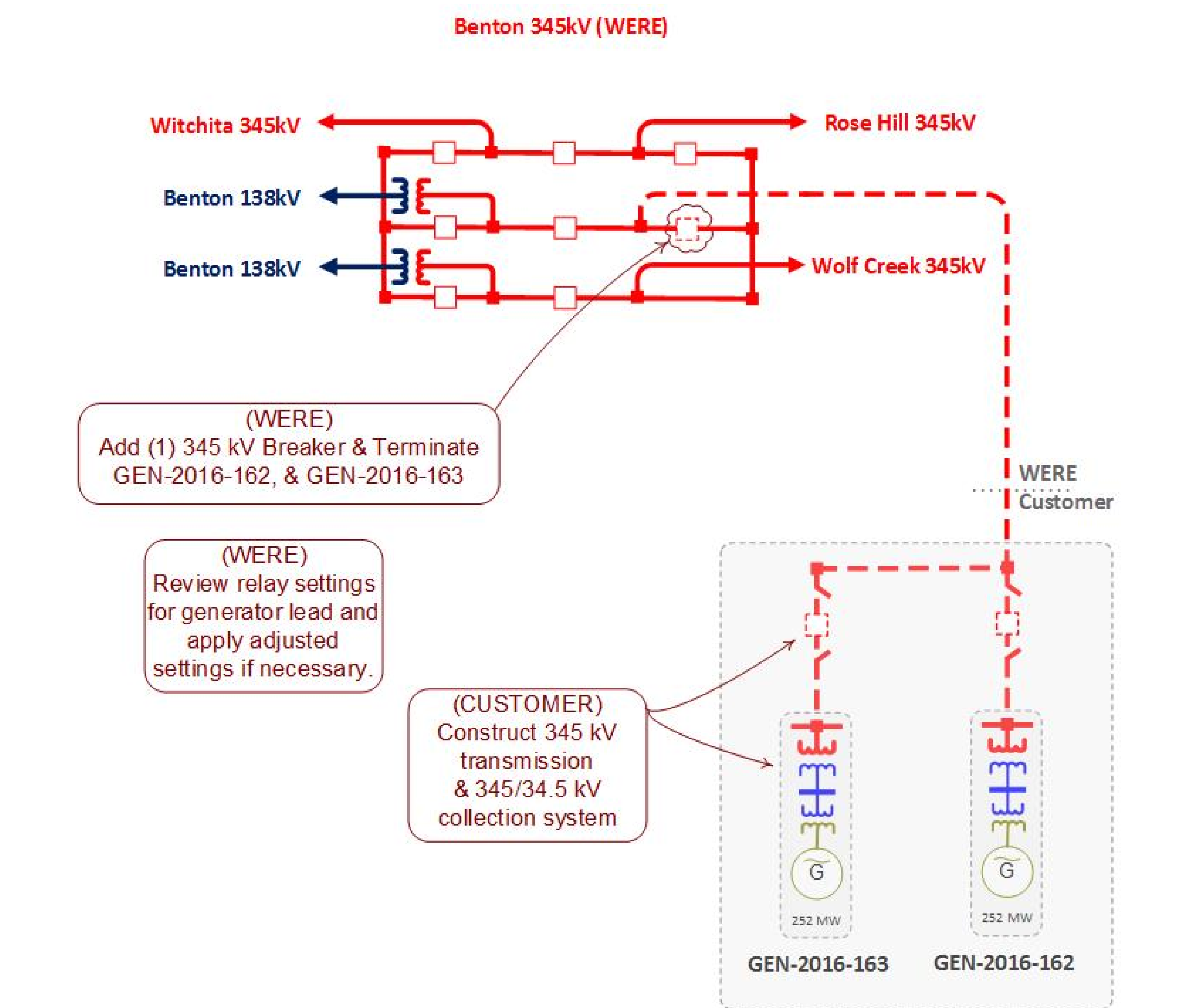
Interconnection Request: GEN-2016-160
Cluster Interconnection Costs: $0



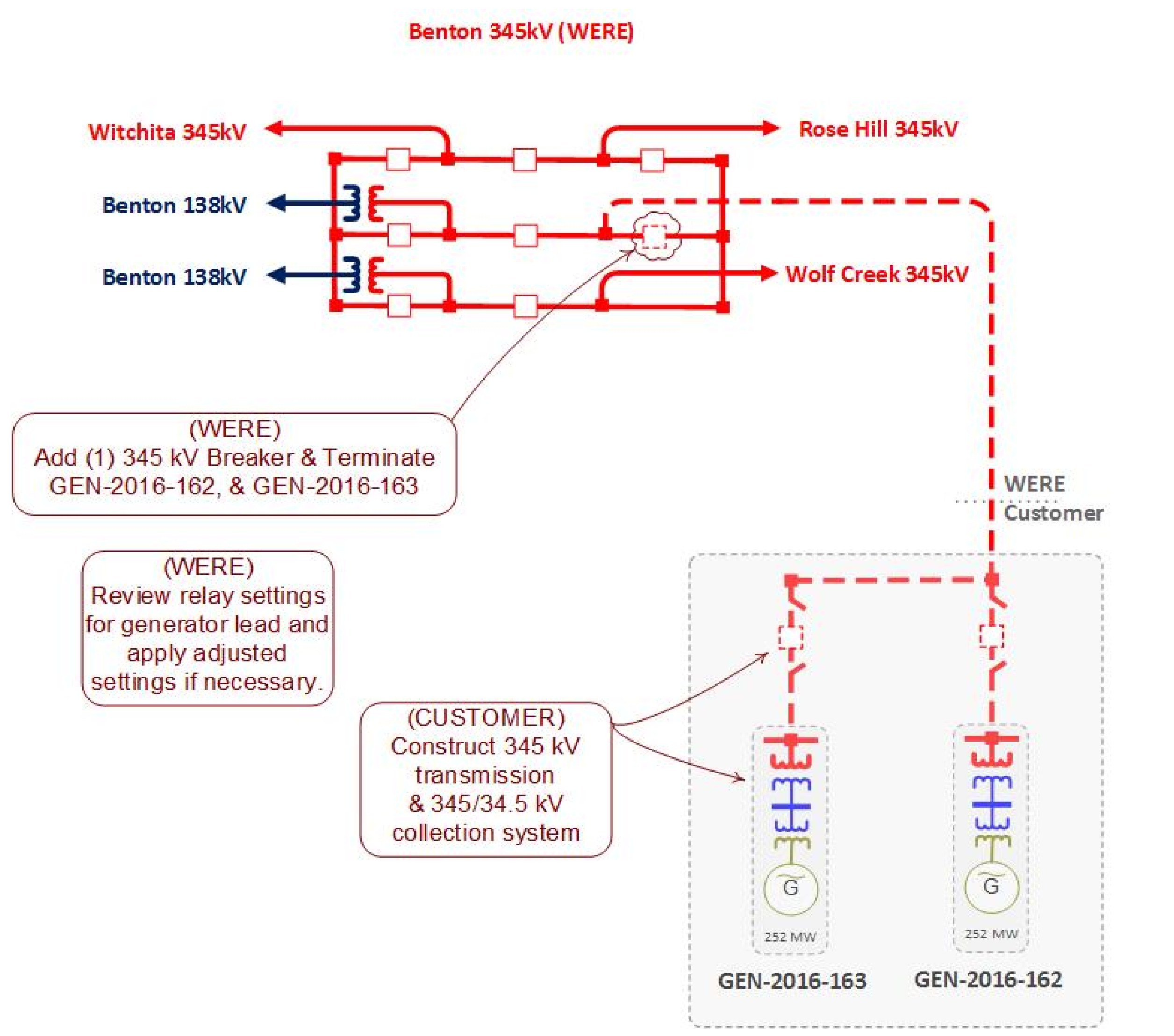
Interconnection Request: GEN-2016-161
Cluster Interconnection Costs: $0



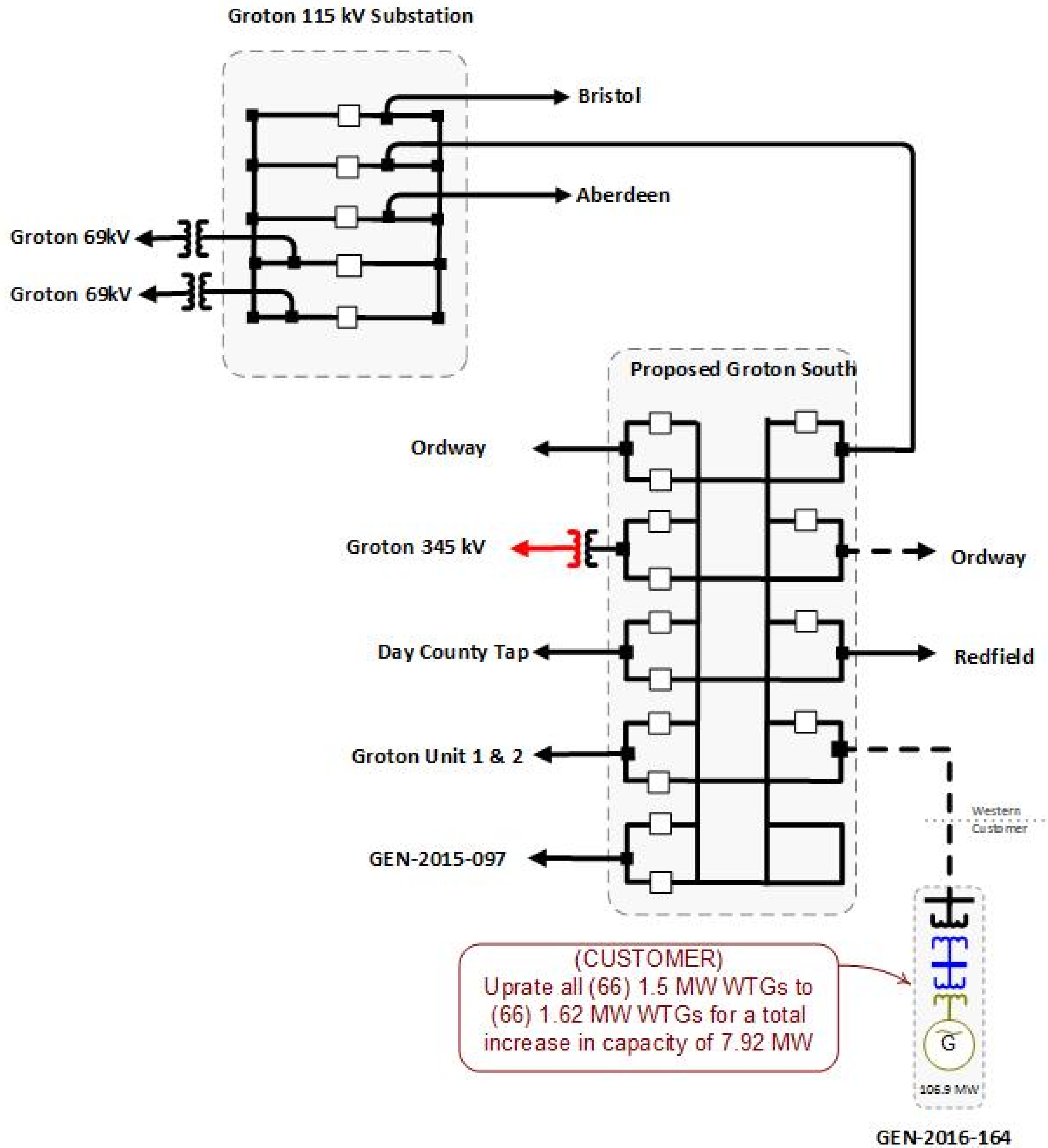
Interconnection Request: GEN-2016-162
Cluster Interconnection Costs: $959,269
(Total of $1,918,537 shared with GEN-2016-163)



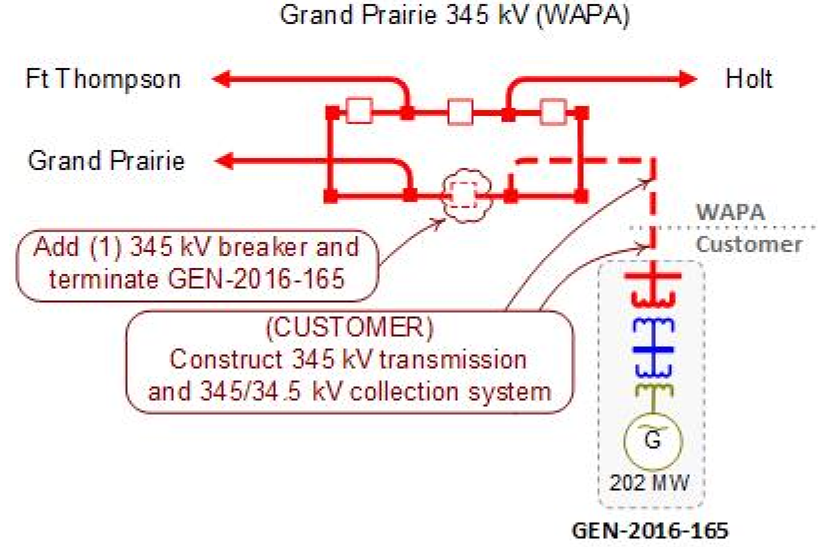
Interconnection Request: GEN-2016-163
Cluster Interconnection Costs: $959,269
(Total of $1,918,537 shared with GEN-2016-162)



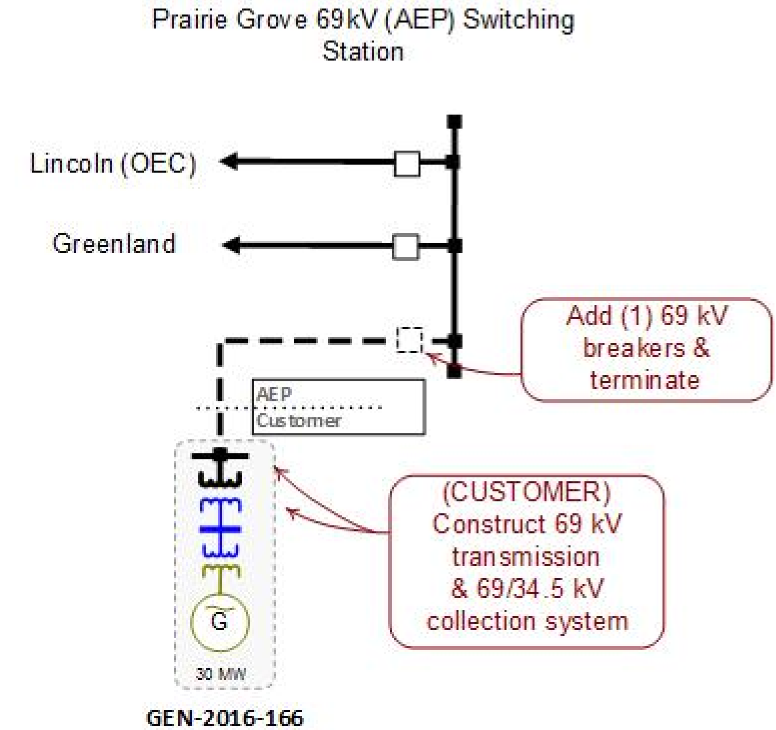
Interconnection Request: GEN-2016-164
Cluster Interconnection Costs: $0



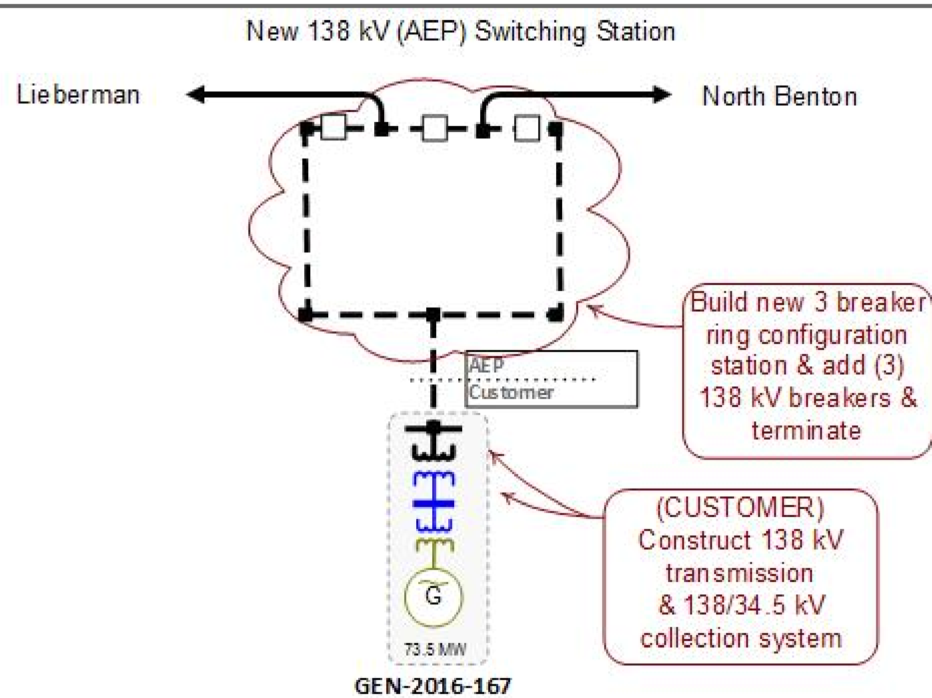
Interconnection Request: GEN-2016-165
Cluster Interconnection Costs: $2,190,000



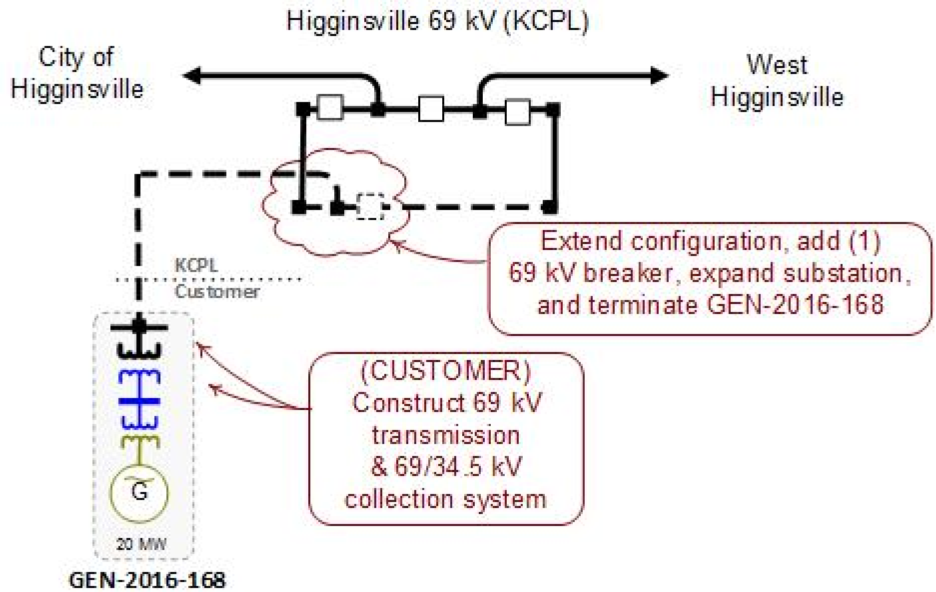
Interconnection Request: GEN-2016-166
Cluster Interconnection Costs: $2,143,750



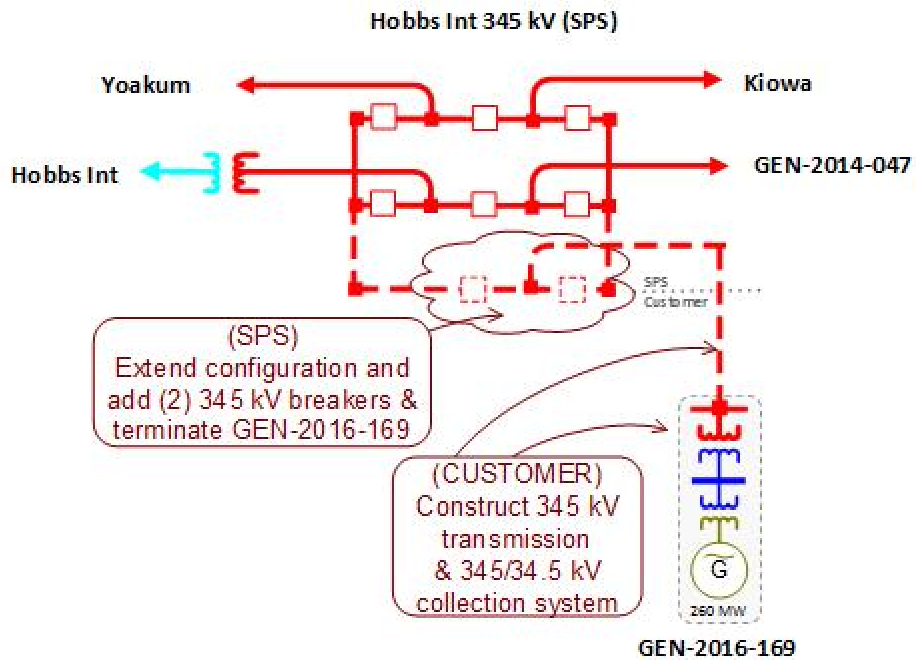
Interconnection Request: GEN-2016-167
Cluster Interconnection Costs: $6,431,250



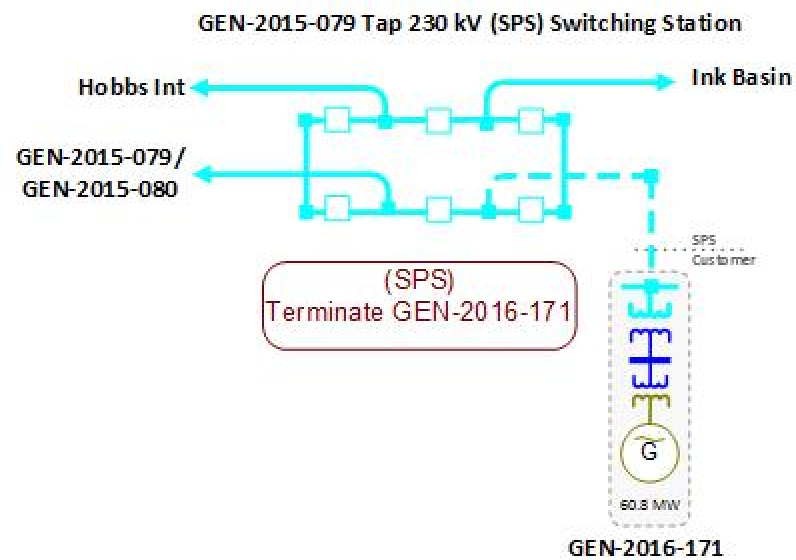
Interconnection Request: GEN-2016-168
Cluster Interconnection Costs: $4,563,000



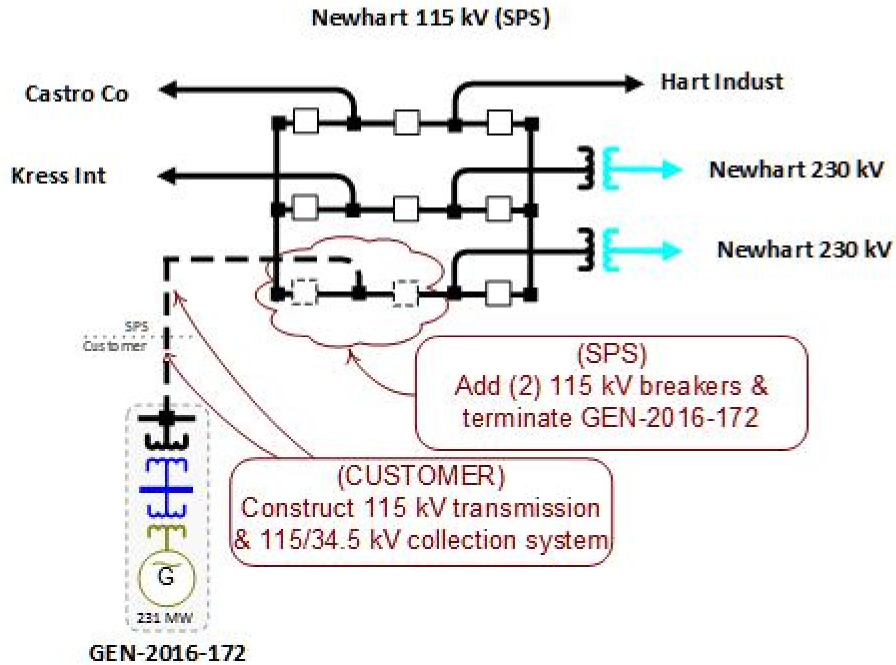
Interconnection Request: GEN-2016-169
Cluster Interconnection Costs: $4,418,000



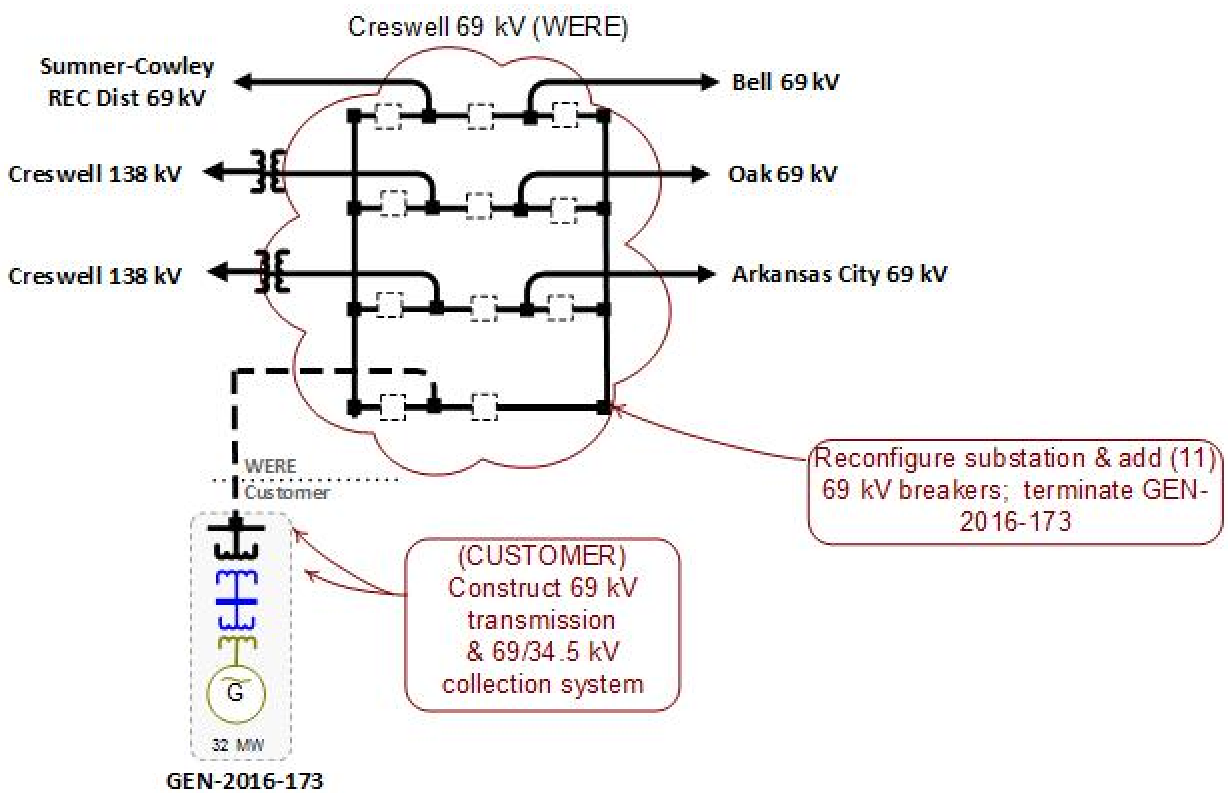
Interconnection Request: GEN-2016-171
Cluster Interconnection Costs: $210,000



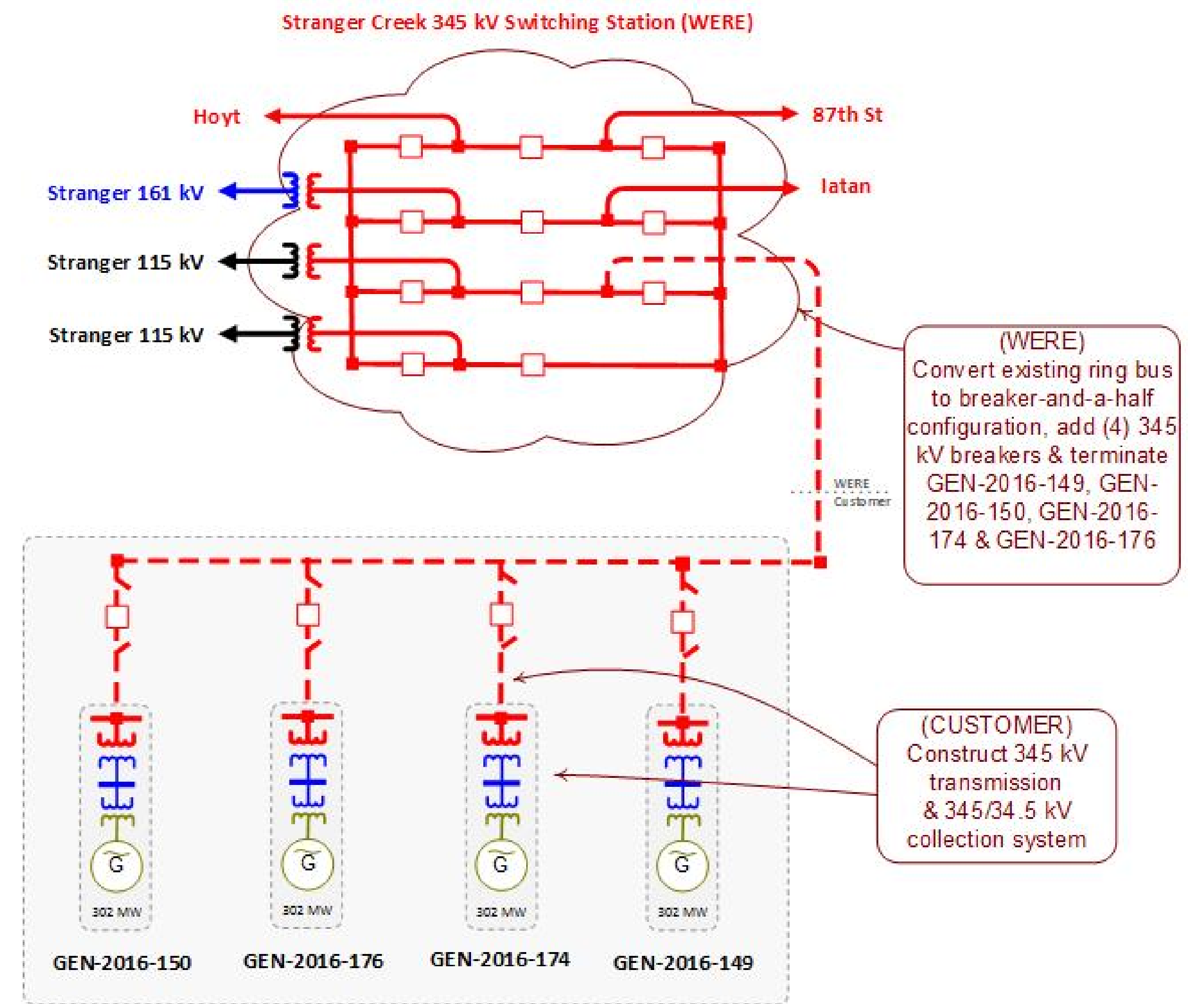
Interconnection Request: GEN-2016-172
Cluster Interconnection Costs: $1,166,280



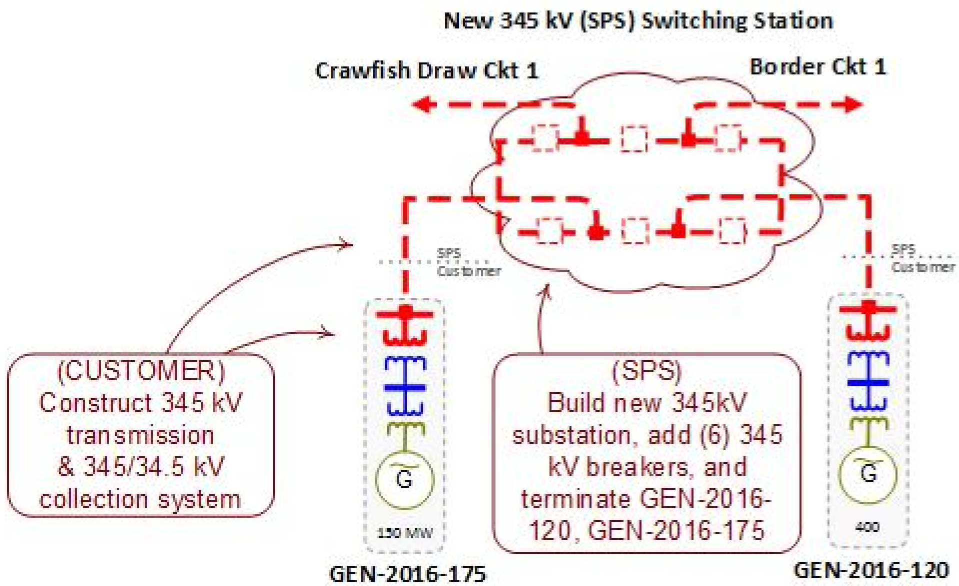
Interconnection Request: GEN-2016-173
Cluster Interconnection Costs: $15,838,400



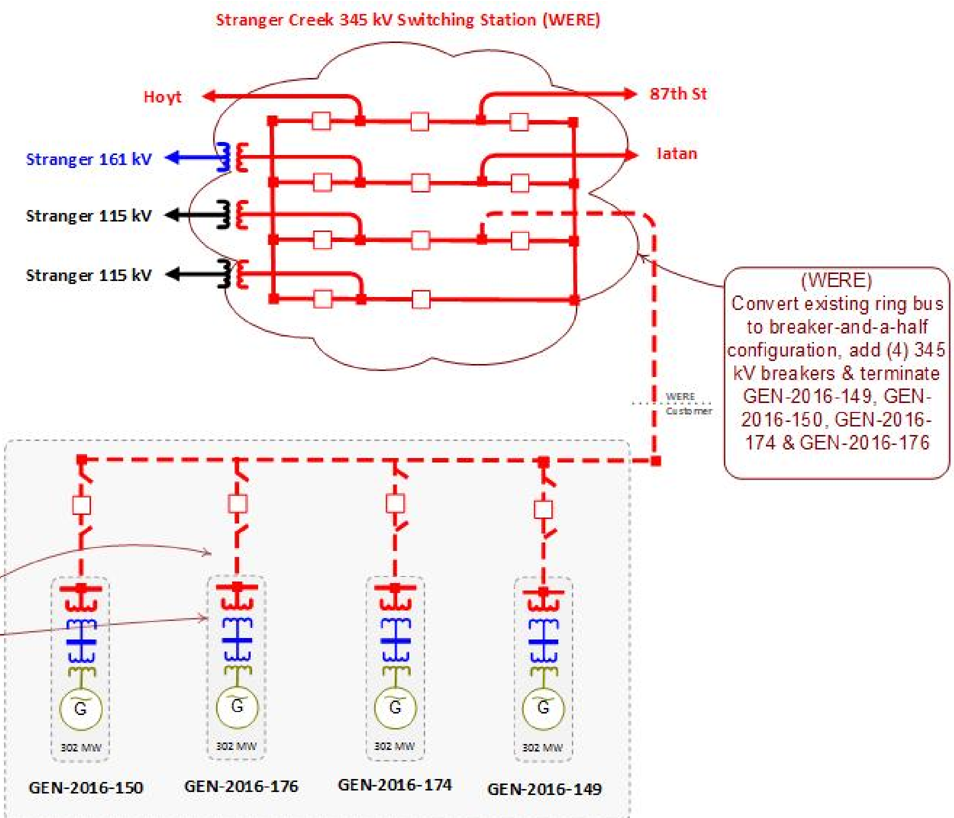
Interconnection Request: GEN-2016-174
Cluster Interconnection Costs: $7,298,094
(Total of $29,192,376 shared among GEN-2016-149, GEN-2016-150, and GEN-2016-176)

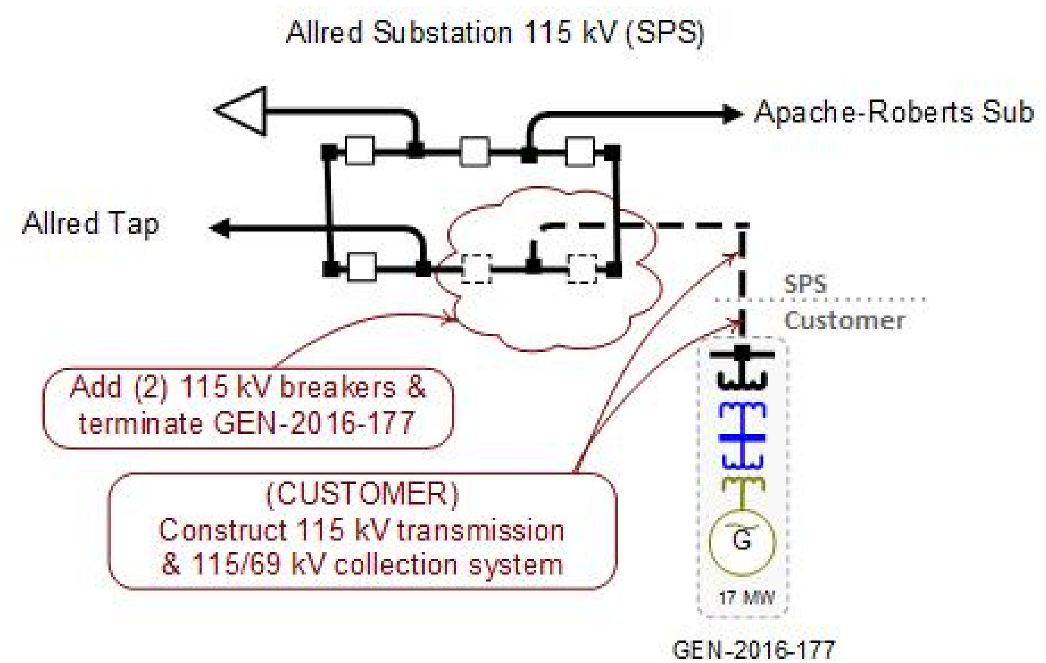


Interconnection Request: GEN-2016-175
Cluster Interconnection Costs: $16,546,802



Interconnection Request: GEN-2016-176
Cluster Interconnection Costs: $7,298,094
(Total of $29,192,376 shared among GEN-2016-149, GEN-2016-150, and GEN-2016-174)



Interconnection Request: GEN-2016-177 **Cluster Interconnection Costs: $1,458,215**


11.5 E: COST ALLOCATION PER REQUEST

Appendix E. Cost Allocation Per Request

(Including Previously Allocated Network Upgrades*)

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
ASGI-2016-009			
ASGI-2016-009 Interconnection Costs See One-Line Diagram.	Current Study	TBD	TBD
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$1,826,189	$1,300,000,000
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$1,826,189	$1,300,000,000
Crawfish Draw 345/230kv Transformer CKT 2 Add Crawfish 345/230/13.2 Transformer circuit #2	Current Study	$205,675	$9,413,717
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$181,533	$129,226,800
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$107,451	$380,000,000
Crossroads - Tolk 345kV CKT 1 Replace Crossroads - Tolk 345kV terminal equipment and resolve clearance issues	Current Study	$636	$1,500,000
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$63,115	$45,530,000
Andrews 345/115/13kV Transformer CKT 1 Replace 230/115kV transformer CKT 1 with 345/115kV transformer	Previously Allocated		$8,000,000
Andrews 345/115/13kV Transformer CKT 2 Replace 230/115kV transformer CKT 2 with 345/115kV transformer	Previously Allocated		$8,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crawfish Draw - Tuco 345kV CKT 2 Build second circuit from Crawfish Draw - Tuco 345 kV	Previously Allocated		$3,600,000
Crawfish Draw 345/230kV Substation Upgrade Tap Border-TUCO approximately 3 miles from TUCO, build Crawfish Draw 345kV substation, add 345/230/13.2kV transformer, and tie on TUCO-Swisher 230kV.	Previously Allocated		$24,764,205
Drinkard Tap - West Hobbs 115kV CKT 1 Rebuild approximately 12.5 miles from Drinkard Tap to West Hobbs	Previously Allocated		$9,375,000
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
Livingston Ridge - Sage Brush - Lagarto - Cardinal 115kV CKT 1 Per HPILs SPP-NTC-200283 (Total Project E&C Cost Shown)	Previously Allocated		$37,316,546
National Enrich Plant Tap - Targa 115kV CKT 1 The rating increases in 2019 NTC#200324 PID:30914 UID:51250 (4.26 mile line)	Previously Allocated		$2,909,669
National Enrichment Plant-Targa 115kV CKT 1 - Rebuild approximately 4 miles of 115kV from National Enrichment Plant to Targa per 2015 ITPNT.	Previously Allocated		$2,909,669
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
South Jal - Teague 115kV CKT 1 Rebuild approximately 10 miles from Jal to Teague assigned in SPP-2014-AG1-AFS-6 per SPP-NTC-200365	Previously Allocated		$6,640,592
Targa-Cardinal 115kV CKT 1 Rebuild approximately 3 miles of 115kV from Targa to Cardinal per 2015 ITPNT.	Previously Allocated		$2,049,062
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000
TUCO 345/230/13.2kV Transformer CKT 1 Replace existing TUCO 345/230/13.2kV Transformer circuit #1 with 640MVA.	Previously Allocated		$3,347,036
	Current Study Total	$4,210,788	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
ASGI-2016-010			
ASGI-2016-010 Interconnection Costs See One-Line Diagram.	Current Study	TBD	TBD
West Tie 115/69/13.8 kV Transformer CKT 1 Mitigation requires TCEC review and feedback	Current Study	TBD	TBD
West Tie 115/69/13.8 kV Transformer CKT 2 Mitigation requires TCEC review and feedback	Current Study	TBD	TBD
Beaver County - Clark County 345kV CKT 1 Build approximately 125 miles of new 345kV from Beaver - Clark	Previously Allocated		$150,000,000
Bushland - Potter County 230kV CKT 1 Replace line traps at both terminals	Previously Allocated		$250,000
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Cleo Corner - Cleo Plant Tap 138kV CKT 1 Replace terminal equipment to at least 1200 amps	Previously Allocated		$61,890
Highland Park Tap - Pantex South 115kV CKT 1 Upgrade terminal equipment assigned in 2017 ITP10 per SPP-NTC-200444	Previously Allocated		$324,392
Martin - Pantex North 115kV CKT 1 Upgrade terminal equipment assigned in 2017 ITP10 per SPP-NTC-200444	Previously Allocated		$324,392
Martin - Pantex North 115kV CKT 1 Previously assigned per SPP NTC-200444 to replace terminal equipment.	Previously Allocated		$400,000
Martin - Pantex North 115kV CKT 1 Upgrade terminal equipment assigned in 2017 ITP10 per SPP-NTC-200444	Previously Allocated		$324,392
Martin - Pantex North 115kV CKT 1 Previously assigned per SPP NTC-200444 to replace terminal equipment.	Previously Allocated		$400,000
	Current Study Total	TBD	
GEN-2015-039			
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$24,053,855	$1,300,000,000
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$24,053,855	$1,300,000,000
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$2,391,079	$129,226,800

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$4,459,858	$380,000,000
Elk City 230/138/13.8KV Transformer CKT 1 Replace terminal equipment at Elk City 230/138/13.8KV Transformer	Current Study	$188,381	$3,900,000
GEN-2015-039 Interconnection Costs See One-Line Diagram.	Current Study	$8,609,632	$8,609,632
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$906,079	$45,530,000
Tolk 345/230/13kV Transformer CKT 3 Build third 345/230/13kV transformer at Tolk	Current Study	$1,333,972	$15,000,000
Andrews 345/115/13kV Transformer CKT 1 Replace 230/115kV transformer CKT 1 with 345/115kV transformer	Previously Allocated		$8,000,000
Andrews 345/115/13kV Transformer CKT 2 Replace 230/115kV transformer CKT 2 with 345/115kV transformer	Previously Allocated		$8,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Crawfish Draw - Tuco 345kV CKT 2 Build second circuit from Crawfish Draw - Tuco 345 kV	Previously Allocated		$3,600,000
Crawfish Draw 345/230kV Substation Upgrade Tap Border-TUCO approximately 3 miles from TUCO, build Crawfish Draw 345kV substation, add 345/230/13.2kV transformer, and tie on TUCO-Swisher 230kV.	Previously Allocated		$24,764,205
Drinkard - Drinkard Tap 115kV CKT 1 Rebuild approximately 2 miles from Drinkard to Drinkard Tap	Previously Allocated		$1,500,000
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
National Enrich Plant Tap - Targa 115kV CKT 1 The rating increases in 2019 NTC#200324 PID:30914 UID:51250 (4.26 mile line)	Previously Allocated		$2,909,669

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
National Enrichment Plant-Targa 115kV CKT 1 - Rebuild approximately 4 miles of 115kV from National Enrichment Plant to Targa per 2015 ITPNT.	Previously Allocated		$2,909,669
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
South Jal - Teague 115kV CKT 1 Rebuild approximately 10 miles from Jal to Teague assigned in SPP-2014-AG1-AFS-6 per SPP-NTC-200365	Previously Allocated		$6,640,592
Targa-Cardinal 115kV CKT 1 Rebuild approximately 3 miles of 115kV from Targa to Cardinal per 2015 ITPNT.	Previously Allocated		$2,049,062
Terry county - Wolfforth 115kv CKT 1 The rating increases in2018 NTC#200395 PID:31051 UID:51549	Previously Allocated		$1,700,000
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Tolk	Previously Allocated		$15,000,000
TUCO 345/230/13.2kV Transformer CKT 1 Replace existing TUCO 345/230/13.2kV Transformer circuit #1 with 640MVA.	Previously Allocated		$3,347,036
	Current Study Total	$65,996,713	

GEN-2015-040

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cochran - Lost Draw 115kV CKT 1 Reconductor Cochran - Lost Draw 115kV CKT 1	Current Study	$519,532	$4,691,172
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$30,384,030	$1,300,000,000
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$30,384,030	$1,300,000,000
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$3,020,332	$129,226,800
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$5,082,351	$380,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crossroads - Tolk 345kV CKT 1 Replace Crossroads - Tolk 345kV terminal equipment and resolve clearance issues	Current Study	$11,286	$1,500,000
GEN-2015-040 Interconnection Costs See One-Line Diagram.	Current Study	$1,237,460	$1,237,460
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$1,051,817	$45,530,000
Tolk 345/230/13kV Transformer CKT 3 Build third 345/230/13kV transformer at Tolk	Current Study	$902,772	$15,000,000
Amoco - Sundown 230kV CKT1 NTC #200395 PID 30844 Terminal Equiptment upgrade Effective 12/14/2018 summer rating of 497/547 and winter rating 553/608	Previously Allocated		$2,200,956
Andrews 345/115/13kV Transformer CKT 1 Replace 230/115kV transformer CKT 1 with 345/115kV transformer	Previously Allocated		$8,000,000
Andrews 345/115/13kV Transformer CKT 2 Replace 230/115kV transformer CKT 2 with 345/115kV transformer	Previously Allocated		$8,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Crawfish Draw - Tuco 345kV CKT 2 Build second circuit from Crawfish Draw - Tuco 345 kV	Previously Allocated		$3,600,000
Crawfish Draw 345/230kV Substation Upgrade Tap Border-TUCO approximately 3 miles from TUCO, build Crawfish Draw 345kV substation, add 345/230/13.2kV transformer, and tie on TUCO-Swisher 230kV.	Previously Allocated		$24,764,205
Drinkard Tap - West Hobbs 115kV CKT 1 Rebuild approximately 12.5 miles from Drinkard Tap to West Hobbs	Previously Allocated		$9,375,000
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Livingston Ridge - Sage Brush - Lagarto - Cardinal 115kV CKT 1 Per HPILs SPP-NTC-200283 (Total Project E&C Cost Shown)	Previously Allocated		$37,316,546
National Enrich Plant Tap - Targa 115kV CKT 1 The rating increases in 2019 NTC#200324 PID:30914 UID:51250 (4.26 mile line)	Previously Allocated		$2,909,669
National Enrichment Plant-Targa 115kV CKT 1 - Rebuild approximately 4 miles of 115kV from National Enrichment Plant to Targa per 2015 ITPNT.	Previously Allocated		$2,909,669
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
South Jal - Teague 115kV CKT 1 Rebuild approximately 10 miles from Jal to Teague assigned in SPP-2014-AG1-AFS-6 per SPP-NTC-200365	Previously Allocated		$6,640,592
Targa-Cardinal 115kV CKT 1 Rebuild approximately 3 miles of 115kV from Targa to Cardinal per 2015 ITPNT.	Previously Allocated		$2,049,062
Terry county - Wolfforth 115kv CKT 1 The rating increases in2018 NTC#200395 PID:31051 UID:51549	Previously Allocated		$1,700,000
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000
Tolk 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Tolk	Previously Allocated		$15,000,000
TUCO 345/230/13.2kV Transformer CKT 1 Replace existing TUCO 345/230/13.2kV Transformer circuit #1 with 640MVA.	Previously Allocated		$3,347,036
	Current Study Total	$72,593,611	

GEN-2015-078

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cochran - Lost Draw 115kV CKT 1 Reconductor Cochran - Lost Draw 115kV CKT 1	Current Study	$387,944	$4,691,172
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$30,392,125	$1,300,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$30,392,125	$1,300,000,000
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$3,021,136	$129,226,800
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$5,250,819	$380,000,000
Crossroads - Tolk 345kV CKT 1 Replace Crossroads - Tolk 345kV terminal equipment and resolve clearance issues	Current Study	$9,806	$1,500,000
GEN-2015-078 Interconnection Costs See One-Line Diagram.	Current Study	$3,562,000	$3,562,000
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$1,051,817	$45,530,000
Tolk 345/230/13kV Transformer CKT 3 Build third 345/230/13kV transformer at Tolk	Current Study	$883,604	$15,000,000
Amoco - Sundown 230kV CKT1 NTC #200395 PID 30844 Terminal Equiptment upgrade Effective 12/14/2018 summer rating of 497/547 and winter rating 553/608	Previously Allocated		$2,200,956
Andrews Substation Voltage Conversion Convert Andrews 230kV to 345kV	Previously Allocated		$10,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Crawfish Draw - Tuco 345kV CKT 2 Build second circuit from Crawfish Draw - Tuco 345 kV	Previously Allocated		$3,600,000
Crawfish Draw 345/230kV Substation Upgrade Tap Border-TUCO approximately 3 miles from TUCO, build Crawfish Draw 345kV substation, add 345/230/13.2kV transformer, and tie on TUCO-Swisher 230kV.	Previously Allocated		$24,764,205
Drinkard Tap - West Hobbs 115kV CKT 1 Rebuild approximately 12.5 miles from Drinkard Tap to West Hobbs	Previously Allocated		$9,375,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
Livingston Ridge - Sage Brush - Lagarto - Cardinal 115kV CKT 1 Per HPILs SPP-NTC-200283 (Total Project E&C Cost Shown)	Previously Allocated		$37,316,546
National Enrich Plant Tap - Targa 115kV CKT 1 The rating increases in 2019 NTC#200324 PID:30914 UID:51250 (4.26 mile line)	Previously Allocated		$2,909,669
National Enrichment Plant-Targa 115kV CKT 1 - Rebuild approximately 4 miles of 115kV from National Enrichment Plant to Targa per 2015 ITPNT.	Previously Allocated		$2,909,669
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
South Jal - Teague 115kV CKT 1 Rebuild approximately 10 miles from Jal to Teague assigned in SPP-2014-AG1-AFS-6 per SPP-NTC-200365	Previously Allocated		$6,640,592
Targa-Cardinal 115kV CKT 1 Rebuild approximately 3 miles of 115kV from Targa to Cardinal per 2015 ITPNT.	Previously Allocated		$2,049,062
Terry county - Wolfforth 115kv CKT 1 The rating increases in2018 NTC#200395 PID:31051 UID:51549	Previously Allocated		$1,700,000
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000
Tolk 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Tolk	Previously Allocated		$15,000,000
TUCO 345/230/13.2kV Transformer CKT 1 Replace existing TUCO 345/230/13.2kV Transformer circuit #1 with 640MVA.	Previously Allocated		$3,347,036
	Current Study Total	$74,951,377	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2015-099			
Cochran - Lost Draw 115kV CKT 1 Reconductor Cochran - Lost Draw 115kV CKT 1	Current Study	$540,633	$4,691,172
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$44,884,390	$1,300,000,000
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$44,884,390	$1,300,000,000
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$4,461,743	$129,226,800
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$10,371,639	$380,000,000
Crossroads - Tolk 345kV CKT 1 Replace Crossroads - Tolk 345kV terminal equipment and resolve clearance issues	Current Study	$9,546	$1,500,000
GEN-2015-099 Interconnection Costs See One-Line Diagram.	Current Study	$4,688,000	$4,688,000
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$1,546,425	$45,530,000
Tolk 345/230/13kV Transformer CKT 3 Build third 345/230/13kV transformer at Tolk	Current Study	$1,009,106	$15,000,000
Amoco - Sundown 230kV CKT1 NTC #200395 PID 30844 Terminal Equiptment upgrade Effective 12/14/2018 summer rating of 497/547 and winter rating 553/608	Previously Allocated		$2,200,956
Andrews Substation Voltage Conversion Convert Andrews 230kV to 345kV	Previously Allocated		$10,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Crawfish Draw - Tuco 345kV CKT 2 Build second circuit from Crawfish Draw - Tuco 345 kV	Previously Allocated		$3,600,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crawfish Draw 345/230kV Substation Upgrade Tap Border-TUCO approximately 3 miles from TUCO, build Crawfish Draw 345kV substation, add 345/230/13.2kV transformer, and tie on TUCO-Swisher 230kV.	Previously Allocated		$24,764,205
Drinkard Tap - West Hobbs 115kV CKT 1 Rebuild approximately 12.5 miles from Drinkard Tap to West Hobbs	Previously Allocated		$9,375,000
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
Livingston Ridge - Sage Brush - Lagarto - Cardinal 115kV CKT 1 Per HPILs SPP-NTC-200283 (Total Project E&C Cost Shown)	Previously Allocated		$37,316,546
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
Terry county - Wolfforth 115kv CKT 1 The rating increases in2018 NTC#200395 PID:31051 UID:51549	Previously Allocated		$1,700,000
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk - Plant X 230kV CKT 1 & 2 Rebuild circuit 1 and 2 betweek Tolk - Plant X 230kV to 1200 amps each.	Previously Allocated		$9,921,693
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000
Tolk 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Tolk	Previously Allocated		$15,000,000
TUCO 345/230/13.2kV Transformer CKT 1 Replace existing TUCO 345/230/13.2kV Transformer circuit #1 with 640MVA.	Previously Allocated		$3,347,036
	Current Study Total	$112,395,872	

GEN-2016-024

Benton - Wichita 345kV CKT 1 Replace terminal equipment	Current Study	$63,248	$1,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-024 Interconnection Costs See One-Line Diagram.	Current Study	$1,929,855	$1,929,855
Lacygne - Waverly 345kV CKT 1 Replace terminal equipment to achieve conductor element	Current Study	$74,730	$2,000,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$461,139	$15,000,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$80,659	$11,500,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$724,307	$52,500,000
Reno County 345/115/13kV Transformer CKT 3 Add 3rd xfmr at Reno Sub	Current Study	$160,850	$20,000,000
Wolf Creek - Neosho 345kV CKT 1 NRIS Only Required Upgrade: Build approximately 95 miles of Wolf Creek – Neosho 345kV CKT 1	Current Study	$12,141,076	$117,126,900
Wolf Creek - Waverly 345kV CKT 1 Replace terminal equipment	Current Study	$37,365	$1,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$481,738	$30,000,000
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Kildare - White Eagle 138kV CKT 1 Rebuild approximately 11 miles of 138kV from Kildare to White Eagle	Previously Allocated		$7,000,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - White Eagle 138kV CKT 1 Rebuild approximately 3 miles of 138kV from Osage to White Eagle	Previously Allocated		$2,000,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$16,154,967	

GEN-2016-034

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Atwood Switch 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Atwood Switch 115kV	Current Study	$79,282	$796,899
GEN-2016-023-Tap - Stegall 345kV CKT 2 Build GEN-2016-023-Tap - Stegall 345kV CKT 2	Current Study	$7,639,891	$43,248,906
GEN-2016-034 Interconnection Costs See One-Line Diagram.	Current Study	$2,531,976	$2,531,976
GGS - Red Willow 345kV CKT 1 Rebuild GGS - Red Willow 345kV CKT 1	Current Study	$4,188,673	$67,339,931
Grand Prairie - Antelope 345kV CKT 1 Build Grand Prairie - Antelope 345kV CKT 1	Current Study	$1,614,761	$72,081,510
Heizer 69kV Reactive Power Support Install up to 10MVAR capactior bank at Heizer 69kV	Current Study	$26,225	$398,449
Keystone - Red Willow 345kV CKT 1 Build Keystone - Red Willow 345kV CKT 1	Current Study	$20,200,894	$175,000,000
Keystone 345kV Reactive Support Install +100Mvar SVC at Keystone 345kV	Current Study	$17,596,421	$215,378,000
LRS - Stegall 345kV CKT 1 Reroute Reroute LRS - Stegall 345kV CKT 1 through the GEN-2016-023-Tap Substation	Current Study	$2,279,441	$12,515,657
Mingo 115kV Reactive Power Support Install up to 50MVAR capacitor bank at Mingo 115kV	Current Study	$168,708	$1,992,248
NPPD Flowgate Mitigation Potential Mitigation for NPPD Flowgates Limit. TBD in the Facilities Study with NPPD.	Current Study	TBD	TBD
PH Run 115kV Reactive Power Support Install up to 30MVAR capacitor bank at PH Run 115kV	Current Study	$103,188	$1,195,348
Red Willow - Caprock 345kV CKT 1 Build Red Willow - Caprock 345kV CKT 1	Current Study	$25,147,243	$275,000,000
Red Willow - Mingo 345kV CKT 1 Rebuild Red Willow - Mingo 345kV CKT 1	Current Study	$5,172,236	$67,188,964

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Albion - Petersburg - North Petersburg 115kV CKT 1 Reconductor 115kV lines and replace all terminal equipment for at least a 193MVA rate.	Previously Allocated		$2,500,000
Atwood Capacitive Reactive Power Support Install 10 Mvars of Capicator Bank(s)	Previously Allocated		$2,000,000
Banner County - Keystone 345kV CKT 1 Build approximately 140 of new 345kV from Banner County to Keystone. Banner County and Keystone Substation Work.	Previously Allocated		$259,100,000
Beatrice - Harbine 115kV CKT 1 Uprate Beatrice - Harbine to at least 102MVA per NPPD facility study	Previously Allocated		$900,000
Belvidere - Fairbury 115kV CKT 1 Uprate Belvidere - Fairbury to at least 107MVA per NPPD facility study	Previously Allocated		$1,700,000
Gavins Point - Yankton Junction 115kV CKT 1 Rebuild approximately 5 miles of 115kV from Gavins to Yankton	Previously Allocated		$1,048,341
Gentleman - Thedford 345kV CKT 1 Build approximately 76 Miles of 345kV from Gentleman to Thedford per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Hoskins - Dixon County - Twin Church 230kV Rerate per NPPD Facility Study	Previously Allocated		$500,000
Keystone - Gentleman 345kV CKT 2 Build approximately 30 miles of new 345kV. Gentleman and Keystone Substation Work.	Previously Allocated		$69,900,000
Thedford - Holt County 345kV CKT 1 Build approximately 146 Miles of 345kV from Thedford to Holt County per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Thedford 345/115kV Transformer CKT 1 Install Thedford 345/115kV transformer per SPP-NTC-200277 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Twin Church - Dixon County 230kV Increase conductor clearances to accommodate 320MVA facility rating	Previously Allocated		$100,000
	Current Study Total	$86,748,939	
GEN-2016-036			
Flandreau 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Flandreau 115kV	Current Study	$57,232	$796,899
Ft. Thompson - Grand Prairie 345kV CKT 1 Rebuild Ft. Thompson – Grand Praire 345kV	Current Study	$3,220,929	$164,908,759
Gen-2016-017 - Ft. Thompson 345kV CKT 1 Rebuild Gen-2016-017 - Ft. Thompson 345kV CKT 1	Current Study	$107,986	$39,897,280

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Gen-2016-017 - Ft. Thompson 345kV CKT 2 Build Gen-2016-017 - Ft. Thompson 345kV CKT 2	Current Study	$117,058	$43,248,906
GEN-2016-036 Interconnection Costs See One-Line Diagram.	Current Study	$1,340,000	$1,340,000
Grand Prairie - Antelope 345kV CKT 1 Build Grand Prairie - Antelope 345kV CKT 1	Current Study	$54,900	$72,081,510
NPPD Flowgate Mitigation Potential Mitigation for NPPD Flowgates Limit. TBD in the Facilities Study with NPPD.	Current Study	TBD	TBD
	Current Study Total	$4,898,105	

GEN-2016-039

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$58,426,850	$1,300,000,000
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$58,426,850	$1,300,000,000
Crawfish Draw 345/230kv Transformer CKT 2 Add Crawfish 345/230/13.2 Transformer circuit #2	Current Study	$7,120,341	$9,413,717
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$5,807,934	$129,226,800
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$5,715,642	$380,000,000
Elk City 230/138/13.8KV Transformer CKT 1 Replace terminal equipment at Elk City 230/138/13.8KV Transformer	Current Study	$390,728	$3,900,000
GEN-2016-039 Interconnection Costs See One-Line Diagram.	Current Study	$210,000	$210,000
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$2,130,876	$45,530,000
Andrews 345/115/13kV Transformer CKT 1 Replace 230/115kV transformer CKT 1 with 345/115kV transformer	Previously Allocated		$8,000,000
Andrews 345/115/13kV Transformer CKT 2 Replace 230/115kV transformer CKT 2 with 345/115kV transformer	Previously Allocated		$8,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Crawfish Draw - Tuco 345kV CKT 2 Build second circuit from Crawfish Draw - Tuco 345 kV	Previously Allocated		$3,600,000
Crawfish Draw 345/230kV Substation Upgrade Tap Border-TUCO approximately 3 miles from TUCO, build Crawfish Draw 345kV substation, add 345/230/13.2kV transformer, and tie on TUCO-Swisher 230kV.	Previously Allocated		$24,764,205
Drinkard - Drinkard Tap 115kV CKT 1 Rebuild approximately 2 miles from Drinkard to Drinkard Tap	Previously Allocated		$1,500,000
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
National Enrich Plant Tap - Targa 115kV CKT 1 The rating increases in 2019 NTC#200324 PID:30914 UID:51250 (4.26 mile line)	Previously Allocated		$2,909,669
National Enrichment Plant-Targa 115kV CKT 1 - Rebuild approximately 4 miles of 115kV from National Enrichment Plant to Targa per 2015 ITPNT.	Previously Allocated		$2,909,669
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
South Jal - Teague 115kV CKT 1 Rebuild approximately 10 miles from Jal to Teague assigned in SPP-2014-AG1-AFS-6 per SPP-NTC-200365	Previously Allocated		$6,640,592
Targa-Cardinal 115kV CKT 1 Rebuild approximately 3 miles of 115kV from Targa to Cardinal per 2015 ITPNT.	Previously Allocated		$2,049,062
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
TUCO 345/230/13.2kV Transformer CKT 1 Replace existing TUCO 345/230/13.2kV Transformer circuit #1 with 640MVA.	Previously Allocated		$3,347,036
	Current Study Total	$138,229,220	

GEN-2016-072

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-072 Interconnection Costs See One-Line Diagram.	Current Study	$1,940,000	$1,940,000
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$188	$411,000
Hunter - Woodring 345kV CKT 2 Build approximately 20 miles of new 345kV from Hunter to Woodring	Current Study	$23,775,898	$30,000,000
Lacygne - Waverly 345kV CKT 1 Replace terminal equipment to achieve conductor element	Current Study	$213,811	$2,000,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$1,319,378	$15,000,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$639,471	$11,500,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$11,109,219	$52,500,000
Remington - Fairfax 138kV CKT 1 Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C	Current Study	$139,556	$6,700,000
Renfrow - Renfrow 138kV CKT 1 Rebuild/Re-conductor approximately 2 miles of 138kV	Current Study	$1,700,000	$1,700,000
Renfrow - Wakita 138kV CKT 1 Rebuild/Re-conductor approximately 17 miles of 138kV	Current Study	$14,500,000	$14,500,000
Viola - Buffalo Flats 345kV CKT 1 Build approximately 35 miles of new 345kV from Viola to Buffalo Flats	Current Study	$18,183,100	$52,500,000
Wolf Creek - Waverly 345kV CKT 1 Replace terminal equipment	Current Study	$106,906	$1,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$7,255,645	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Kildare - White Eagle 138kV CKT 1 Rebuild approximately 11 miles of 138kV from Kildare to White Eagle	Previously Allocated		$7,000,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - White Eagle 138kV CKT 1 Rebuild approximately 3 miles of 138kV from Osage to White Eagle	Previously Allocated		$2,000,000
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$80,883,173	

GEN-2016-074

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Atwood Switch 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Atwood Switch 115kV	Current Study	$84,967	$796,899
GEN-2016-023-Tap - Stegall 345kV CKT 2 Build GEN-2016-023-Tap - Stegall 345kV CKT 2	Current Study	$899,987	$43,248,906
GEN-2016-074 Interconnection Costs See One-Line Diagram.	Current Study	$7,500,000	$7,500,000
GGS - Red Willow 345kV CKT 1 Rebuild GGS - Red Willow 345kV CKT 1	Current Study	$7,906,737	$67,339,931
Grand Island - Seward County 345kV CKT 1 NRIS only required upgrade: Build Grand Island - Seward County 345kV CKT 1	Current Study	$15,418,195	$100,000,000
Grand Prairie - Antelope 345kV CKT 1 Build Grand Prairie - Antelope 345kV CKT 1	Current Study	$3,086,665	$72,081,510

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Grand Prairie - Hoskins 345kV CKT 1 NRIS only required upgrade: Build Grand Prairie - Hoskins 345kV CKT 1	Current Study	$3,439,198	$147,692,308
Heizer 69kV Reactive Power Support Install up to 10MVAR capactior bank at Heizer 69kV	Current Study	$55,630	$398,449
Hoskins - Ft. Calhoun 345kV CKT 1 NRIS only required upgrade: Build Hoskins - Ft. Calhoun 345kV CKT 1	Current Study	$5,865,784	$172,307,692
Keystone - Red Willow 345kV CKT 1 Build Keystone - Red Willow 345kV CKT 1	Current Study	$16,221,864	$175,000,000
Keystone 345kV Reactive Support Install +100Mvar SVC at Keystone 345kV	Current Study	$43,716,579	$215,378,000
LRS - Stegall 345kV CKT 1 Reroute Reroute LRS - Stegall 345kV CKT 1 through the GEN-2016-023-Tap Substation	Current Study	$491,302	$12,515,657
Mingo 115kV Reactive Power Support Install up to 50MVAR capacitor bank at Mingo 115kV	Current Study	$220,129	$1,992,248
NPPD Flowgate Mitigation Potential Mitigation for NPPD Flowgates Limit. TBD in the Facilities Study with NPPD.	Current Study	TBD	TBD
PH Run 115kV Reactive Power Support Install up to 30MVAR capacitor bank at PH Run 115kV	Current Study	$131,963	$1,195,348
Post Rock 345/230/13kV Transformer CKT 2 NRIS only required upgrade: Build Post Rock 345/230/13kV Transformer CKT 2	Current Study	$2,126,229	$9,413,718
Red Willow - Caprock 345kV CKT 1 Build Red Willow - Caprock 345kV CKT 1	Current Study	$26,089,957	$275,000,000
Red Willow - Mingo 345kV CKT 1 Rebuild Red Willow - Mingo 345kV CKT 1	Current Study	$7,836,003	$67,188,964
Sheldon - Monolith 115 kV Ckt 1 NRIS only required upgrade: Uprate Sheldon - Monolith 115 kV Ckt 1 (NTC #200477; UID #71967)	Current Study	$282,837	$1,273,506
Albion - Petersburg - North Petersburg 115kV CKT 1 Reconductor 115kV lines and replace all terminal equipment for at least a 193MVA rate.	Previously Allocated		$2,500,000
Atwood Capacitive Reactive Power Support Install 10 Mvars of Capicator Bank(s)	Previously Allocated		$2,000,000
Banner County - Keystone 345kV CKT 1 Build approximately 140 of new 345kV from Banner County to Keystone. Banner County and Keystone Substation Work.	Previously Allocated		$259,100,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Beatrice - Harbine 115kV CKT 1 Uprate Beatrice - Harbine to at least 102MVA per NPPD facility study	Previously Allocated		$900,000
Belvidere - Fairbury 115kV CKT 1 Uprate Belvidere - Fairbury to at least 107MVA per NPPD facility study	Previously Allocated		$1,700,000
Gavins Point - Yankton Junction 115kV CKT 1 Rebuild approximately 5 miles of 115kV from Gavins to Yankton	Previously Allocated		$1,048,341
Gentleman - Thedford 345kV CKT 1 Build approximately 76 Miles of 345kV from Gentleman to Thedford per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Hoskins - Dixon County - Twin Church 230kV Rerate per NPPD Facility Study	Previously Allocated		$500,000
Keystone - Gentleman 345kV CKT 2 Build approximately 30 miles of new 345kV. Gentleman and Keystone Substation Work.	Previously Allocated		$69,900,000
Thedford - Holt County 345kV CKT 1 Build approximately 146 Miles of 345kV from Thedford to Holt County per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Thedford 345/115kV Transformer CKT 1 Install Thedford 345/115kV transformer per SPP-NTC-200277 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Twin Church - Dixon County 230kV Increase conductor clearances to accommodate 320MVA facility rating	Previously Allocated		$100,000
	Current Study Total	$141,374,027	

GEN-2016-077

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$32,560,213	$1,300,000,000
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$32,560,213	$1,300,000,000
Crawfish Draw 345/230kv Transformer CKT 2 Add Crawfish 345/230/13.2 Transformer circuit #2	Current Study	$2,087,702	$9,413,717
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$3,236,655	$129,226,800
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$4,477,020	$380,000,000
Crossroads - Tolk 345kV CKT 1 Replace Crossroads - Tolk 345kV terminal equipment and resolve clearance issues	Current Study	$18,362	$1,500,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-077 Interconnection Costs See One-Line Diagram.	Current Study	$1,700,000	$1,700,000
GEN-2016-077 Interconnection Facilities Upgrade Mitigate frequency tripping (Refer to Stability Report for details)	Current Study	TBD	TBD
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$1,129,729	$45,530,000
Tolk 345/230/13kV Transformer CKT 3 Build third 345/230/13kV transformer at Tolk	Current Study	$1,009,432	$15,000,000
Amoco - Sundown 230kV CKT1 NTC #200395 PID 30844 Terminal Equiptment upgrade Effective 12/14/2018 summer rating of 497/547 and winter rating 553/608	Previously Allocated		$2,200,956
Andrews Substation Voltage Conversion Convert Andrews 230kV to 345kV	Previously Allocated		$10,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Crawfish Draw - Tuco 345kV CKT 2 Build second circuit from Crawfish Draw - Tuco 345 kV	Previously Allocated		$3,600,000
Crawfish Draw 345/230kV Substation Upgrade Tap Border-TUCO approximately 3 miles from TUCO, build Crawfish Draw 345kV substation, add 345/230/13.2kV transformer, and tie on TUCO-Swisher 230kV.	Previously Allocated		$24,764,205
Drinkard Tap - West Hobbs 115kV CKT 1 Rebuild approximately 12.5 miles from Drinkard Tap to West Hobbs	Previously Allocated		$9,375,000
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
Livingston Ridge - Sage Brush - Lagarto - Cardinal 115kV CKT 1 Per HPILs SPP-NTC-200283 (Total Project E&C Cost Shown)	Previously Allocated		$37,316,546

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
National Enrich Plant Tap - Targa 115kV CKT 1 The rating increases in 2019 NTC#200324 PID:30914 UID:51250 (4.26 mile line)	Previously Allocated		$2,909,669
National Enrichment Plant-Targa 115kV CKT 1 - Rebuild approximately 4 miles of 115kV from National Enrichment Plant to Targa per 2015 ITPNT.	Previously Allocated		$2,909,669
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
South Jal - Teague 115kV CKT 1 Rebuild approximately 10 miles from Jal to Teague assigned in SPP-2014-AG1-AFS-6 per SPP-NTC-200365	Previously Allocated		$6,640,592
Targa-Cardinal 115kV CKT 1 Rebuild approximately 3 miles of 115kV from Targa to Cardinal per 2015 ITPNT.	Previously Allocated		$2,049,062
Terry county - Wolfforth 115kv CKT 1 The rating increases in2018 NTC#200395 PID:31051 UID:51549	Previously Allocated		$1,700,000
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000
Tolk 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Tolk	Previously Allocated		$15,000,000
TUCO 345/230/13.2kV Transformer CKT 1 Replace existing TUCO 345/230/13.2kV Transformer circuit #1 with 640MVA.	Previously Allocated		$3,347,036
	Current Study Total	$78,779,326	
GEN-2016-078			
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$58,762,816	$1,300,000,000
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$58,762,816	$1,300,000,000
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$5,841,331	$129,226,800

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$11,698,118	$380,000,000
Elk City 230/138/13.8KV Transformer CKT 1 Replace terminal equipment at Elk City 230/138/13.8KV Transformer	Current Study	$332,855	$3,900,000
GEN-2016-078 Interconnection Costs See One-Line Diagram.	Current Study	$1,282,250	$1,282,250
GEN-2016-078 Interconnection Facilities Upgrade Mitigate frequency tripping (Refer to Stability Report for details)	Current Study	TBD	TBD
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$2,111,894	$45,530,000
Tolk 345/230/13kV Transformer CKT 3 Build third 345/230/13kV transformer at Tolk	Current Study	$4,182,534	$15,000,000
Andrews Substation Voltage Conversion Convert Andrews 230kV to 345kV	Previously Allocated		$10,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Crawfish Draw - Tuco 345kV CKT 2 Build second circuit from Crawfish Draw - Tuco 345 kV	Previously Allocated		$3,600,000
Crawfish Draw 345/230kV Substation Upgrade Tap Border-TUCO approximately 3 miles from TUCO, build Crawfish Draw 345kV substation, add 345/230/13.2kV transformer, and tie on TUCO-Swisher 230kV.	Previously Allocated		$24,764,205
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
South Jal - Teague 115kV CKT 1 Rebuild approximately 10 miles from Jal to Teague assigned in SPP-2014-AG1-AFS-6 per SPP-NTC-200365	Previously Allocated		$6,640,592
Terry county - Wolfforth 115kv CKT 1 The rating increases in2018 NTC#200395 PID:31051 UID:51549	Previously Allocated		$1,700,000
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000
Tolk 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Tolk	Previously Allocated		$15,000,000
TUCO 345/230/13.2kV Transformer CKT 1 Replace existing TUCO 345/230/13.2kV Transformer circuit #1 with 640MVA.	Previously Allocated		$3,347,036
	Current Study Total	$142,974,614	

GEN-2016-087

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Flandreau 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Flandreau 115kV	Current Study	$51,550	$796,899
Ft. Thompson - Grand Prairie 345kV CKT 1 Rebuild Ft. Thompson – Grand Praire 345kV	Current Study	$15,884,112	$164,908,759
Gen-2016-017 - Ft. Thompson 345kV CKT 1 Rebuild Gen-2016-017 - Ft. Thompson 345kV CKT 1	Current Study	$330,460	$39,897,280
Gen-2016-017 - Ft. Thompson 345kV CKT 2 Build Gen-2016-017 - Ft. Thompson 345kV CKT 2	Current Study	$358,221	$43,248,906
GEN-2016-087 Interconnection Costs See One-Line Diagram.	Current Study	$1,565,000	$1,565,000
Grand Prairie - Antelope 345kV CKT 1 Build Grand Prairie - Antelope 345kV CKT 1	Current Study	$1,312,947	$72,081,510
Hanlon 230kV Reactive Power Support Install up to 60MVAR capacitor bank at Hanlon 230kV	Current Study	$129,681	$1,679,949

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
NPPD Flowgate Mitigation Potential Mitigation for NPPD Flowgates Limit. TBD in the Facilities Study with NPPD.	Current Study	TBD	TBD
	Current Study Total	$19,631,972	
GEN-2016-088			
GEN-2016-088 Interconnection Costs See One-Line Diagram.	Current Study	$1,532,553	$1,532,553
	Current Study Total	$1,532,553	
GEN-2016-091			
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
GEN-2016-091 Interconnection Costs See One-Line Diagram.	Current Study	$10,343,736	$10,343,736
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413
	Current Study Total	$10,343,736	
GEN-2016-092			
Flandreau 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Flandreau 115kV	Current Study	$26,262	$796,899
Ft. Thompson - Grand Prairie 345kV CKT 1 Rebuild Ft. Thompson – Grand Praire 345kV	Current Study	$72,473,566	$164,908,759
Ft. Thompson 345/230kV Transformer CKT 1 Replace Ft. Thompson 345/230kV Transformer CKT 1	Current Study	$4,706,859	$9,413,718
Ft. Thompson 345/230kV Transformer CKT 2 Replace Ft. Thompson 345/230kV Transformer CKT 2	Current Study	$4,706,859	$9,413,718
Gen-2016-017 - Ft. Thompson 345kV CKT 1 Rebuild Gen-2016-017 - Ft. Thompson 345kV CKT 1	Current Study	$19,708,698	$39,897,280

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Gen-2016-017 - Ft. Thompson 345kV CKT 2 Build Gen-2016-017 - Ft. Thompson 345kV CKT 2	Current Study	$21,364,354	$43,248,906
GEN-2016-092 Interconnection Costs See One-Line Diagram.	Current Study	$3,404,096	$3,404,096
Grand Prairie - Antelope 345kV CKT 1 Build Grand Prairie - Antelope 345kV CKT 1	Current Study	$7,838,471	$72,081,510
Hanlon 230kV Reactive Power Support Install up to 60MVAR capacitor bank at Hanlon 230kV	Current Study	$452,936	$1,679,949
Holt County - Grand Island 345kV NRIS only required upgrade: Reconductor Holt County - Grand Island 345kV	Current Study	$79,489,863	$159,000,000
NPPD Flowgate Mitigation Potential Mitigation for NPPD Flowgates Limit. TBD in the Facilities Study with NPPD.	Current Study	TBD	TBD
Granite Falls - MN Valley Tap 230 kV Ckt 1 NRIS only required upgrade: Rebuild approximately3 miles of 230 kV	Previously Allocated		$2,500,000
	Current Study Total	$214,171,963	

GEN-2016-094

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Ft. Thompson - GEN-2016-094 230kV CKT 1 & CKT 2 Replace terminal equipment at Ft. Thompson 230kV	Current Study	$750,000	$750,000
GEN-2016-094 Interconnection Costs See One-Line Diagram.	Current Study	$1,960,000	$1,960,000
	Current Study Total	$2,710,000	

GEN-2016-095

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-095 Interconnection Costs See One-Line Diagram.	Current Study	$10,343,736	$10,343,736
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
	Current Study Total	$10,343,736	

GEN-2016-096

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Atwood Switch 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Atwood Switch 115kV	Current Study	$18,849	$796,899
GEN-2016-096 Interconnection Costs See One-Line Diagram.	Current Study	$1,700,000	$1,700,000
GGS - Red Willow 345kV CKT 1 Rebuild GGS - Red Willow 345kV CKT 1	Current Study	$4,274,467	$67,339,931
Grand Prairie - Antelope 345kV CKT 1 Build Grand Prairie - Antelope 345kV CKT 1	Current Study	$218,868	$72,081,510
Heizer 69kV Reactive Power Support Install up to 10MVAR capactior bank at Heizer 69kV	Current Study	$43,429	$398,449
Keystone - Red Willow 345kV CKT 1 Build Keystone - Red Willow 345kV CKT 1	Current Study	$8,669,539	$175,000,000
Keystone 345kV Reactive Support Install +100Mvar SVC at Keystone 345kV	Current Study	$15,033,551	$215,378,000
Mingo 115kV Reactive Power Support Install up to 50MVAR capacitor bank at Mingo 115kV	Current Study	$116,573	$1,992,248
NPPD Flowgate Mitigation Potential Mitigation for NPPD Flowgates Limit. TBD in the Facilities Study with NPPD.	Current Study	TBD	TBD
PH Run 115kV Reactive Power Support Install up to 30MVAR capacitor bank at PH Run 115kV	Current Study	$65,778	$1,195,348
Red Willow - Caprock 345kV CKT 1 Build Red Willow - Caprock 345kV CKT 1	Current Study	$10,928,704	$275,000,000
Red Willow - Mingo 345kV CKT 1 Rebuild Red Willow - Mingo 345kV CKT 1	Current Study	$5,247,818	$67,188,964
Albion - Petersburg - North Petersburg 115kV CKT 1 Reconductor 115kV lines and replace all terminal equipment for at least a 193MVA rate.	Previously Allocated		$2,500,000
Atwood Capacitive Reactive Power Support Install 10 Mvars of Capicator Bank(s)	Previously Allocated		$2,000,000
Banner County - Keystone 345kV CKT 1 Build approximately 140 of new 345kV from Banner County to Keystone. Banner County and Keystone Substation Work.	Previously Allocated		$259,100,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Beatrice - Harbine 115kV CKT 1 Uprate Beatrice - Harbine to at least 102MVA per NPPD facility study	Previously Allocated		$900,000
Belvidere - Fairbury 115kV CKT 1 Uprate Belvidere - Fairbury to at least 107MVA per NPPD facility study	Previously Allocated		$1,700,000
Gavins Point - Yankton Junction 115kV CKT 1 Rebuild approximately 5 miles of 115kV from Gavins to Yankton	Previously Allocated		$1,048,341
Gentleman - Thedford 345kV CKT 1 Build approximately 76 Miles of 345kV from Gentleman to Thedford per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Hoskins - Dixon County - Twin Church 230kV Rerate per NPPD Facility Study	Previously Allocated		$500,000
Keystone - Gentleman 345kV CKT 2 Build approximately 30 miles of new 345kV. Gentleman and Keystone Substation Work.	Previously Allocated		$69,900,000
Thedford - Holt County 345kV CKT 1 Build approximately 146 Miles of 345kV from Thedford to Holt County per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Thedford 345/115kV Transformer CKT 1 Install Thedford 345/115kV transformer per SPP-NTC-200277 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Twin Church - Dixon County 230kV Increase conductor clearances to accommodate 320MVA facility rating	Previously Allocated		$100,000
	Current Study Total	$46,317,576	

GEN-2016-097

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cornville - Norge Road 138kV CKT 1 Rebuild Cornville - Norge Road 138kV CKT 1	Current Study	$9,300,000	$9,300,000
GEN-2016-097 Interconnection Costs See One-Line Diagram.	Current Study	$7,778,750	$7,778,750
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
	Current Study Total	$17,078,750	
GEN-2016-100			
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Cimarron 345/138kV 3rd xfmr NRIS only required upgrade: No room in Cimarron for new XFMR; build new substation for 3rd XFMR at Cimarron 345kV	Current Study	$2,043,359	$27,000,000
GEN-2016-100 Interconnection Costs See One-Line Diagram.	Current Study	$6,465,000	$6,465,000
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$2,198	$411,000
Lacygne - Waverly 345kV CKT 1 Replace terminal equipment to achieve conductor element	Current Study	$56,530	$2,000,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$348,831	$15,000,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$723,539	$11,500,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$1,559,010	$52,500,000
Remington - Fairfax 138kV CKT 1 Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C	Current Study	$11,242	$6,700,000
Viola - Buffalo Flats 345kV CKT 1 Build approximately 35 miles of new 345kV from Viola to Buffalo Flats	Current Study	$1,334,012	$52,500,000
Wolf Creek - Waverly 345kV CKT 1 Replace terminal equipment	Current Study	$28,265	$1,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$47,877	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - White Eagle 138kV CKT 1 Rebuild approximately 3 miles of 138kV from Osage to White Eagle	Previously Allocated		$2,000,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$12,619,862	

GEN-2016-101

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Cimarron 345/138kV 3rd xfmr NRIS only required upgrade: No room in Cimarron for new XFMR; build new substation for 3rd XFMR at Cimarron 345kV	Current Study	$3,984,550	$27,000,000
GEN-2016-101 Interconnection Costs See One-Line Diagram.	Current Study	$20,000	$20,000
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$4,286	$411,000
Lacygne - Waverly 345kV CKT 1 Replace terminal equipment to achieve conductor element	Current Study	$110,233	$2,000,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$680,220	$15,000,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$1,410,900	$11,500,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$3,040,069	$52,500,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Remington - Fairfax 138kV CKT 1 Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C	Current Study	$21,922	$6,700,000
Viola - Buffalo Flats 345kV CKT 1 Build approximately 35 miles of new 345kV from Viola to Buffalo Flats	Current Study	$2,601,323	$52,500,000
Wolf Creek - Waverly 345kV CKT 1 Replace terminal equipment	Current Study	$55,116	$1,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$93,360	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - White Eagle 138kV CKT 1 Rebuild approximately 3 miles of 138kV from Osage to White Eagle	Previously Allocated		$2,000,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$12,021,980	

GEN-2016-102

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
G16-126 Tap - Arbuckle 138kV CKT 2 Build G16-126 Tap - Arbuckle 138kV CKT 2	Current Study	$1,819,163	$4,500,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-102 Interconnection Costs See One-Line Diagram.	Current Study	$3,405,000	$3,405,000
	Current Study Total	$5,224,163	
GEN-2016-103			
Flandreau 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Flandreau 115kV	Current Study	$26,262	$796,899
Ft. Thompson - Grand Prairie 345kV CKT 1 Rebuild Ft. Thompson – Grand Praire 345kV	Current Study	$72,473,566	$164,908,759
Ft. Thompson 345/230kV Transformer CKT 1 Replace Ft. Thompson 345/230kV Transformer CKT 1	Current Study	$4,706,859	$9,413,718
Ft. Thompson 345/230kV Transformer CKT 2 Replace Ft. Thompson 345/230kV Transformer CKT 2	Current Study	$4,706,859	$9,413,718
Gen-2016-017 - Ft. Thompson 345kV CKT 1 Rebuild Gen-2016-017 - Ft. Thompson 345kV CKT 1	Current Study	$19,708,698	$39,897,280
Gen-2016-017 - Ft. Thompson 345kV CKT 2 Build Gen-2016-017 - Ft. Thompson 345kV CKT 2	Current Study	$21,364,354	$43,248,906
GEN-2016-103 Interconnection Costs See One-Line Diagram.	Current Study	$3,404,096	$3,404,096
Grand Prairie - Antelope 345kV CKT 1 Build Grand Prairie - Antelope 345kV CKT 1	Current Study	$7,838,471	$72,081,510
Hanlon 230kV Reactive Power Support Install up to 60MVAR capacitor bank at Hanlon 230kV	Current Study	$452,936	$1,679,949
Holt County - Grand Island 345kV NRIS only required upgrade: Reconductor Holt County - Grand Island 345kV	Current Study	$79,489,863	$159,000,000
NPPD Flowgate Mitigation Potential Mitigation for NPPD Flowgates Limit. TBD in the Facilities Study with NPPD.	Current Study	TBD	TBD
Granite Falls - MN Valley Tap 230 kV Ckt 1 NRIS only required upgrade: Rebuild approximately3 miles of 230 kV	Previously Allocated		$2,500,000
	Current Study Total	$214,171,963	
GEN-2016-106			
Atwood Switch 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Atwood Switch 115kV	Current Study	$349,241	$796,899

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-023-Tap - Stegall 345kV CKT 2 Build GEN-2016-023-Tap - Stegall 345kV CKT 2	Current Study	$3,641,218	$43,248,906
GEN-2016-106 Interconnection Costs See One-Line Diagram.	Current Study	$1,700,000	$1,700,000
GGS - Red Willow 345kV CKT 1 Rebuild GGS - Red Willow 345kV CKT 1	Current Study	$27,978,698	$67,339,931
Grand Island - Seward County 345kV CKT 1 NRIS only required upgrade: Build Grand Island - Seward County 345kV CKT 1	Current Study	$19,361,249	$100,000,000
Grand Prairie - Antelope 345kV CKT 1 Build Grand Prairie - Antelope 345kV CKT 1	Current Study	$7,570,029	$72,081,510
Grand Prairie - Hoskins 345kV CKT 1 NRIS only required upgrade: Build Grand Prairie - Hoskins 345kV CKT 1	Current Study	$13,544,884	$147,692,308
Heizer 69kV Reactive Power Support Install up to 10MVAR capactior bank at Heizer 69kV	Current Study	$119,736	$398,449
Hoskins - Ft. Calhoun 345kV CKT 1 NRIS only required upgrade: Build Hoskins - Ft. Calhoun 345kV CKT 1	Current Study	$14,203,482	$172,307,692
Keystone - Red Willow 345kV CKT 1 Build Keystone - Red Willow 345kV CKT 1	Current Study	$57,961,033	$175,000,000
Keystone 345kV Reactive Support Install +100Mvar SVC at Keystone 345kV	Current Study	$90,493,817	$215,378,000
LRS - Stegall 345kV CKT 1 Reroute Reroute LRS - Stegall 345kV CKT 1 through the GEN-2016-023-Tap Substation	Current Study	$1,506,419	$12,515,657
Mingo 115kV Reactive Power Support Install up to 50MVAR capacitor bank at Mingo 115kV	Current Study	$746,109	$1,992,248
NPPD Flowgate Mitigation Potential Mitigation for NPPD Flowgates Limit. TBD in the Facilities Study with NPPD.	Current Study	TBD	TBD
PH Run 115kV Reactive Power Support Install up to 30MVAR capacitor bank at PH Run 115kV	Current Study	$456,363	$1,195,348
Post Rock 345/230/13kV Transformer CKT 2 NRIS only required upgrade: Build Post Rock 345/230/13kV Transformer CKT 2	Current Study	$3,988,883	$9,413,718
Red Willow - Caprock 345kV CKT 1 Build Red Willow - Caprock 345kV CKT 1	Current Study	$110,115,208	$275,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Red Willow - Mingo 345kV CKT 1 Rebuild Red Willow - Mingo 345kV CKT 1	Current Study	$23,000,343	$67,188,964
Sheldon - Monolith 115 kV Ckt 1 NRIS only required upgrade: Uprate Sheldon - Monolith 115 kV Ckt 1 (NTC #200477; UID #71967)	Current Study	$150,846	$1,273,506
Albion - Petersburg - North Petersburg 115kV CKT 1 Reconductor 115kV lines and replace all terminal equipment for at least a 193MVA rate.	Previously Allocated		$2,500,000
Atwood Capacitive Reactive Power Support Install 10 Mvars of Capicator Bank(s)	Previously Allocated		$2,000,000
Banner County - Keystone 345kV CKT 1 Build approximately 140 of new 345kV from Banner County to Keystone. Banner County and Keystone Substation Work.	Previously Allocated		$259,100,000
Beatrice - Harbine 115kV CKT 1 Uprate Beatrice - Harbine to at least 102MVA per NPPD facility study	Previously Allocated		$900,000
Belvidere - Fairbury 115kV CKT 1 Uprate Belvidere - Fairbury to at least 107MVA per NPPD facility study	Previously Allocated		$1,700,000
Gavins Point - Yankton Junction 115kV CKT 1 Rebuild approximately 5 miles of 115kV from Gavins to Yankton	Previously Allocated		$1,048,341
Gentleman - Thedford 345kV CKT 1 Build approximately 76 Miles of 345kV from Gentleman to Thedford per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Hoskins - Dixon County - Twin Church 230kV Rerate per NPPD Facility Study	Previously Allocated		$500,000
Keystone - Gentleman 345kV CKT 2 Build approximately 30 miles of new 345kV. Gentleman and Keystone Substation Work.	Previously Allocated		$69,900,000
Thedford - Holt County 345kV CKT 1 Build approximately 146 Miles of 345kV from Thedford to Holt County per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Thedford 345/115kV Transformer CKT 1 Install Thedford 345/115kV transformer per SPP-NTC-200277 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Twin Church - Dixon County 230kV Increase conductor clearances to accommodate 320MVA facility rating	Previously Allocated		$100,000
	Current Study Total	$376,887,558	

GEN-2016-108

Antelope - Emmons County 345kV CKT 1 Re-tap CTs at Antelope Valley Substation	Current Study	$62,031	$173,511

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Bismark - Hilken 230kV Convert Hilken 230kV to breaker-and-a-half configuration	Current Study	$879,223	$3,500,000
Broadland 345/230kV Transformer CKT 1 Replace Broadland 345/230kV Transformer	Current Study	$2,841,384	$9,413,718
Emmons County - McIntosh County 345kV Build Emmons County - McIntosh County 345kV; includes costs of new Emmons Co. and new McIntosh Co. Substations	Current Study	$56,599,620	$122,667,737
Flandreau 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Flandreau 115kV	Current Study	$176,222	$796,899
GEN-2016-108 Interconnection Costs See One-Line Diagram.	Current Study	$23,074,093	$23,074,093
Hanlon 230kV Reactive Power Support Install up to 60MVAR capacitor bank at Hanlon 230kV	Current Study	$187,309	$1,679,949
Leland Olds - McIntosh County 345kV Raise structures on Leland Olds - McIntosh 345kV CKT 1 & re-tap CTs at Leland Olds	Current Study	$46,964	$173,511
Neset - Tioga 230kV Reconductor Neset - Tioga 230kV and replace terminal equipment	Current Study	$31,768	$1,061,463
Dickinson 230/115/13.8kV CKT 2 Build new 230/115/13.8kV Transformer circuit #2 at Dickinson and expand Dickinson 115kV switchyard	Previously Allocated		$11,764,180
Neset - Tande 230kV CKT 1 Build new 230kV line from Neset - Tande	Previously Allocated		$3,000,000
Neset 230kV Terminal Upgrade(s) Install necessary terminal equInstall necessary terminal upgrades at Neset 230kV to accommodate new 230kV line from new Tande substation	Previously Allocated		$4,000,000
Tande 345/230kV Substation Construct new 345kV Tande Substation & Tande 345/230/13kV transformer Construct new 345kV Tande Substation adjacent to the existing 230kV Neset Substation and	Previously Allocated		$18,000,000
	Current Study Total	$83,898,614	

GEN-2016-110

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Atwood Switch 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Atwood Switch 115kV	Current Study	$129,388	$796,899
GEN-2016-023-Tap - Stegall 345kV CKT 2 Build GEN-2016-023-Tap - Stegall 345kV CKT 2	Current Study	$30,815,750	$43,248,906
GEN-2016-110 Interconnection Costs See One-Line Diagram.	Current Study	$23,052,493	$23,052,493

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GGS - Red Willow 345kV CKT 1 Rebuild GGS - Red Willow 345kV CKT 1	Current Study	$6,920,538	$67,339,931
Grand Island - Seward County 345kV CKT 1 NRIS only required upgrade: Build Grand Island - Seward County 345kV CKT 1	Current Study	$12,347,392	$100,000,000
Grand Prairie - Antelope 345kV CKT 1 Build Grand Prairie - Antelope 345kV CKT 1	Current Study	$2,702,926	$72,081,510
Grand Prairie - Hoskins 345kV CKT 1 NRIS only required upgrade: Build Grand Prairie - Hoskins 345kV CKT 1	Current Study	$3,003,219	$147,692,308
Great Bend - South Hays 230kV CKT 1 NRIS only required upgrade: Rebuild Great Bend - South Hays 230kV CKT 1	Current Study	$26,225,037	$26,225,037
Heizer 69kV Reactive Power Support Install up to 10MVAR capactior bank at Heizer 69kV	Current Study	$43,486	$398,449
Hoskins - Ft. Calhoun 345kV CKT 1 NRIS only required upgrade: Build Hoskins - Ft. Calhoun 345kV CKT 1	Current Study	$1,599,395	$172,307,692
Keystone - Red Willow 345kV CKT 1 Build Keystone - Red Willow 345kV CKT 1	Current Study	$32,800,050	$175,000,000
Keystone 345kV Reactive Support Install +100Mvar SVC at Keystone 345kV	Current Study	$28,487,158	$215,378,000
LRS - Stegall 345kV CKT 1 Reroute Reroute LRS - Stegall 345kV CKT 1 through the GEN-2016-023-Tap Substation	Current Study	$8,213,885	$12,515,657
Mingo 115kV Reactive Power Support Install up to 50MVAR capacitor bank at Mingo 115kV	Current Study	$277,087	$1,992,248
NPPD Flowgate Mitigation Potential Mitigation for NPPD Flowgates Limit. TBD in the Facilities Study with NPPD.	Current Study	TBD	TBD
PH Run 115kV Reactive Power Support Install up to 30MVAR capacitor bank at PH Run 115kV	Current Study	$169,318	$1,195,348
Post Rock 345/230/13kV Transformer CKT 2 NRIS only required upgrade: Build Post Rock 345/230/13kV Transformer CKT 2	Current Study	$2,315,299	$9,413,718
Red Willow - Caprock 345kV CKT 1 Build Red Willow - Caprock 345kV CKT 1	Current Study	$41,232,415	$275,000,000
Red Willow - Mingo 345kV CKT 1 Rebuild Red Willow - Mingo 345kV CKT 1	Current Study	$8,521,303	$67,188,964

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Albion - Petersburg - North Petersburg 115kV CKT 1 Reconductor 115kV lines and replace all terminal equipment for at least a 193MVA rate.	Previously Allocated		$2,500,000
Atwood Capacitive Reactive Power Support Install 10 Mvars of Capicator Bank(s)	Previously Allocated		$2,000,000
Banner County - Keystone 345kV CKT 1 Build approximately 140 of new 345kV from Banner County to Keystone. Banner County and Keystone Substation Work.	Previously Allocated		$259,100,000
Beatrice - Harbine 115kV CKT 1 Uprate Beatrice - Harbine to at least 102MVA per NPPD facility study	Previously Allocated		$900,000
Belvidere - Fairbury 115kV CKT 1 Uprate Belvidere - Fairbury to at least 107MVA per NPPD facility study	Previously Allocated		$1,700,000
Gavins Point - Yankton Junction 115kV CKT 1 Rebuild approximately 5 miles of 115kV from Gavins to Yankton	Previously Allocated		$1,048,341
Gentleman - Thedford 345kV CKT 1 Build approximately 76 Miles of 345kV from Gentleman to Thedford per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Hoskins - Dixon County - Twin Church 230kV Rerate per NPPD Facility Study	Previously Allocated		$500,000
Keystone - Gentleman 345kV CKT 2 Build approximately 30 miles of new 345kV. Gentleman and Keystone Substation Work.	Previously Allocated		$69,900,000
Thedford - Holt County 345kV CKT 1 Build approximately 146 Miles of 345kV from Thedford to Holt County per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Thedford 345/115kV Transformer CKT 1 Install Thedford 345/115kV transformer per SPP-NTC-200277 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Twin Church - Dixon County 230kV Increase conductor clearances to accommodate 320MVA facility rating	Previously Allocated		$100,000
	Current Study Total	$228,856,138	

GEN-2016-111

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-111 Interconnection Costs See One-Line Diagram.	Current Study	$8,792,574	$8,792,574
Hoyt - Jeffrey Energy Center 345kV CKT 1 Rebuild approximately 24 miles of 345kV	Current Study	$8,616,681	$37,000,000
Reno County 345/115/13kV Transformer CKT 3 Add 3rd xfmr at Reno Sub	Current Study	$5,123,978	$20,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
	Current Study Total	$22,533,233	
GEN-2016-112			
GEN-2016-112 Interconnection Costs See One-Line Diagram.	Current Study	$5,371,860	$5,371,860
Hoyt - Jeffrey Energy Center 345kV CKT 1 Rebuild approximately 24 miles of 345kV	Current Study	$7,164,074	$37,000,000
Reno County 345/115/13kV Transformer CKT 3 Add 3rd xfmr at Reno Sub	Current Study	$2,417,230	$20,000,000
	Current Study Total	$14,953,164	
GEN-2016-113			
GEN-2016-113 Interconnection Costs See One-Line Diagram.	Current Study	$5,371,860	$5,371,860
Hoyt - Jeffrey Energy Center 345kV CKT 1 Rebuild approximately 24 miles of 345kV	Current Study	$5,047,415	$37,000,000
Reno County 345/115/13kV Transformer CKT 3 Add 3rd xfmr at Reno Sub	Current Study	$1,703,049	$20,000,000
	Current Study Total	$12,122,324	
GEN-2016-114			
GEN-2016-114 Interconnection Costs See One-Line Diagram.	Current Study	$8,792,574	$8,792,574
Hoyt - Jeffrey Energy Center 345kV CKT 1 Rebuild approximately 24 miles of 345kV	Current Study	$8,844,937	$37,000,000
Reno County 345/115/13kV Transformer CKT 3 Add 3rd xfmr at Reno Sub	Current Study	$5,259,713	$20,000,000
	Current Study Total	$22,897,224	
GEN-2016-115			
GEN-2016-115 Interconnection Costs See One-Line Diagram.	Current Study	$1,532,553	$1,532,553
	Current Study Total	$1,532,553	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GEN-2016-118

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Dover - Henessey 138kV CKT 1 Upgrade terminal Equipment: OKGE to Upgrade 800A CT to 1200A CT	Current Study	$20,000	$20,000
GEN-2016-118 Interconnection Costs See One-Line Diagram.	Current Study	$5,010,000	$5,010,000
Tupelo - Tupleo Tap 138kV CKT 1 NRIS only required upgrade: Build approximately 1.3 miles of circuit 138kV from Tupelo to Tupelo Tap and replace CT	Current Study	$757,500	$757,500
Cimarron - Draper Lake 345kV CKT 1 Replace terminal equipment to at least per SPP-NTC-200416	Previously Allocated		$1,500,000
	Current Study Total	$5,787,500	

GEN-2016-119

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Cimarron 345/138kV 3rd xfmr NRIS only required upgrade: No room in Cimarron for new XFMR; build new substation for 3rd XFMR at Cimarron 345kV	Current Study	$12,260,155	$27,000,000
GEN-2016-119 Interconnection Costs See One-Line Diagram.	Current Study	$6,465,000	$6,465,000
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$13,189	$411,000
Lacygne - Waverly 345kV CKT 1 Replace terminal equipment to achieve conductor element	Current Study	$339,178	$2,000,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$2,092,986	$15,000,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$4,341,231	$11,500,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$9,354,057	$52,500,000
Remington - Fairfax 138kV CKT 1 Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C	Current Study	$67,452	$6,700,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Viola - Buffalo Flats 345kV CKT 1 Build approximately 35 miles of new 345kV from Viola to Buffalo Flats	Current Study	$8,004,071	$52,500,000
Wolf Creek - Waverly 345kV CKT 1 Replace terminal equipment	Current Study	$169,589	$1,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$287,262	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - White Eagle 138kV CKT 1 Rebuild approximately 3 miles of 138kV from Osage to White Eagle	Previously Allocated		$2,000,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$43,394,170	

GEN-2016-120

AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$213,072,902	$1,300,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$213,072,902	$1,300,000,000
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$21,180,561	$129,226,800
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$7,088,043	$380,000,000
Elk City 230/138/13.8KV Transformer CKT 1 Replace terminal equipment at Elk City 230/138/13.8KV Transformer	Current Study	$1,584,278	$3,900,000
GEN-2016-120 Interconnection Costs See One-Line Diagram.	Current Study	$16,546,802	$16,546,802
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$7,710,174	$45,530,000
Andrews 345/115/13kV Transformer CKT 1 Replace 230/115kV transformer CKT 1 with 345/115kV transformer	Previously Allocated		$8,000,000
Andrews 345/115/13kV Transformer CKT 2 Replace 230/115kV transformer CKT 2 with 345/115kV transformer	Previously Allocated		$8,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Drinkard - Drinkard Tap 115kV CKT 1 Rebuild approximately 2 miles from Drinkard to Drinkard Tap	Previously Allocated		$1,500,000
National Enrich Plant Tap - Targa 115kV CKT 1 The rating increases in 2019 NTC#200324 PID:30914 UID:51250 (4.26 mile line)	Previously Allocated		$2,909,669
National Enrichment Plant-Targa 115kV CKT 1 - Rebuild approximately 4 miles of 115kV from National Enrichment Plant to Targa per 2015 ITPNT.	Previously Allocated		$2,909,669
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
South Jal - Teague 115kV CKT 1 Rebuild approximately 10 miles from Jal to Teague assigned in SPP-2014-AG1-AFS-6 per SPP-NTC-200365	Previously Allocated		$6,640,592
Targa-Cardinal 115kV CKT 1 Rebuild approximately 3 miles of 115kV from Targa to Cardinal per 2015 ITPNT.	Previously Allocated		$2,049,062
Tolk - Plant X 230kV CKT 1 & 2 Rebuild circuit 1 and 2 betweek Tolk - Plant X 230kV to 1200 amps each.	Previously Allocated		$9,921,693
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000
	Current Study Total	$480,255,663	

GEN-2016-121

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cochran - Lost Draw 115kV CKT 1 Reconductor Cochran - Lost Draw 115kV CKT 1	Current Study	$703,334	$4,691,172
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$67,632,685	$1,300,000,000
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$67,632,685	$1,300,000,000
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$6,723,043	$129,226,800
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$19,241,944	$380,000,000
Crossroads - Tolk 345kV CKT 1 Replace Crossroads - Tolk 345kV terminal equipment and resolve clearance issues	Current Study	$38,229	$1,500,000
GEN-2016-121 Interconnection Costs See One-Line Diagram.	Current Study	$2,799,536	$2,799,536
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$2,323,924	$45,530,000
Tolk 345/230/13kV Transformer CKT 3 Build third 345/230/13kV transformer at Tolk	Current Study	$1,309,878	$15,000,000
Amoco - Sundown 230kV CKT1 NTC #200395 PID 30844 Terminal Equiptment upgrade Effective 12/14/2018 summer rating of 497/547 and winter rating 553/608	Previously Allocated		$2,200,956

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Andrews Substation Voltage Conversion Convert Andrews 230kV to 345kV	Previously Allocated		$10,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Crawfish Draw - Tuco 345kV CKT 2 Build second circuit from Crawfish Draw - Tuco 345 kV	Previously Allocated		$3,600,000
Crawfish Draw 345/230kV Substation Upgrade Tap Border-TUCO approximately 3 miles from TUCO, build Crawfish Draw 345kV substation, add 345/230/13.2kV transformer, and tie on TUCO-Swisher 230kV.	Previously Allocated		$24,764,205
Drinkard - Drinkard Tap 115kV CKT 1 Rebuild approximately 2 miles from Drinkard to Drinkard Tap	Previously Allocated		$1,500,000
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
Terry county - Wolfforth 115kv CKT 1 The rating increases in2018 NTC#200395 PID:31051 UID:51549	Previously Allocated		$1,700,000
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk - Plant X 230kV CKT 1 & 2 Rebuild circuit 1 and 2 betweek Tolk - Plant X 230kV to 1200 amps each.	Previously Allocated		$9,921,693
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Tolk 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Tolk	Previously Allocated		$15,000,000
TUCO 345/230/13.2kV Transformer CKT 1 Replace existing TUCO 345/230/13.2kV Transformer circuit #1 with 640MVA.	Previously Allocated		$3,347,036
	Current Study Total	$168,405,257	

GEN-2016-122

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-122 Interconnection Costs See One-Line Diagram.	Current Study	$5,371,860	$5,371,860
Hoyt - Jeffrey Energy Center 345kV CKT 1 Rebuild approximately 24 miles of 345kV	Current Study	$7,326,893	$37,000,000
Reno County 345/115/13kV Transformer CKT 3 Add 3rd xfmr at Reno Sub	Current Study	$2,472,167	$20,000,000
	Current Study Total	$15,170,921	

GEN-2016-123

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$194,457,864	$1,300,000,000
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$194,457,864	$1,300,000,000
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$19,330,129	$129,226,800
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$142,193,458	$380,000,000
Crossroads - Tolk 345kV CKT 1 Replace Crossroads - Tolk 345kV terminal equipment and resolve clearance issues	Current Study	$793,202	$1,500,000
GEN-2016-123 Interconnection Costs See One-Line Diagram.	Current Study	$1,585,403	$1,585,403
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$6,514,627	$45,530,000
Amoco - Sundown 230kV CKT1 NTC #200395 PID 30844 Terminal Equiptment upgrade Effective 12/14/2018 summer rating of 497/547 and winter rating 553/608	Previously Allocated		$2,200,956

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Andrews Substation Voltage Conversion Convert Andrews 230kV to 345kV	Previously Allocated		$10,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Drinkard - Drinkard Tap 115kV CKT 1 Rebuild approximately 2 miles from Drinkard to Drinkard Tap	Previously Allocated		$1,500,000
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
Terry county - Wolfforth 115kv CKT 1 The rating increases in2018 NTC#200395 PID:31051 UID:51549	Previously Allocated		$1,700,000
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk - Plant X 230kV CKT 1 & 2 Rebuild circuit 1 and 2 betweek Tolk - Plant X 230kV to 1200 amps each.	Previously Allocated		$9,921,693
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000
	Current Study Total	$559,332,548	

GEN-2016-124

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$97,881,475	$1,300,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$97,881,475	$1,300,000,000
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$9,729,931	$129,226,800
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$71,573,888	$380,000,000
Crossroads - Tolk 345kV CKT 1 Replace Crossroads - Tolk 345kV terminal equipment and resolve clearance issues	Current Study	$399,263	$1,500,000
GEN-2016-124 Interconnection Costs See One-Line Diagram.	Current Study	$1,585,403	$1,585,403
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$3,279,175	$45,530,000
Amoco - Sundown 230kV CKT1 NTC #200395 PID 30844 Terminal Equiptment upgrade Effective 12/14/2018 summer rating of 497/547 and winter rating 553/608	Previously Allocated		$2,200,956
Andrews Substation Voltage Conversion Convert Andrews 230kV to 345kV	Previously Allocated		$10,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Drinkard - Drinkard Tap 115kV CKT 1 Rebuild approximately 2 miles from Drinkard to Drinkard Tap	Previously Allocated		$1,500,000
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
Terry county - Wolfforth 115kv CKT 1 The rating increases in2018 NTC#200395 PID:31051 UID:51549	Previously Allocated		$1,700,000
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk - Plant X 230kV CKT 1 & 2 Rebuild circuit 1 and 2 betweek Tolk - Plant X 230kV to 1200 amps each.	Previously Allocated		$9,921,693
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000
	Current Study Total	$282,330,610	

GEN-2016-125

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$48,288,194	$1,300,000,000
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$48,288,194	$1,300,000,000
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$4,800,099	$129,226,800
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$35,309,785	$380,000,000
Crossroads - Tolk 345kV CKT 1 Replace Crossroads - Tolk 345kV terminal equipment and resolve clearance issues	Current Study	$196,970	$1,500,000
GEN-2016-125 Interconnection Costs See One-Line Diagram.	Current Study	$1,585,403	$1,585,403
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$1,617,726	$45,530,000
Amoco - Sundown 230kV CKT1 NTC #200395 PID 30844 Terminal Equiptment upgrade Effective 12/14/2018 summer rating of 497/547 and winter rating 553/608	Previously Allocated		$2,200,956

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Andrews Substation Voltage Conversion Convert Andrews 230kV to 345kV	Previously Allocated		$10,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Drinkard - Drinkard Tap 115kV CKT 1 Rebuild approximately 2 miles from Drinkard to Drinkard Tap	Previously Allocated		$1,500,000
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
Terry county - Wolfforth 115kv CKT 1 The rating increases in2018 NTC#200395 PID:31051 UID:51549	Previously Allocated		$1,700,000
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk - Plant X 230kV CKT 1 & 2 Rebuild circuit 1 and 2 betweek Tolk - Plant X 230kV to 1200 amps each.	Previously Allocated		$9,921,693
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000
	Current Study Total	$140,086,372	

GEN-2016-126

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
G16-126 Tap - Arbuckle 138kV CKT 2 Build G16-126 Tap - Arbuckle 138kV CKT 2	Current Study	$2,680,837	$4,500,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-126 Interconnection Costs See One-Line Diagram.	Current Study	$4,000,000	$4,000,000
	Current Study Total	$6,680,837	

GEN-2016-127

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Fairfax 138/69kV Transformers CKT 1 & 2 Upgrade the Fairfax 138/69 kV 56 MVA transformer to two 84 MVA units	Current Study	$2,962,207	$5,000,000
GEN-2016-127 Interconnection Costs See One-Line Diagram.	Current Study	$1,653,750	$1,653,750
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$4,821	$411,000
Lacygne - Waverly 345kV CKT 1 Replace terminal equipment to achieve conductor element	Current Study	$81,583	$2,000,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$503,429	$15,000,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$309,642	$11,500,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$1,603,435	$52,500,000
Remington - ASGI-2017-008 Tap 138kV CKT 1 AECI Upgrade Remington-Shidler 138 kV line to 1192.5 ACSR at 100 C	Current Study	$1,484,790	$2,500,000
Remington - Fairfax 138kV CKT 1 Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C	Current Study	$3,761,039	$6,700,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$61,237	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$551,132	$9,000,000
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$120,059	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$19,926	$414,600

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$195,851	$4,075,100
Viola - Buffalo Flats 345kV CKT 1 Build approximately 35 miles of new 345kV from Viola to Buffalo Flats	Current Study	$2,091,469	$52,500,000
Wolf Creek - Neosho 345kV CKT 1 NRIS Only Required Upgrade: Build approximately 95 miles of Wolf Creek – Neosho 345kV CKT 1	Current Study	$8,810,138	$117,126,900
Wolf Creek - Waverly 345kV CKT 1 Replace terminal equipment	Current Study	$40,791	$1,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$1,402,855	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Shidler - Pawhuska - Domes - Mound Rd - Bartlesville Comanche 138kV CKT 1 Rebuild approximately 45 miles of 138kV assigned to higher queued AECI project (GIA-59)	Previously Allocated		$75,811,843
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$25,658,153	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-128			
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Cimarron 345/138kV 3rd xfmr NRIS only required upgrade: No room in Cimarron for new XFMR; build new substation for 3rd XFMR at Cimarron 345kV	Current Study	$4,134,177	$27,000,000
GEN-2016-128 Interconnection Costs See One-Line Diagram.	Current Study	$5,052,000	$5,052,000
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$1,857	$411,000
Lacygne - Waverly 345kV CKT 1 Replace terminal equipment to achieve conductor element	Current Study	$103,384	$2,000,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$637,956	$15,000,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$484,938	$11,500,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$9,267,799	$52,500,000
Remington - Fairfax 138kV CKT 1 Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C	Current Study	$47,272	$6,700,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$16,169	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$145,518	$9,000,000
Viola - Buffalo Flats 345kV CKT 1 Build approximately 35 miles of new 345kV from Viola to Buffalo Flats	Current Study	$4,920,829	$52,500,000
Wolf Creek - Neosho 345kV CKT 1 NRIS Only Required Upgrade: Build approximately 95 miles of Wolf Creek – Neosho 345kV CKT 1	Current Study	$16,350,083	$117,126,900
Wolf Creek - Waverly 345kV CKT 1 Replace terminal equipment	Current Study	$51,692	$1,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$6,120,638	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Kildare - White Eagle 138kV CKT 1 Rebuild approximately 11 miles of 138kV from Kildare to White Eagle	Previously Allocated		$7,000,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - White Eagle 138kV CKT 1 Rebuild approximately 3 miles of 138kV from Osage to White Eagle	Previously Allocated		$2,000,000
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$47,334,312	
GEN-2016-129			
GEN-2016-129 Interconnection Costs See One-Line Diagram.	Current Study	$5,367,500	$5,367,500
	Current Study Total	$5,367,500	
GEN-2016-130			
Antelope - Emmons County 345kV CKT 1 Re-tap CTs at Antelope Valley Substation	Current Study	$38,435	$173,511
Bismark - Hilken 230kV Convert Hilken 230kV to breaker-and-a-half configuration	Current Study	$1,056,457	$3,500,000
Broadland 345/230kV Transformer CKT 1 Replace Broadland 345/230kV Transformer	Current Study	$2,833,548	$9,413,718
Emmons County - McIntosh County 345kV Build Emmons County - McIntosh County 345kV; includes costs of new Emmons Co. and new McIntosh Co. Substations	Current Study	$12,255,897	$122,667,737

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Flandreau 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Flandreau 115kV	Current Study	$180,885	$796,899
GEN-2016-130 Interconnection Costs See One-Line Diagram.	Current Study	$2,853,562	$2,853,562
Hanlon 230kV Reactive Power Support Install up to 60MVAR capacitor bank at Hanlon 230kV	Current Study	$185,697	$1,679,949
Leland Olds - McIntosh County 345kV Raise structures on Leland Olds - McIntosh 345kV CKT 1 & re-tap CTs at Leland Olds	Current Study	$60,066	$173,511
Neset - Tioga 230kV Reconductor Neset - Tioga 230kV and replace terminal equipment	Current Study	$4,778	$1,061,463
Dickinson 230/115/13.8kV CKT 2 Build new 230/115/13.8kV Transformer circuit #2 at Dickinson and expand Dickinson 115kV switchyard	Previously Allocated		$11,764,180
Neset - Tande 230kV CKT 1 Build new 230kV line from Neset - Tande	Previously Allocated		$3,000,000
Neset 230kV Terminal Upgrade(s) Install necessary terminal equInstall necessary terminal upgrades at Neset 230kV to accommodate new 230kV line from new Tande substation	Previously Allocated		$4,000,000
Tande 345/230kV Substation Construct new 345kV Tande Substation & Tande 345/230/13kV transformer Construct new 345kV Tande Substation adjacent to the existing 230kV Neset Substation and	Previously Allocated		$18,000,000
	Current Study Total	$19,469,324	

GEN-2016-131

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cimarron 345/138kV 3rd xfmr NRIS only required upgrade: No room in Cimarron for new XFMR; build new substation for 3rd XFMR at Cimarron 345kV	Current Study	$68,586	$27,000,000
GEN-2016-131 Interconnection Costs See One-Line Diagram.	Current Study	$0	$0
Cimarron - Draper Lake 345kV CKT 1 Replace terminal equipment to at least per SPP-NTC-200416	Previously Allocated		$1,500,000
Cleo Corner - Cleo Plant Tap 138kV CKT 1 Replace terminal equipment to at least 1200 amps	Previously Allocated		$61,890
	Current Study Total	$68,586	

GEN-2016-132

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-132 Interconnection Costs See One-Line Diagram.	Current Study	$210,000	$210,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
	Current Study Total	$210,000	

GEN-2016-133

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Cherokee DCE Tap - Owasso 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV	Current Study	$225,000	$3,000,000
GEN-2016-133 Interconnection Costs See One-Line Diagram.	Current Study	$2,270,461	$2,270,461
GEN-2016-133 through -146 Reactive Power Support Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.	Current Study	TBD	TBD
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$28,435	$411,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$199,385	$15,000,000
North Tulsa - Cherokee DCE Tap 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV	Current Study	$360,000	$4,800,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$168,066	$11,500,000
Owasso - Catossa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV	Current Study	$750,000	$10,000,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$280,770	$52,500,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$66,810	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$601,291	$9,000,000
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$133,496	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$29,601	$414,600
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$290,944	$4,075,100

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Tulsa North - Wekiwa 345kV CKT 1 Rebuild/Re-conductor approximately 17.5 miles of 345kV Rebuild/Re-conductor approximately 17.5 miles of 345kV	Current Study	$1,650,000	$22,000,000
Tulsa North 345/138kV Transformer CKT 2 Install second 345/138kV transformer	Current Study	$1,125,000	$15,000,000
Tulsa North 345kV Reactive Power Support Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer	Current Study	$3,000,000	$40,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$461,140	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$11,640,397	

GEN-2016-134

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cherokee DCE Tap - Owasso 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV	Current Study	$225,000	$3,000,000
GEN-2016-133 through -146 Reactive Power Support Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.	Current Study	TBD	TBD
GEN-2016-134 Interconnection Costs See One-Line Diagram.	Current Study	$2,270,461	$2,270,461
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$28,435	$411,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$199,385	$15,000,000
North Tulsa - Cherokee DCE Tap 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV	Current Study	$360,000	$4,800,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$168,066	$11,500,000
Owasso - Catossa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV	Current Study	$750,000	$10,000,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$280,770	$52,500,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$66,810	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$601,291	$9,000,000
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$133,496	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$29,601	$414,600
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$290,944	$4,075,100
Tulsa North - Wekiwa 345kV CKT 1 Rebuild/Re-conductor approximately 17.5 miles of 345kV Rebuild/Re-conductor approximately 17.5 miles of 345kV	Current Study	$1,650,000	$22,000,000
Tulsa North 345/138kV Transformer CKT 2 Install second 345/138kV transformer	Current Study	$1,125,000	$15,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Tulsa North 345kV Reactive Power Support Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer	Current Study	$3,000,000	$40,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$461,140	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$11,640,397	

GEN-2016-135

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cherokee DCE Tap - Owasso 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV	Current Study	$120,000	$3,000,000
GEN-2016-133 through -146 Reactive Power Support Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.	Current Study	TBD	TBD
GEN-2016-135 Interconnection Costs See One-Line Diagram.	Current Study	$2,270,461	$2,270,461

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$15,165	$411,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$106,339	$15,000,000
North Tulsa - Cherokee DCE Tap 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV	Current Study	$192,000	$4,800,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$89,635	$11,500,000
Owasso - Catossa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV	Current Study	$400,000	$10,000,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$149,744	$52,500,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$35,632	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$320,688	$9,000,000
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$71,198	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$15,787	$414,600
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$155,170	$4,075,100
Tulsa North - Wekiwa 345kV CKT 1 Rebuild/Re-conductor approximately 17.5 miles of 345kV Rebuild/Re-conductor approximately 17.5 miles of 345kV	Current Study	$880,000	$22,000,000
Tulsa North 345/138kV Transformer CKT 2 Install second 345/138kV transformer	Current Study	$600,000	$15,000,000
Tulsa North 345kV Reactive Power Support Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer	Current Study	$1,600,000	$40,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$245,941	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$7,267,760	

GEN-2016-136

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cherokee DCE Tap - Owasso 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV	Current Study	$90,000	$3,000,000
GEN-2016-133 through -146 Reactive Power Support Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.	Current Study	TBD	TBD
GEN-2016-136 Interconnection Costs See One-Line Diagram.	Current Study	$2,270,461	$2,270,461
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$11,374	$411,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$79,754	$15,000,000
North Tulsa - Cherokee DCE Tap 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV	Current Study	$144,000	$4,800,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$67,226	$11,500,000
Owasso - Catossa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV	Current Study	$300,000	$10,000,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$112,308	$52,500,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$26,724	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$240,516	$9,000,000
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$53,398	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$11,840	$414,600
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$116,377	$4,075,100
Tulsa North - Wekiwa 345kV CKT 1 Rebuild/Re-conductor approximately 17.5 miles of 345kV Rebuild/Re-conductor approximately 17.5 miles of 345kV	Current Study	$660,000	$22,000,000
Tulsa North 345/138kV Transformer CKT 2 Install second 345/138kV transformer	Current Study	$450,000	$15,000,000
Tulsa North 345kV Reactive Power Support Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer	Current Study	$1,200,000	$40,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$184,456	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$6,018,435	

GEN-2016-137

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Cherokee DCE Tap - Owasso 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV	Current Study	$225,000	$3,000,000
GEN-2016-133 through -146 Reactive Power Support Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.	Current Study	TBD	TBD
GEN-2016-137 Interconnection Costs See One-Line Diagram.	Current Study	$2,270,461	$2,270,461
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$28,435	$411,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$199,385	$15,000,000
North Tulsa - Cherokee DCE Tap 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV	Current Study	$360,000	$4,800,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$168,066	$11,500,000
Owasso - Catossa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV	Current Study	$750,000	$10,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$280,770	$52,500,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$66,810	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$601,291	$9,000,000
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$133,496	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$29,601	$414,600
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$290,944	$4,075,100
Tulsa North - Wekiwa 345kV CKT 1 Rebuild/Re-conductor approximately 17.5 miles of 345kV Rebuild/Re-conductor approximately 17.5 miles of 345kV	Current Study	$1,650,000	$22,000,000
Tulsa North 345/138kV Transformer CKT 2 Install second 345/138kV transformer	Current Study	$1,125,000	$15,000,000
Tulsa North 345kV Reactive Power Support Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer	Current Study	$3,000,000	$40,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$461,140	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$11,640,397	

GEN-2016-138

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Cherokee DCE Tap - Owasso 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV	Current Study	$225,000	$3,000,000
GEN-2016-133 through -146 Reactive Power Support Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.	Current Study	TBD	TBD
GEN-2016-138 Interconnection Costs See One-Line Diagram.	Current Study	$2,270,461	$2,270,461
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$28,435	$411,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$199,385	$15,000,000
North Tulsa - Cherokee DCE Tap 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV	Current Study	$360,000	$4,800,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$168,066	$11,500,000
Owasso - Catossa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV	Current Study	$750,000	$10,000,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$280,770	$52,500,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$66,810	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$601,291	$9,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$133,496	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$29,601	$414,600
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$290,944	$4,075,100
Tulsa North - Wekiwa 345kV CKT 1 Rebuild/Re-conductor approximately 17.5 miles of 345kV Rebuild/Re-conductor approximately 17.5 miles of 345kV	Current Study	$1,650,000	$22,000,000
Tulsa North 345/138kV Transformer CKT 2 Install second 345/138kV transformer	Current Study	$1,125,000	$15,000,000
Tulsa North 345kV Reactive Power Support Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer	Current Study	$3,000,000	$40,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$461,140	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$11,640,397	

GEN-2016-139

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cherokee DCE Tap - Owasso 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV	Current Study	$120,000	$3,000,000
GEN-2016-133 through -146 Reactive Power Support Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.	Current Study	TBD	TBD
GEN-2016-139 Interconnection Costs See One-Line Diagram.	Current Study	$2,270,461	$2,270,461
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$15,165	$411,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$106,339	$15,000,000
North Tulsa - Cherokee DCE Tap 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV	Current Study	$192,000	$4,800,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$89,635	$11,500,000
Owasso - Catossa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV	Current Study	$400,000	$10,000,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$149,744	$52,500,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$35,632	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$320,688	$9,000,000
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$71,198	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$15,787	$414,600
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$155,170	$4,075,100

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Tulsa North - Wekiwa 345kV CKT 1 Rebuild/Re-conductor approximately 17.5 miles of 345kV Rebuild/Re-conductor approximately 17.5 miles of 345kV	Current Study	$880,000	$22,000,000
Tulsa North 345/138kV Transformer CKT 2 Install second 345/138kV transformer	Current Study	$600,000	$15,000,000
Tulsa North 345kV Reactive Power Support Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer	Current Study	$1,600,000	$40,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$245,941	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$7,267,760	

GEN-2016-140

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cherokee DCE Tap - Owasso 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV	Current Study	$90,000	$3,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-133 through -146 Reactive Power Support Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.	Current Study	TBD	TBD
GEN-2016-140 Interconnection Costs See One-Line Diagram.	Current Study	$2,270,461	$2,270,461
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$11,374	$411,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$79,754	$15,000,000
North Tulsa - Cherokee DCE Tap 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV	Current Study	$144,000	$4,800,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$67,226	$11,500,000
Owasso - Catossa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV	Current Study	$300,000	$10,000,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$112,308	$52,500,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$26,724	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$240,516	$9,000,000
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$53,398	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$11,840	$414,600
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$116,377	$4,075,100
Tulsa North - Wekiwa 345kV CKT 1 Rebuild/Re-conductor approximately 17.5 miles of 345kV Rebuild/Re-conductor approximately 17.5 miles of 345kV	Current Study	$660,000	$22,000,000
Tulsa North 345/138kV Transformer CKT 2 Install second 345/138kV transformer	Current Study	$450,000	$15,000,000
Tulsa North 345kV Reactive Power Support Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer	Current Study	$1,200,000	$40,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$184,456	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$6,018,435	

GEN-2016-141

AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Cherokee DCE Tap - Owasso 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV	Current Study	$420,000	$3,000,000
GEN-2016-133 through -146 Reactive Power Support Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.	Current Study	TBD	TBD
GEN-2016-141 Interconnection Costs See One-Line Diagram.	Current Study	$2,270,461	$2,270,461

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$53,078	$411,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$372,185	$15,000,000
North Tulsa - Cherokee DCE Tap 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV	Current Study	$672,000	$4,800,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$313,724	$11,500,000
Owasso - Catossa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV	Current Study	$1,400,000	$10,000,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$524,104	$52,500,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$124,712	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$1,122,409	$9,000,000
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$249,192	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$55,254	$414,600
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$543,095	$4,075,100
Tulsa North - Wekiwa 345kV CKT 1 Rebuild/Re-conductor approximately 17.5 miles of 345kV Rebuild/Re-conductor approximately 17.5 miles of 345kV	Current Study	$3,080,000	$22,000,000
Tulsa North 345/138kV Transformer CKT 2 Install second 345/138kV transformer	Current Study	$2,100,000	$15,000,000
Tulsa North 345kV Reactive Power Support Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer	Current Study	$5,600,000	$40,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$860,794	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$19,761,008	

GEN-2016-142

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Cherokee DCE Tap - Owasso 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV	Current Study	$420,000	$3,000,000
GEN-2016-133 through -146 Reactive Power Support Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.	Current Study	TBD	TBD
GEN-2016-142 Interconnection Costs See One-Line Diagram.	Current Study	$2,270,461	$2,270,461
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$53,078	$411,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$372,185	$15,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
North Tulsa - Cherokee DCE Tap 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV	Current Study	$672,000	$4,800,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$313,724	$11,500,000
Owasso - Catossa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV	Current Study	$1,400,000	$10,000,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$524,104	$52,500,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$124,712	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$1,122,409	$9,000,000
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$249,192	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$55,254	$414,600
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$543,095	$4,075,100
Tulsa North - Wekiwa 345kV CKT 1 Rebuild/Re-conductor approximately 17.5 miles of 345kV Rebuild/Re-conductor approximately 17.5 miles of 345kV	Current Study	$3,080,000	$22,000,000
Tulsa North 345/138kV Transformer CKT 2 Install second 345/138kV transformer	Current Study	$2,100,000	$15,000,000
Tulsa North 345kV Reactive Power Support Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer	Current Study	$5,600,000	$40,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$860,794	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$19,761,008	

GEN-2016-143

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Cherokee DCE Tap - Owasso 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV	Current Study	$210,000	$3,000,000
GEN-2016-133 through -146 Reactive Power Support Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.	Current Study	TBD	TBD
GEN-2016-143 Interconnection Costs See One-Line Diagram.	Current Study	$2,270,461	$2,270,461
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$26,539	$411,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$186,093	$15,000,000
North Tulsa - Cherokee DCE Tap 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV	Current Study	$336,000	$4,800,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$156,862	$11,500,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Owasso - Catossa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV	Current Study	$700,000	$10,000,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$262,052	$52,500,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$62,356	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$561,205	$9,000,000
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$124,596	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$27,627	$414,600
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$271,547	$4,075,100
Tulsa North - Wekiwa 345kV CKT 1 Rebuild/Re-conductor approximately 17.5 miles of 345kV Rebuild/Re-conductor approximately 17.5 miles of 345kV	Current Study	$1,540,000	$22,000,000
Tulsa North 345/138kV Transformer CKT 2 Install second 345/138kV transformer	Current Study	$1,050,000	$15,000,000
Tulsa North 345kV Reactive Power Support Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer	Current Study	$2,800,000	$40,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$430,397	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$11,015,735	

GEN-2016-144

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Cherokee DCE Tap - Owasso 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV	Current Study	$210,000	$3,000,000
GEN-2016-133 through -146 Reactive Power Support Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.	Current Study	TBD	TBD
GEN-2016-144 Interconnection Costs See One-Line Diagram.	Current Study	$2,270,461	$2,270,461
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$26,539	$411,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$186,093	$15,000,000
North Tulsa - Cherokee DCE Tap 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV	Current Study	$336,000	$4,800,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$156,862	$11,500,000
Owasso - Catossa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV	Current Study	$700,000	$10,000,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$262,052	$52,500,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$62,356	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$561,205	$9,000,000
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$124,596	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$27,627	$414,600
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$271,547	$4,075,100
Tulsa North - Wekiwa 345kV CKT 1 Rebuild/Re-conductor approximately 17.5 miles of 345kV Rebuild/Re-conductor approximately 17.5 miles of 345kV	Current Study	$1,540,000	$22,000,000
Tulsa North 345/138kV Transformer CKT 2 Install second 345/138kV transformer	Current Study	$1,050,000	$15,000,000
Tulsa North 345kV Reactive Power Support Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer	Current Study	$2,800,000	$40,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$430,397	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$11,015,735	

GEN-2016-145

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Cherokee DCE Tap - Owasso 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV	Current Study	$210,000	$3,000,000
GEN-2016-133 through -146 Reactive Power Support Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.	Current Study	TBD	TBD
GEN-2016-145 Interconnection Costs See One-Line Diagram.	Current Study	$2,270,461	$2,270,461
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$26,539	$411,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$186,093	$15,000,000
North Tulsa - Cherokee DCE Tap 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV	Current Study	$336,000	$4,800,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$156,862	$11,500,000
Owasso - Catossa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV	Current Study	$700,000	$10,000,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$262,052	$52,500,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$62,356	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$561,205	$9,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$124,596	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$27,627	$414,600
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$271,547	$4,075,100
Tulsa North - Wekiwa 345kV CKT 1 Rebuild/Re-conductor approximately 17.5 miles of 345kV Rebuild/Re-conductor approximately 17.5 miles of 345kV	Current Study	$1,540,000	$22,000,000
Tulsa North 345/138kV Transformer CKT 2 Install second 345/138kV transformer	Current Study	$1,050,000	$15,000,000
Tulsa North 345kV Reactive Power Support Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer	Current Study	$2,800,000	$40,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$430,397	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$11,015,735	

GEN-2016-146

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Cherokee DCE Tap - Owasso 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV	Current Study	$210,000	$3,000,000
GEN-2016-133 through -146 Reactive Power Support Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-143,-144,-145, and -146.	Current Study	TBD	TBD
GEN-2016-146 Interconnection Costs See One-Line Diagram.	Current Study	$2,270,461	$2,270,461
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$26,539	$411,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$186,093	$15,000,000
North Tulsa - Cherokee DCE Tap 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV	Current Study	$336,000	$4,800,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$156,862	$11,500,000
Owasso - Catossa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV	Current Study	$700,000	$10,000,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$262,052	$52,500,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$62,356	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$561,205	$9,000,000
SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile	Current Study	$124,596	$1,900,000
SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1	Current Study	$27,627	$414,600

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2 NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2	Current Study	$271,547	$4,075,100
Tulsa North - Wekiwa 345kV CKT 1 Rebuild/Re-conductor approximately 17.5 miles of 345kV Rebuild/Re-conductor approximately 17.5 miles of 345kV	Current Study	$1,540,000	$22,000,000
Tulsa North 345/138kV Transformer CKT 2 Install second 345/138kV transformer	Current Study	$1,050,000	$15,000,000
Tulsa North 345kV Reactive Power Support Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer	Current Study	$2,800,000	$40,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$430,397	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$11,015,735	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-147			
Atwood Switch 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Atwood Switch 115kV	Current Study	$35,486	$796,899
GEN-2016-023-Tap - Stegall 345kV CKT 2 Build GEN-2016-023-Tap - Stegall 345kV CKT 2	Current Study	$252,060	$43,248,906
GEN-2016-147 Interconnection Costs See One-Line Diagram.	Current Study	$3,521,000	$3,521,000
GGS - Red Willow 345kV CKT 1 Rebuild GGS - Red Willow 345kV CKT 1	Current Study	$1,864,563	$67,339,931
Grand Island - Seward County 345kV CKT 1 NRIS only required upgrade: Build Grand Island - Seward County 345kV CKT 1	Current Study	$1,641,399	$100,000,000
Grand Prairie - Antelope 345kV CKT 1 Build Grand Prairie - Antelope 345kV CKT 1	Current Study	$717,377	$72,081,510
Grand Prairie - Hoskins 345kV CKT 1 NRIS only required upgrade: Build Grand Prairie - Hoskins 345kV CKT 1	Current Study	$1,268,335	$147,692,308
Heizer 69kV Reactive Power Support Install up to 10MVAR capactior bank at Heizer 69kV	Current Study	$11,762	$398,449
Hoskins - Ft. Calhoun 345kV CKT 1 NRIS only required upgrade: Build Hoskins - Ft. Calhoun 345kV CKT 1	Current Study	$1,436,382	$172,307,692
Keystone - Red Willow 345kV CKT 1 Build Keystone - Red Willow 345kV CKT 1	Current Study	$8,167,736	$175,000,000
Keystone 345kV Reactive Support Install +100Mvar SVC at Keystone 345kV	Current Study	$7,826,115	$215,378,000
LRS - Stegall 345kV CKT 1 Reroute Reroute LRS - Stegall 345kV CKT 1 through the GEN-2016-023-Tap Substation	Current Study	$24,610	$12,515,657
Mingo 115kV Reactive Power Support Install up to 50MVAR capacitor bank at Mingo 115kV	Current Study	$75,458	$1,992,248
NPPD Flowgate Mitigation Potential Mitigation for NPPD Flowgates Limit. TBD in the Facilities Study with NPPD.	Current Study	TBD	TBD
PH Run 115kV Reactive Power Support Install up to 30MVAR capacitor bank at PH Run 115kV	Current Study	$46,131	$1,195,348
Post Rock 345/230/13kV Transformer CKT 2 NRIS only required upgrade: Build Post Rock 345/230/13kV Transformer CKT 2	Current Study	$368,853	$9,413,718

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Red Willow - Caprock 345kV CKT 1 Build Red Willow - Caprock 345kV CKT 1	Current Study	$11,231,287	$275,000,000
Red Willow - Mingo 345kV CKT 1 Rebuild Red Willow - Mingo 345kV CKT 1	Current Study	$2,312,158	$67,188,964
Sheldon - Monolith 115 kV Ckt 1 NRIS only required upgrade: Uprate Sheldon - Monolith 115 kV Ckt 1 (NTC #200477; UID #71967)	Current Study	$6,285	$1,273,506
Albion - Petersburg - North Petersburg 115kV CKT 1 Reconductor 115kV lines and replace all terminal equipment for at least a 193MVA rate.	Previously Allocated		$2,500,000
Atwood Capacitive Reactive Power Support Install 10 Mvars of Capicator Bank(s)	Previously Allocated		$2,000,000
Banner County - Keystone 345kV CKT 1 Build approximately 140 of new 345kV from Banner County to Keystone. Banner County and Keystone Substation Work.	Previously Allocated		$259,100,000
Beatrice - Harbine 115kV CKT 1 Uprate Beatrice - Harbine to at least 102MVA per NPPD facility study	Previously Allocated		$900,000
Belvidere - Fairbury 115kV CKT 1 Uprate Belvidere - Fairbury to at least 107MVA per NPPD facility study	Previously Allocated		$1,700,000
Gavins Point - Yankton Junction 115kV CKT 1 Rebuild approximately 5 miles of 115kV from Gavins to Yankton	Previously Allocated		$1,048,341
Gentleman - Thedford 345kV CKT 1 Build approximately 76 Miles of 345kV from Gentleman to Thedford per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Hoskins - Dixon County - Twin Church 230kV Rerate per NPPD Facility Study	Previously Allocated		$500,000
Keystone - Gentleman 345kV CKT 2 Build approximately 30 miles of new 345kV. Gentleman and Keystone Substation Work.	Previously Allocated		$69,900,000
Thedford - Holt County 345kV CKT 1 Build approximately 146 Miles of 345kV from Thedford to Holt County per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Thedford 345/115kV Transformer CKT 1 Install Thedford 345/115kV transformer per SPP-NTC-200277 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Twin Church - Dixon County 230kV Increase conductor clearances to accommodate 320MVA facility rating	Previously Allocated		$100,000
	Current Study Total	$40,806,996	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-148			
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Anadarko - Gracemont 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 5 miles of 138kV	Current Study	$4,500,000	$4,500,000
Bristow - Silver City 138kV CKT 1 NRIS Only Required Upgrade: Relay change out	Current Study	$100,000	$100,000
Cimarron 345/138kV 3rd xfmr NRIS only required upgrade: No room in Cimarron for new XFMR; build new substation for 3rd XFMR at Cimarron 345kV	Current Study	$4,509,172	$27,000,000
Fairfax 138/69kV Transformers CKT 1 & 2 Upgrade the Fairfax 138/69 kV 56 MVA transformer to two 84 MVA units	Current Study	$2,037,793	$5,000,000
GEN-2016-148 Interconnection Costs See One-Line Diagram.	Current Study	$635,000	$635,000
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$3,509	$411,000
Hardy - Webb City 138kV CKT 1 Rebuild/Re-conductor approximately 2 miles of 138kV	Current Study	$1,700,000	$1,700,000
Lacygne - Waverly 345kV CKT 1 Replace terminal equipment to achieve conductor element	Current Study	$64,649	$2,000,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$398,932	$15,000,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$244,413	$11,500,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$1,318,460	$52,500,000
Remington - ASGI-2017-008 Tap 138kV CKT 1 AECI Upgrade Remington-Shidler 138 kV line to 1192.5 ACSR at 100 C	Current Study	$1,015,210	$2,500,000
Remington - Fairfax 138kV CKT 1 Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C	Current Study	$2,571,574	$6,700,000
Sand Springs - Sheffield 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV	Current Study	$31,794	$1,000,000
Sheffield - Wekiwa 138kV CKT 1 NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV	Current Study	$286,142	$9,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Viola - Buffalo Flats 345kV CKT 1 Build approximately 35 miles of new 345kV from Viola to Buffalo Flats	Current Study	$1,657,852	$52,500,000
Webb City - Shidler (WFEC) 138kV CKT 1 Rebuild/Re-conductor approximately 13 miles of 138kV	Current Study	$11,000,000	$11,000,000
Webb City Tap - Shidler (WFEC) 138kV CKT 1 Rebuild/Re-conductor approximately 2.5 miles of 138kV	Current Study	$2,200,000	$2,200,000
Wolf Creek - Waverly 345kV CKT 1 Replace terminal equipment	Current Study	$32,324	$1,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$1,131,665	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Shidler - Pawhuska - Domes - Mound Rd - Bartlesville Comanche 138kV CKT 1 Rebuild approximately 45 miles of 138kV assigned to higher queued AECI project (GIA-59)	Previously Allocated		$75,811,843
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$35,438,489	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-149			
166th Street - Jarbalo Junction 115kV CKT 1 NRIS only required upgrade: Replace terminal equipment at Jarbalo Junction	Current Study	$187,500	$750,000
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
GEN-2016-149 Interconnection Costs See One-Line Diagram.	Current Study	$7,298,094	$7,298,094
	Current Study Total	$7,485,594	
GEN-2016-150			
166th Street - Jarbalo Junction 115kV CKT 1 NRIS only required upgrade: Replace terminal equipment at Jarbalo Junction	Current Study	$187,500	$750,000
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
GEN-2016-150 Interconnection Costs See One-Line Diagram.	Current Study	$7,298,094	$7,298,094
	Current Study Total	$7,485,594	
GEN-2016-151			
Antelope - Emmons County 345kV CKT 1 Re-tap CTs at Antelope Valley Substation	Current Study	$48,422	$173,511
Bismark - Hilken 230kV Convert Hilken 230kV to breaker-and-a-half configuration	Current Study	$960,923	$3,500,000
Broadland 345/230kV Transformer CKT 1 Replace Broadland 345/230kV Transformer	Current Study	$2,476,681	$9,413,718
Emmons County - McIntosh County 345kV Build Emmons County - McIntosh County 345kV; includes costs of new Emmons Co. and new McIntosh Co. Substations	Current Study	$35,756,364	$122,667,737
Flandreau 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Flandreau 115kV	Current Study	$175,766	$796,899
GEN-2016-151 Interconnection Costs See One-Line Diagram.	Current Study	$1,298,461	$1,298,461
Hanlon 230kV Reactive Power Support Install up to 60MVAR capacitor bank at Hanlon 230kV	Current Study	$177,018	$1,679,949

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Leland Olds - McIntosh County 345kV Raise structures on Leland Olds - McIntosh 345kV CKT 1 & re-tap CTs at Leland Olds	Current Study	$44,022	$173,511
Neset - Tioga 230kV Reconductor Neset - Tioga 230kV and replace terminal equipment	Current Study	$681,030	$1,061,463
Tande 345/230kV Transformer CKT 2 Build Tande 345/230kV Transformer CKT 2	Current Study	$6,255,168	$9,413,718
Dickinson 230/115/13.8kV CKT 2 Build new 230/115/13.8kV Transformer circuit #2 at Dickinson and expand Dickinson 115kV switchyard	Previously Allocated		$11,764,180
Neset - Tande 230kV CKT 1 Build new 230kV line from Neset - Tande	Previously Allocated		$3,000,000
Neset 230kV Terminal Upgrade(s) Install necessary terminal equInstall necessary terminal upgrades at Neset 230kV to accommodate new 230kV line from new Tande substation	Previously Allocated		$4,000,000
Tande 345/230kV Substation Construct new 345kV Tande Substation & Tande 345/230/13kV transformer Construct new 345kV Tande Substation adjacent to the existing 230kV Neset Substation and	Previously Allocated		$18,000,000
	Current Study Total	$47,873,854	

GEN-2016-152

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Antelope - Emmons County 345kV CKT 1 Re-tap CTs at Antelope Valley Substation	Current Study	$24,451	$173,511
Bismark - Hilken 230kV Convert Hilken 230kV to breaker-and-a-half configuration	Current Study	$485,219	$3,500,000
Broadland 345/230kV Transformer CKT 1 Replace Broadland 345/230kV Transformer	Current Study	$1,250,601	$9,413,718
Emmons County - McIntosh County 345kV Build Emmons County - McIntosh County 345kV; includes costs of new Emmons Co. and new McIntosh Co. Substations	Current Study	$18,055,194	$122,667,737
Flandreau 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Flandreau 115kV	Current Study	$88,753	$796,899
GEN-2016-152 Interconnection Costs See One-Line Diagram.	Current Study	$1,298,461	$1,298,461
Hanlon 230kV Reactive Power Support Install up to 60MVAR capacitor bank at Hanlon 230kV	Current Study	$89,385	$1,679,949
Leland Olds - McIntosh County 345kV Raise structures on Leland Olds - McIntosh 345kV CKT 1 & re-tap CTs at Leland Olds	Current Study	$22,229	$173,511

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Neset - Tioga 230kV Reconductor Neset - Tioga 230kV and replace terminal equipment	Current Study	$343,887	$1,061,463
Tande 345/230kV Transformer CKT 2 Build Tande 345/230kV Transformer CKT 2	Current Study	$3,158,550	$9,413,718
Dickinson 230/115/13.8kV CKT 2 Build new 230/115/13.8kV Transformer circuit #2 at Dickinson and expand Dickinson 115kV switchyard	Previously Allocated		$11,764,180
Neset - Tande 230kV CKT 1 Build new 230kV line from Neset - Tande	Previously Allocated		$3,000,000
Neset 230kV Terminal Upgrade(s) Install necessary terminal equInstall necessary terminal upgrades at Neset 230kV to accommodate new 230kV line from new Tande substation	Previously Allocated		$4,000,000
Tande 345/230kV Substation Construct new 345kV Tande Substation & Tande 345/230/13kV transformer Construct new 345kV Tande Substation adjacent to the existing 230kV Neset Substation and	Previously Allocated		$18,000,000
	Current Study Total	$24,816,728	

GEN-2016-153

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-153 Interconnection Costs See One-Line Diagram.	Current Study	$10,000	$10,000
GRDA - GREC Tap 345kV CKT 1 Replace terminal equipment	Current Study	$1,822	$411,000
Hunter - Woodring 345kV CKT 2 Build approximately 20 miles of new 345kV from Hunter to Woodring	Current Study	$6,224,102	$30,000,000
Lacygne - Waverly 345kV CKT 1 Replace terminal equipment to achieve conductor element	Current Study	$114,173	$2,000,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$704,536	$15,000,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$209,508	$11,500,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$3,168,227	$52,500,000
Reno County 345/115/13kV Transformer CKT 3 Add 3rd xfmr at Reno Sub	Current Study	$698,966	$20,000,000
Viola - Buffalo Flats 345kV CKT 1 Build approximately 35 miles of new 345kV from Viola to Buffalo Flats	Current Study	$13,639,899	$52,500,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Wolf Creek - Waverly 345kV CKT 1 Replace terminal equipment	Current Study	$57,087	$1,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$2,008,219	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Kildare - White Eagle 138kV CKT 1 Rebuild approximately 11 miles of 138kV from Kildare to White Eagle	Previously Allocated		$7,000,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - White Eagle 138kV CKT 1 Rebuild approximately 3 miles of 138kV from Osage to White Eagle	Previously Allocated		$2,000,000
Viola 345/138 kV Transformer CKT 1 SPP 2013 ITP NT assigned upgrade per SPP-NTC-200288 for 6/1/2019 in-service.	Previously Allocated		$18,339,327
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$26,836,538	

GEN-2016-155

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Antelope - Emmons County 345kV CKT 1 Re-tap CTs at Antelope Valley Substation	Current Study	$172	$173,511
Bismark - Hilken 230kV Convert Hilken 230kV to breaker-and-a-half configuration	Current Study	$118,179	$3,500,000
Broadland 345/230kV Transformer CKT 1 Replace Broadland 345/230kV Transformer	Current Study	$11,505	$9,413,718
Emmons County - McIntosh County 345kV Build Emmons County - McIntosh County 345kV; includes costs of new Emmons Co. and new McIntosh Co. Substations	Current Study	$662	$122,667,737

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Flandreau 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Flandreau 115kV	Current Study	$1,169	$796,899
GEN-2016-155 Interconnection Costs See One-Line Diagram.	Current Study	$0	$0
Hanlon 230kV Reactive Power Support Install up to 60MVAR capacitor bank at Hanlon 230kV	Current Study	$990	$1,679,949
Leland Olds - McIntosh County 345kV Raise structures on Leland Olds - McIntosh 345kV CKT 1 & re-tap CTs at Leland Olds	Current Study	$230	$173,511
Dickinson 230/115/13.8kV CKT 2 Build new 230/115/13.8kV Transformer circuit #2 at Dickinson and expand Dickinson 115kV switchyard	Previously Allocated		$11,764,180
Neset - Tande 230kV CKT 1 Build new 230kV line from Neset - Tande	Previously Allocated		$3,000,000
	Current Study Total	$132,907	
GEN-2016-157			
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
GEN-2016-157 Interconnection Costs See One-Line Diagram.	Current Study	$15,002,000	$15,002,000
	Current Study Total	$15,002,000	
GEN-2016-158			
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
GEN-2016-158 Interconnection Costs See One-Line Diagram.	Current Study	$197,500	$197,500
	Current Study Total	$197,500	
GEN-2016-159			
Atwood Switch 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Atwood Switch 115kV	Current Study	$50,782	$796,899
GEN-2016-159 Interconnection Costs See One-Line Diagram.	Current Study	$6,200,000	$6,200,000
GGS - Red Willow 345kV CKT 1 Rebuild GGS - Red Willow 345kV CKT 1	Current Study	$8,659,180	$67,339,931

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Grand Island - Seward County 345kV CKT 1 NRIS only required upgrade: Build Grand Island - Seward County 345kV CKT 1	Current Study	$42,745,427	$100,000,000
Grand Prairie - Antelope 345kV CKT 1 Build Grand Prairie - Antelope 345kV CKT 1	Current Study	$20,122,878	$72,081,510
Grand Prairie - Hoskins 345kV CKT 1 NRIS only required upgrade: Build Grand Prairie - Hoskins 345kV CKT 1	Current Study	$68,076,844	$147,692,308
Heizer 69kV Reactive Power Support Install up to 10MVAR capactior bank at Heizer 69kV	Current Study	$62,329	$398,449
Hoskins - Ft. Calhoun 345kV CKT 1 NRIS only required upgrade: Build Hoskins - Ft. Calhoun 345kV CKT 1	Current Study	$128,355,767	$172,307,692
Keystone - Red Willow 345kV CKT 1 Build Keystone - Red Willow 345kV CKT 1	Current Study	$18,830,286	$175,000,000
Keystone 345kV Reactive Support Install +100Mvar SVC at Keystone 345kV	Current Study	$10,411,891	$215,378,000
Mingo 115kV Reactive Power Support Install up to 50MVAR capacitor bank at Mingo 115kV	Current Study	$233,730	$1,992,248
NPPD Flowgate Mitigation Potential Mitigation for NPPD Flowgates Limit. TBD in the Facilities Study with NPPD.	Current Study	TBD	TBD
PH Run 115kV Reactive Power Support Install up to 30MVAR capacitor bank at PH Run 115kV	Current Study	$132,239	$1,195,348
Red Willow - Caprock 345kV CKT 1 Build Red Willow - Caprock 345kV CKT 1	Current Study	$29,872,221	$275,000,000
Red Willow - Mingo 345kV CKT 1 Rebuild Red Willow - Mingo 345kV CKT 1	Current Study	$9,421,935	$67,188,964
Sheldon - Monolith 115 kV Ckt 1 NRIS only required upgrade: Uprate Sheldon - Monolith 115 kV Ckt 1 (NTC #200477; UID #71967)	Current Study	$833,538	$1,273,506
Albion - Petersburg - North Petersburg 115kV CKT 1 Reconductor 115kV lines and replace all terminal equipment for at least a 193MVA rate.	Previously Allocated		$2,500,000
Atwood Capacitive Reactive Power Support Install 10 Mvars of Capicator Bank(s)	Previously Allocated		$2,000,000
Banner County - Keystone 345kV CKT 1 Build approximately 140 of new 345kV from Banner County to Keystone. Banner County and Keystone Substation Work.	Previously Allocated		$259,100,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Beatrice - Harbine 115kV CKT 1 Uprate Beatrice - Harbine to at least 102MVA per NPPD facility study	Previously Allocated		$900,000
Belvidere - Fairbury 115kV CKT 1 Uprate Belvidere - Fairbury to at least 107MVA per NPPD facility study	Previously Allocated		$1,700,000
Gavins Point - Yankton Junction 115kV CKT 1 Rebuild approximately 5 miles of 115kV from Gavins to Yankton	Previously Allocated		$1,048,341
Gentleman - Thedford 345kV CKT 1 Build approximately 76 Miles of 345kV from Gentleman to Thedford per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Hoskins - Dixon County - Twin Church 230kV Rerate per NPPD Facility Study	Previously Allocated		$500,000
Keystone - Gentleman 345kV CKT 2 Build approximately 30 miles of new 345kV. Gentleman and Keystone Substation Work.	Previously Allocated		$69,900,000
Thedford - Holt County 345kV CKT 1 Build approximately 146 Miles of 345kV from Thedford to Holt County per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Thedford 345/115kV Transformer CKT 1 Install Thedford 345/115kV transformer per SPP-NTC-200277 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Twin Church - Dixon County 230kV Increase conductor clearances to accommodate 320MVA facility rating	Previously Allocated		$100,000
	Current Study Total	$344,009,045	

GEN-2016-160

GEN-2016-160 Interconnection Costs See One-Line Diagram.	Current Study	$0	$0
	Current Study Total	$0	

GEN-2016-161

GEN-2016-161 Interconnection Costs See One-Line Diagram.	Current Study	$0	$0
Beaver County - Clark County 345kV CKT 1 Build approximately 125 miles of new 345kV from Beaver - Clark	Previously Allocated		$150,000,000
Bushland - Potter County 230kV CKT 1 Replace line traps at both terminals	Previously Allocated		$250,000
Cleo Corner - Cleo Plant Tap 138kV CKT 1 Replace terminal equipment to at least 1200 amps	Previously Allocated		$61,890

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Highland Park Tap - Pantex South 115kV CKT 1 Upgrade terminal equipment assigned in 2017 ITP10 per SPP-NTC-200444	Previously Allocated		$324,392
Martin - Pantex North 115kV CKT 1 Previously assigned per SPP NTC-200444 to replace terminal equipment.	Previously Allocated		$400,000
Martin - Pantex North 115kV CKT 1 Upgrade terminal equipment assigned in 2017 ITP10 per SPP-NTC-200444	Previously Allocated		$324,392
Martin - Pantex North 115kV CKT 1 Previously assigned per SPP NTC-200444 to replace terminal equipment.	Previously Allocated		$400,000
Martin - Pantex North 115kV CKT 1 Upgrade terminal equipment assigned in 2017 ITP10 per SPP-NTC-200444	Previously Allocated		$324,392
	Current Study Total	$0	

GEN-2016-162

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Benton - Wichita 345kV CKT 1 Replace terminal equipment	Current Study	$468,376	$1,000,000
Benton 345/138/13kV Transformer CKT 3 NRIS Only Required Upgrade: Install 3rd transformer at Benton	Current Study	$7,500,000	$15,000,000
GEN-2016-162 Interconnection Costs See One-Line Diagram.	Current Study	$959,269	$959,269
Lacygne - Waverly 345kV CKT 1 Replace terminal equipment to achieve conductor element	Current Study	$399,356	$2,000,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$2,464,335	$15,000,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$369,209	$11,500,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$3,472,603	$52,500,000
Reno County 345/115/13kV Transformer CKT 3 Add 3rd xfmr at Reno Sub	Current Study	$1,037,796	$20,000,000
Wolf Creek - Neosho 345kV CKT 1 NRIS Only Required Upgrade: Build approximately 95 miles of Wolf Creek – Neosho 345kV CKT 1	Current Study	$33,843,345	$117,126,900

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Wolf Creek - Waverly 345kV CKT 1 Replace terminal equipment	Current Study	$199,678	$1,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$2,276,979	$30,000,000
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Kildare - White Eagle 138kV CKT 1 Rebuild approximately 11 miles of 138kV from Kildare to White Eagle	Previously Allocated		$7,000,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - White Eagle 138kV CKT 1 Rebuild approximately 3 miles of 138kV from Osage to White Eagle	Previously Allocated		$2,000,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$52,990,946	

GEN-2016-163

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
Benton - Wichita 345kV CKT 1 Replace terminal equipment	Current Study	$468,376	$1,000,000
Benton 345/138/13kV Transformer CKT 3 NRIS Only Required Upgrade: Install 3rd transformer at Benton	Current Study	$7,500,000	$15,000,000
GEN-2016-163 Interconnection Costs See One-Line Diagram.	Current Study	$959,269	$959,269
Lacygne - Waverly 345kV CKT 1 Replace terminal equipment to achieve conductor element	Current Study	$399,356	$2,000,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$2,464,335	$15,000,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$369,209	$11,500,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$3,472,603	$52,500,000
Reno County 345/115/13kV Transformer CKT 3 Add 3rd xfmr at Reno Sub	Current Study	$1,037,796	$20,000,000
Wolf Creek - Neosho 345kV CKT 1 NRIS Only Required Upgrade: Build approximately 95 miles of Wolf Creek – Neosho 345kV CKT 1	Current Study	$33,843,345	$117,126,900
Wolf Creek - Waverly 345kV CKT 1 Replace terminal equipment	Current Study	$199,678	$1,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$2,276,979	$30,000,000
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Kildare - White Eagle 138kV CKT 1 Rebuild approximately 11 miles of 138kV from Kildare to White Eagle	Previously Allocated		$7,000,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - White Eagle 138kV CKT 1 Rebuild approximately 3 miles of 138kV from Osage to White Eagle	Previously Allocated		$2,000,000
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$52,990,946	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-164			
Aberdeen Siebrecht - Groton 115kV CKT 2 NRIS only required upgrade: build Aberdeen Siebrecht - Groton 115kV CKT 2	Current Study	$25,989,607	$25,989,607
Bristol - Groton 115kV CKT 2 NRIS only required upgrade: build Bristol - Groton 115kV CKT 2	Current Study	$18,008,467	$18,008,467
Bristol - Summit 115kV CKT 2 NRIS only required upgrade: build Briston - Summit 115kV CKT 2	Current Study	$27,477,708	$27,477,708
Flandreau 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Flandreau 115kV	Current Study	$12,800	$796,899
Ft. Thompson - Grand Prairie 345kV CKT 1 Rebuild Ft. Thompson – Grand Praire 345kV	Current Study	$856,587	$164,908,759
G13_01 - Summt 115 CKT 2 NRIS only required upgrade: build G13_01 - Summt 115 CKT 2	Current Study	$3,381,872	$3,381,872
G13_01 - Watertown 115kV CKT 2 NRIS only required upgrade: build G13_01 - Watertown 115kV CKT 2	Current Study	$22,573,994	$22,573,994
Gen-2016-017 - Ft. Thompson 345kV CKT 1 Rebuild Gen-2016-017 - Ft. Thompson 345kV CKT 1	Current Study	$41,438	$39,897,280
Gen-2016-017 - Ft. Thompson 345kV CKT 2 Build Gen-2016-017 - Ft. Thompson 345kV CKT 2	Current Study	$44,919	$43,248,906
GEN-2016-164 Interconnection Costs See One-Line Diagram.	Current Study	$0	$0
Grand Prairie - Antelope 345kV CKT 1 Build Grand Prairie - Antelope 345kV CKT 1	Current Study	$33,028	$72,081,510
Hanlon 230kV Reactive Power Support Install up to 60MVAR capacitor bank at Hanlon 230kV	Current Study	$3,996	$1,679,949
Holt County - Grand Island 345kV NRIS only required upgrade: Reconductor Holt County - Grand Island 345kV	Current Study	$20,274	$159,000,000
NPPD Flowgate Mitigation Potential Mitigation for NPPD Flowgates Limit. TBD in the Facilities Study with NPPD.	Current Study	TBD	TBD
Granite Falls - MN Valley Tap 230 kV Ckt 1 NRIS only required upgrade: Rebuild approximately3 miles of 230 kV	Previously Allocated		$2,500,000
	Current Study Total	$98,444,692	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-165			
Atwood Switch 115kV Reactive Power Support Install up to 20MVAR capacitor bank at Atwood Switch 115kV	Current Study	$48,903	$796,899
GEN-2016-165 Interconnection Costs See One-Line Diagram.	Current Study	$2,190,000	$2,190,000
GGS - Red Willow 345kV CKT 1 Rebuild GGS - Red Willow 345kV CKT 1	Current Study	$5,547,074	$67,339,931
Grand Island - Seward County 345kV CKT 1 NRIS only required upgrade: Build Grand Island - Seward County 345kV CKT 1	Current Study	$8,486,338	$100,000,000
Grand Prairie - Antelope 345kV CKT 1 Build Grand Prairie - Antelope 345kV CKT 1	Current Study	$18,970,186	$72,081,510
Grand Prairie - Hoskins 345kV CKT 1 NRIS only required upgrade: Build Grand Prairie - Hoskins 345kV CKT 1	Current Study	$58,359,828	$147,692,308
Heizer 69kV Reactive Power Support Install up to 10MVAR capactior bank at Heizer 69kV	Current Study	$35,852	$398,449
Hoskins - Ft. Calhoun 345kV CKT 1 NRIS only required upgrade: Build Hoskins - Ft. Calhoun 345kV CKT 1	Current Study	$20,846,883	$172,307,692
Keystone - Red Willow 345kV CKT 1 Build Keystone - Red Willow 345kV CKT 1	Current Study	$12,148,598	$175,000,000
Keystone 345kV Reactive Support Install +100Mvar SVC at Keystone 345kV	Current Study	$1,812,468	$215,378,000
Mingo 115kV Reactive Power Support Install up to 50MVAR capacitor bank at Mingo 115kV	Current Study	$154,455	$1,992,248
NPPD Flowgate Mitigation Potential Mitigation for NPPD Flowgates Limit. TBD in the Facilities Study with NPPD.	Current Study	TBD	TBD
PH Run 115kV Reactive Power Support Install up to 30MVAR capacitor bank at PH Run 115kV	Current Study	$90,369	$1,195,348
Post Rock 345/230/13kV Transformer CKT 2 NRIS only required upgrade: Build Post Rock 345/230/13kV Transformer CKT 2	Current Study	$614,453	$9,413,718
Red Willow - Caprock 345kV CKT 1 Build Red Willow - Caprock 345kV CKT 1	Current Study	$20,382,965	$275,000,000
Red Willow - Mingo 345kV CKT 1 Rebuild Red Willow - Mingo 345kV CKT 1	Current Study	$5,677,169	$67,188,964

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Albion - Petersburg - North Petersburg 115kV CKT 1 Reconductor 115kV lines and replace all terminal equipment for at least a 193MVA rate.	Previously Allocated		$2,500,000
Atwood Capacitive Reactive Power Support Install 10 Mvars of Capicator Bank(s)	Previously Allocated		$2,000,000
Banner County - Keystone 345kV CKT 1 Build approximately 140 of new 345kV from Banner County to Keystone. Banner County and Keystone Substation Work.	Previously Allocated		$259,100,000
Beatrice - Harbine 115kV CKT 1 Uprate Beatrice - Harbine to at least 102MVA per NPPD facility study	Previously Allocated		$900,000
Belvidere - Fairbury 115kV CKT 1 Uprate Belvidere - Fairbury to at least 107MVA per NPPD facility study	Previously Allocated		$1,700,000
Gavins Point - Yankton Junction 115kV CKT 1 Rebuild approximately 5 miles of 115kV from Gavins to Yankton	Previously Allocated		$1,048,341
Gentleman - Thedford 345kV CKT 1 Build approximately 76 Miles of 345kV from Gentleman to Thedford per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Hoskins - Dixon County - Twin Church 230kV Rerate per NPPD Facility Study	Previously Allocated		$500,000
Keystone - Gentleman 345kV CKT 2 Build approximately 30 miles of new 345kV. Gentleman and Keystone Substation Work.	Previously Allocated		$69,900,000
Thedford - Holt County 345kV CKT 1 Build approximately 146 Miles of 345kV from Thedford to Holt County per SPP-NTC-200220 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Thedford 345/115kV Transformer CKT 1 Install Thedford 345/115kV transformer per SPP-NTC-200277 (Total Project E&C Cost Shown).	Previously Allocated		$311,717,040
Twin Church - Dixon County 230kV Increase conductor clearances to accommodate 320MVA facility rating	Previously Allocated		$100,000
	Current Study Total	$155,365,542	
GEN-2016-166			
GEN-2016-166 Interconnection Costs See One-Line Diagram.	Current Study	$2,143,750	$2,143,750
GEN-2016-166 Interconnection Facilities Upgrade Mitigate frequency tripping (Refer to Stability Report for details)	Current Study	TBD	TBD
	Current Study Total	$2,143,750	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2016-167			
GEN-2016-167 Interconnection Costs See One-Line Diagram.	Current Study	$6,431,250	$6,431,250
GEN-2016-167 Interconnection Facilities Upgrade Mitigate frequency tripping (Refer to Stability Report for details)	Current Study	TBD	TBD
	Current Study Total	$6,431,250	
GEN-2016-168			
GEN-2016-168 Interconnection Costs See One-Line Diagram.	Current Study	$4,563,000	$4,563,000
GEN-2016-168 Interconnection Facilities Upgrade Mitigate frequency tripping (Refer to Stability Report for details)	Current Study	TBD	TBD
	Current Study Total	$4,563,000	
GEN-2016-169			
Cochran - Lost Draw 115kV CKT 1 Reconductor Cochran - Lost Draw 115kV CKT 1	Current Study	$1,971,872	$4,691,172
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$159,565,009	$1,300,000,000
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$159,565,009	$1,300,000,000
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$15,861,597	$129,226,800
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$31,033,490	$380,000,000
Crossroads - Tolk 345kV CKT 1 Replace Crossroads - Tolk 345kV terminal equipment and resolve clearance issues	Current Study	$21,340	$1,500,000
GEN-2016-169 Interconnection Costs See One-Line Diagram.	Current Study	$4,418,000	$4,418,000
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$5,492,912	$45,530,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Tolk 345/230/13kV Transformer CKT 3 Build third 345/230/13kV transformer at Tolk	Current Study	$3,376,895	$15,000,000
Amoco - Sundown 230kV CKT1 NTC #200395 PID 30844 Terminal Equiptment upgrade Effective 12/14/2018 summer rating of 497/547 and winter rating 553/608	Previously Allocated		$2,200,956
Andrews 345/115/13kV Transformer CKT 1 Replace 230/115kV transformer CKT 1 with 345/115kV transformer	Previously Allocated		$8,000,000
Andrews 345/115/13kV Transformer CKT 2 Replace 230/115kV transformer CKT 2 with 345/115kV transformer	Previously Allocated		$8,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Crawfish Draw - Tuco 345kV CKT 2 Build second circuit from Crawfish Draw - Tuco 345 kV	Previously Allocated		$3,600,000
Crawfish Draw 345/230kV Substation Upgrade Tap Border-TUCO approximately 3 miles from TUCO, build Crawfish Draw 345kV substation, add 345/230/13.2kV transformer, and tie on TUCO-Swisher 230kV.	Previously Allocated		$24,764,205
Drinkard - Drinkard Tap 115kV CKT 1 Rebuild approximately 2 miles from Drinkard to Drinkard Tap	Previously Allocated		$1,500,000
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
Livingston Ridge - Sage Brush - Lagarto - Cardinal 115kV CKT 1 Per HPILs SPP-NTC-200283 (Total Project E&C Cost Shown)	Previously Allocated		$37,316,546
National Enrich Plant Tap - Targa 115kV CKT 1 The rating increases in 2019 NTC#200324 PID:30914 UID:51250 (4.26 mile line)	Previously Allocated		$2,909,669
National Enrichment Plant-Targa 115kV CKT 1 - Rebuild approximately 4 miles of 115kV from National Enrichment Plant to Targa per 2015 ITPNT.	Previously Allocated		$2,909,669
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
South Jal - Teague 115kV CKT 1 Rebuild approximately 10 miles from Jal to Teague assigned in SPP-2014-AG1-AFS-6 per SPP-NTC-200365	Previously Allocated		$6,640,592
Targa-Cardinal 115kV CKT 1 Rebuild approximately 3 miles of 115kV from Targa to Cardinal per 2015 ITPNT.	Previously Allocated		$2,049,062
Terry county - Wolfforth 115kv CKT 1 The rating increases in2018 NTC#200395 PID:31051 UID:51549	Previously Allocated		$1,700,000
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk - Plant X 230kV CKT 1 & 2 Rebuild circuit 1 and 2 betweek Tolk - Plant X 230kV to 1200 amps each.	Previously Allocated		$9,921,693
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000
Tolk 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Tolk	Previously Allocated		$15,000,000
TUCO 345/230/13.2kV Transformer CKT 1 Replace existing TUCO 345/230/13.2kV Transformer circuit #1 with 640MVA.	Previously Allocated		$3,347,036
	Current Study Total	$381,306,122	

GEN-2016-171

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Cochran - Lost Draw 115kV CKT 1 Reconductor Cochran - Lost Draw 115kV CKT 1	Current Study	$567,857	$4,691,172
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$39,039,704	$1,300,000,000
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$39,039,704	$1,300,000,000
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$3,880,751	$129,226,800
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$7,895,299	$380,000,000

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crossroads - Tolk 345kV CKT 1 Replace Crossroads - Tolk 345kV terminal equipment and resolve clearance issues	Current Study	$1,361	$1,500,000
GEN-2016-171 Interconnection Costs See One-Line Diagram.	Current Study	$210,000	$210,000
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$1,347,400	$45,530,000
Tolk 345/230/13kV Transformer CKT 3 Build third 345/230/13kV transformer at Tolk	Current Study	$991,806	$15,000,000
Amoco - Sundown 230kV CKT1 NTC #200395 PID 30844 Terminal Equiptment upgrade Effective 12/14/2018 summer rating of 497/547 and winter rating 553/608	Previously Allocated		$2,200,956
Andrews Substation Voltage Conversion Convert Andrews 230kV to 345kV	Previously Allocated		$10,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Crawfish Draw - Tuco 345kV CKT 2 Build second circuit from Crawfish Draw - Tuco 345 kV	Previously Allocated		$3,600,000
Crawfish Draw 345/230kV Substation Upgrade Tap Border-TUCO approximately 3 miles from TUCO, build Crawfish Draw 345kV substation, add 345/230/13.2kV transformer, and tie on TUCO-Swisher 230kV.	Previously Allocated		$24,764,205
Drinkard Tap - West Hobbs 115kV CKT 1 Rebuild approximately 12.5 miles from Drinkard Tap to West Hobbs	Previously Allocated		$9,375,000
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
Livingston Ridge - Sage Brush - Lagarto - Cardinal 115kV CKT 1 Per HPILs SPP-NTC-200283 (Total Project E&C Cost Shown)	Previously Allocated		$37,316,546

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
National Enrich Plant Tap - Targa 115kV CKT 1 The rating increases in 2019 NTC#200324 PID:30914 UID:51250 (4.26 mile line)	Previously Allocated		$2,909,669
National Enrichment Plant-Targa 115kV CKT 1 - Rebuild approximately 4 miles of 115kV from National Enrichment Plant to Targa per 2015 ITPNT.	Previously Allocated		$2,909,669
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
South Jal - Teague 115kV CKT 1 Rebuild approximately 10 miles from Jal to Teague assigned in SPP-2014-AG1-AFS-6 per SPP-NTC-200365	Previously Allocated		$6,640,592
Targa-Cardinal 115kV CKT 1 Rebuild approximately 3 miles of 115kV from Targa to Cardinal per 2015 ITPNT.	Previously Allocated		$2,049,062
Terry county - Wolfforth 115kv CKT 1 The rating increases in2018 NTC#200395 PID:31051 UID:51549	Previously Allocated		$1,700,000
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000
Tolk 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Tolk	Previously Allocated		$15,000,000
TUCO 345/230/13.2kV Transformer CKT 1 Replace existing TUCO 345/230/13.2kV Transformer circuit #1 with 640MVA.	Previously Allocated		$3,347,036
	Current Study Total	$92,973,880	

GEN-2016-172

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$118,869,361	$1,300,000,000
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$118,869,361	$1,300,000,000
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$11,816,236	$129,226,800

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$15,843,179	$380,000,000
Elk City 230/138/13.8KV Transformer CKT 1 Replace terminal equipment at Elk City 230/138/13.8KV Transformer	Current Study	$809,653	$3,900,000
GEN-2016-172 Interconnection Costs See One-Line Diagram.	Current Study	$1,166,280	$1,166,280
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$4,360,994	$45,530,000
Andrews 345/115/13kV Transformer CKT 1 Replace 230/115kV transformer CKT 1 with 345/115kV transformer	Previously Allocated		$8,000,000
Andrews 345/115/13kV Transformer CKT 2 Replace 230/115kV transformer CKT 2 with 345/115kV transformer	Previously Allocated		$8,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Crawfish Draw - Tuco 345kV CKT 2 Build second circuit from Crawfish Draw - Tuco 345 kV	Previously Allocated		$3,600,000
Crawfish Draw 345/230kV Substation Upgrade Tap Border-TUCO approximately 3 miles from TUCO, build Crawfish Draw 345kV substation, add 345/230/13.2kV transformer, and tie on TUCO-Swisher 230kV.	Previously Allocated		$24,764,205
Drinkard - Drinkard Tap 115kV CKT 1 Rebuild approximately 2 miles from Drinkard to Drinkard Tap	Previously Allocated		$1,500,000
Grapevine - Nichols 230kV CKT 1 Replace terminal equipment	Previously Allocated		$457,981
Grapevine - Wheeler - Sweetwater 230kV CKT 1 Rebuild AEP facilties and SPS replace terminal equipment	Previously Allocated		$4,455,302
National Enrich Plant Tap - Targa 115kV CKT 1 The rating increases in 2019 NTC#200324 PID:30914 UID:51250 (4.26 mile line)	Previously Allocated		$2,909,669
National Enrichment Plant-Targa 115kV CKT 1 - Rebuild approximately 4 miles of 115kV from National Enrichment Plant to Targa per 2015 ITPNT.	Previously Allocated		$2,909,669

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413
Potter - Chisholm 345kV CKT 1 Build approximately 140 miles of new 345kV from Potter County - Chisholm	Previously Allocated		$194,910,000
Potter County 345/230/13kV Transformer CKT 2 Build second 345/230/13kV transformer at Potter County	Previously Allocated		$5,924,670
South Jal - Teague 115kV CKT 1 Rebuild approximately 10 miles from Jal to Teague assigned in SPP-2014-AG1-AFS-6 per SPP-NTC-200365	Previously Allocated		$6,640,592
Targa-Cardinal 115kV CKT 1 Rebuild approximately 3 miles of 115kV from Targa to Cardinal per 2015 ITPNT.	Previously Allocated		$2,049,062
Tolk - Crawfish Draw 345kV CKT 1 Build approximately 64 miles of 345kV from Tolk - Crawfish Draw.	Previously Allocated		$88,170,000
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000
TUCO 345/230/13.2kV Transformer CKT 1 Replace existing TUCO 345/230/13.2kV Transformer circuit #1 with 640MVA.	Previously Allocated		$3,347,036
	Current Study Total	$271,735,064	

GEN-2016-173

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
El Paso - Farber 138kV CKT 1 Replace terminal equipment	Current Study	$500,000	$500,000
GEN-2016-173 Interconnection Costs See One-Line Diagram.	Current Study	$15,838,400	$15,838,400
GEN-2016-173 Interconnection Facilities Mitigation Mitigation required for transient stability unstable response for frequencey tripping	Current Study	TBD	TBD
Lacygne - Waverly 345kV CKT 1 Replace terminal equipment to achieve conductor element	Current Study	$43,018	$2,000,000
Neosho 345kV Reactive Power Support Build Neosho +200Mvar Capacitor Bank(s)	Current Study	$265,457	$15,000,000
Northwest - Spring Creek 345kV CKT 2 Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek	Current Study	$76,398	$11,500,000
Redington - Spring Creek 345kV CKT 1 Build approximately 35 miles of new 345kV from Redington to Spring Creek	Current Study	$666,609	$52,500,000

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Remington - Fairfax 138kV CKT 1 Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C	Current Study	$79,943	$6,700,000
Reno County 345/115/13kV Transformer CKT 3 Add 3rd xfmr at Reno Sub	Current Study	$88,454	$20,000,000
Viola - Buffalo Flats 345kV CKT 1 Build approximately 35 miles of new 345kV from Viola to Buffalo Flats	Current Study	$67,445	$52,500,000
Wolf Creek - Neosho 345kV CKT 1 NRIS Only Required Upgrade: Build approximately 95 miles of Wolf Creek – Neosho 345kV CKT 1	Current Study	$12,138,913	$117,126,900
Wolf Creek - Waverly 345kV CKT 1 Replace terminal equipment	Current Study	$21,509	$1,000,000
Woodring - Redington 345kV CKT 2 Build approximately 20 miles of new 345kV from Woodring to Redington	Current Study	$468,255	$30,000,000
Clearwater - Viola 138kV CKT 1 SPP 2013 ITP NT assigneg upgrade per SPP-NTC-200228 for 12/31/2018 in-service.	Previously Allocated		$31,492,903
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
Farber - Belle Plains 138kV CKT 1 Rebuild approximately 10.3 miles of 138kV from Farber to Belle Plains	Previously Allocated		$9,000,000
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Kildare - White Eagle 138kV CKT 1 Rebuild approximately 11 miles of 138kV from Kildare to White Eagle	Previously Allocated		$7,000,000
Northwest - Spring Creek 345kV CKT 1 Replace terminal equipment	Previously Allocated		$2,500,000
Osage - White Eagle 138kV CKT 1 Rebuild approximately 3 miles of 138kV from Osage to White Eagle	Previously Allocated		$2,000,000
Shidler - Pawhuska - Domes - Mound Rd - Bartlesville Comanche 138kV CKT 1 Rebuild approximately 45 miles of 138kV assigned to higher queued AECI project (GIA-59)	Previously Allocated		$75,811,843
Viola - Sumner County 138kV CKT 1 SPP 2014 ITP NT assigned upgrade per SPP-NTC-200296 for 6/1/2019 in-service.	Previously Allocated		$51,513,963

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$30,254,402	

GEN-2016-174

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
166th Street - Jarbalo Junction 115kV CKT 1 NRIS only required upgrade: Replace terminal equipment at Jarbalo Junction	Current Study	$187,500	$750,000
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
GEN-2016-174 Interconnection Costs See One-Line Diagram.	Current Study	$7,298,094	$7,298,094
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Kildare - White Eagle 138kV CKT 1 Rebuild approximately 11 miles of 138kV from Kildare to White Eagle	Previously Allocated		$7,000,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Osage - White Eagle 138kV CKT 1 Rebuild approximately 3 miles of 138kV from Osage to White Eagle	Previously Allocated		$2,000,000
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$7,485,594	

GEN-2016-175

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crawfish Draw - Seminole 765kv CKT 1 Build approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$79,902,338	$1,300,000,000
Crawfish Draw - Seminole 765kv CKT 2 Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole	Current Study	$79,902,338	$1,300,000,000
Crawfish Draw 765kV Reactive Power Support Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV	Current Study	$7,942,710	$129,226,800

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Crossroads - Crawfish Draw 765kv CKT 1 Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw	Current Study	$2,658,016	$380,000,000
Elk City 230/138/13.8KV Transformer CKT 1 Replace terminal equipment at Elk City 230/138/13.8KV Transformer	Current Study	$594,104	$3,900,000
GEN-2016-175 Interconnection Costs See One-Line Diagram.	Current Study	$16,546,802	$16,546,802
Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2	Current Study	$0	$0
Pittsburg - Seminole 345kV CKT 1 Reconductor Pittsburg-Seminole 345 kV Ckt 1	Current Study	$2,891,315	$45,530,000
Andrews 345/115/13kV Transformer CKT 1 Replace 230/115kV transformer CKT 1 with 345/115kV transformer	Previously Allocated		$8,000,000
Andrews 345/115/13kV Transformer CKT 2 Replace 230/115kV transformer CKT 2 with 345/115kV transformer	Previously Allocated		$8,000,000
Border - Chisholm 345kV CKT 1 & 2 Build 30 miles of double 345 kV circuit from Border (OKGE) - Chisholm (AEP); Upgrade Border and Chisholm substations	Previously Allocated		$84,546,835
Chisholm Substation Upgrade 345kV Cost included in Border - Chisholm CKT 1 & CKT 2 build	Previously Allocated		$0
Crawfish Draw - Border 345kV CKT 2 Build approximately 194 miles of second circuit 345kV from Crawfish Draw - Border	Previously Allocated		$234,229,687
Drinkard - Drinkard Tap 115kV CKT 1 Rebuild approximately 2 miles from Drinkard to Drinkard Tap	Previously Allocated		$1,500,000
National Enrich Plant Tap - Targa 115kV CKT 1 The rating increases in 2019 NTC#200324 PID:30914 UID:51250 (4.26 mile line)	Previously Allocated		$2,909,669
National Enrichment Plant-Targa 115kV CKT 1 - Rebuild approximately 4 miles of 115kV from National Enrichment Plant to Targa per 2015 ITPNT.	Previously Allocated		$2,909,669
Oklaunion 345kV Reactive Power Install +50Mvar Capacitor Bank(s) at Oklaunion	Previously Allocated		$8,654,413
South Jal - Teague 115kV CKT 1 Rebuild approximately 10 miles from Jal to Teague assigned in SPP-2014-AG1-AFS-6 per SPP-NTC-200365	Previously Allocated		$6,640,592
Targa-Cardinal 115kV CKT 1 Rebuild approximately 3 miles of 115kV from Targa to Cardinal per 2015 ITPNT.	Previously Allocated		$2,049,062

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Tolk - Plant X 230kV CKT 1 & 2 Rebuild circuit 1 and 2 betweek Tolk - Plant X 230kV to 1200 amps each.	Previously Allocated		$9,921,693
Tolk - Potter County 345kV CKT 1 Build approximately 115 miles of 345kV from Tolk - Potter County	Previously Allocated		$156,000,000
	Current Study Total	$190,437,625	
GEN-2016-176			
166th Street - Jarbalo Junction 115kV CKT 1 NRIS only required upgrade: Replace terminal equipment at Jarbalo Junction	Current Study	$187,500	$750,000
AECI Affected System Review Requires AECI Affected System Review	Current Study	TBD	TBD
GEN-2016-176 Interconnection Costs See One-Line Diagram.	Current Study	$7,298,094	$7,298,094
Cleveland - Silver City 138kV CKT 1 AECI Affected System Mitigation	Previously Allocated		$790,900
GEN-2015-063 Tap - Mathewson 345kV CKT 1 Replace 89 structures	Previously Allocated		$4,277,161
Iatan - Stranger Creek 345kV CKT 2 Voltage Conversion Convert existing Iatan - Stranger Creek 161kV CKT 1 to 345kV CKT2 per SPP-NTC-200328, 200337, and 200338	Previously Allocated		$37,510,000
Kildare - White Eagle 138kV CKT 1 Rebuild approximately 11 miles of 138kV from Kildare to White Eagle	Previously Allocated		$7,000,000
Osage - Webb Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV from Osage to Webb City	Previously Allocated		$17,750,000
Osage - White Eagle 138kV CKT 1 Rebuild approximately 3 miles of 138kV from Osage to White Eagle	Previously Allocated		$2,000,000
Viola HPILS Upgrade Project 138kV CKT 1 HPILS assigned upgrades per SPP-NTC-20363 & 200362. Build Anthony - Bluff City - Caldwell - Mayfield - Milan - Viola 138 kV Ckt 1	Previously Allocated		$49,070,637
	Current Study Total	$7,485,594	
GEN-2016-177			
GEN-2016-177 Interconnection Costs See One-Line Diagram.	Current Study	$1,458,215	$1,458,215
National Enrichment Plant-Targa 115kV CKT 1 - Rebuild approximately 4 miles of 115kV from National Enrichment Plant to Targa per 2015 ITPNT.	Previously Allocated		$2,909,669

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
	Current Study Total	$1,458,215	
	TOTAL CURRENT STUDY COSTS:	**$6,212,462,350**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

11.6 F: COST ALLOCATION PER PROPOSED STUDY NETWORK UPGRADE

Appendix F. Cost Allocation by Upgrade

166th Street - Jarbalo Junction 115kV CKT 1		**$750,000**
NRIS only required upgrade: Replace terminal equipment at Jarbalo Junction		
GEN-2016-149	$187,500	
GEN-2016-150	$187,500	
GEN-2016-174	$187,500	
GEN-2016-176	$187,500	
Total Allocated Costs	**$750,000**	
Aberdeen Siebrecht - Groton 115kV CKT 2		**$25,989,607**
NRIS only required upgrade: build Aberdeen Siebrecht - Groton 115kV CKT 2		
GEN-2016-164	$25,989,607	
Total Allocated Costs	**$25,989,607**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

AECI Affected System Review			**TBD**
Requires AECI Affected System Review			
	GEN-2016-091		
	GEN-2016-100		
	GEN-2016-101		
	GEN-2016-118		
	GEN-2016-119		
	GEN-2016-120		
	GEN-2016-127		
	GEN-2016-128		
	GEN-2016-133		
	GEN-2016-134		
	GEN-2016-137		
	GEN-2016-138		
	GEN-2016-141		
	GEN-2016-142		
	GEN-2016-143		
	GEN-2016-144		
	GEN-2016-145		
	GEN-2016-146		
	GEN-2016-148		
	GEN-2016-149		
	GEN-2016-150		
	GEN-2016-157		
	GEN-2016-158		
	GEN-2016-162		
	GEN-2016-163		
	GEN-2016-174		
	GEN-2016-176		
	Total Allocated Costs	**TBD**	
Anadarko - Gracemont 138kV CKT 1			**$4,500,000**
NRIS Only Required Upgrade: Rebuild approximately 5 miles of 138kV			
	GEN-2016-148	$4,500,000	
	Total Allocated Costs	**$4,500,000**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Antelope - Emmons County 345kV CKT 1			**$173,511**
Re-tap CTs at Antelope Valley Substation			
	GEN-2016-108	$62,031	
	GEN-2016-130	$38,435	
	GEN-2016-151	$48,422	
	GEN-2016-152	$24,451	
	GEN-2016-155	$172	
	Total Allocated Costs	**$173,511**	
ASGI-2016-009 Interconnection Costs			**TBD**
See One-Line Diagram.			
	ASGI-2016-009	TBD	
	Total Allocated Costs	**TBD**	
ASGI-2016-010 Interconnection Costs			**TBD**
See One-Line Diagram.			
	ASGI-2016-010	TBD	
	Total Allocated Costs	**TBD**	
Atwood Switch 115kV Reactive Power Support			**$796,899**
Install up to 20MVAR capacitor bank at Atwood Switch 115kV			
	GEN-2016-034	$79,282	
	GEN-2016-074	$84,967	
	GEN-2016-096	$18,849	
	GEN-2016-106	$349,241	
	GEN-2016-110	$129,388	
	GEN-2016-147	$35,486	
	GEN-2016-159	$50,782	
	GEN-2016-165	$48,903	
	Total Allocated Costs	**$796,899**	
Benton - Wichita 345kV CKT 1			**$1,000,000**
Replace terminal equipment			
	GEN-2016-024	$63,248	
	GEN-2016-162	$468,376	
	GEN-2016-163	$468,376	
	Total Allocated Costs	**$1,000,000**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Benton 345/138/13kV Transformer CKT 3			**$15,000,000**
NRIS Only Required Upgrade: Install 3rd transformer at Benton			
	GEN-2016-162	$7,500,000	
	GEN-2016-163	$7,500,000	
	Total Allocated Costs	**$15,000,000**	
Bismark - Hilken 230kV			**$3,500,000**
Convert Hilken 230kV to breaker-and-a-half configuration			
	GEN-2016-108	$879,223	
	GEN-2016-130	$1,056,457	
	GEN-2016-151	$960,923	
	GEN-2016-152	$485,219	
	GEN-2016-155	$118,179	
	Total Allocated Costs	**$3,500,000**	
Bristol - Groton 115kV CKT 2			**$18,008,467**
NRIS only required upgrade: build Bristol - Groton 115kV CKT 2			
	GEN-2016-164	$18,008,467	
	Total Allocated Costs	**$18,008,467**	
Bristol - Summit 115kV CKT 2			**$27,477,708**
NRIS only required upgrade: build Briston - Summit 115kV CKT 2			
	GEN-2016-164	$27,477,708	
	Total Allocated Costs	**$27,477,708**	
Bristow - Silver City 138kV CKT 1			**$100,000**
NRIS Only Required Upgrade: Relay change out			
	GEN-2016-148	$100,000	
	Total Allocated Costs	**$100,000**	
Broadland 345/230kV Transformer CKT 1			**$9,413,718**
Replace Broadland 345/230kV Transformer			
	GEN-2016-108	$2,841,384	
	GEN-2016-130	$2,833,548	
	GEN-2016-151	$2,476,681	
	GEN-2016-152	$1,250,601	
	GEN-2016-155	$11,505	
	Total Allocated Costs	**$9,413,718**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Cherokee DCE Tap - Owasso 138kV CKT 1 **$3,000,000**

NRIS Only Required Upgrade: Rebuild approximately 2.5 miles of 138kV

GEN-2016-133	$225,000
GEN-2016-134	$225,000
GEN-2016-135	$120,000
GEN-2016-136	$90,000
GEN-2016-137	$225,000
GEN-2016-138	$225,000
GEN-2016-139	$120,000
GEN-2016-140	$90,000
GEN-2016-141	$420,000
GEN-2016-142	$420,000
GEN-2016-143	$210,000
GEN-2016-144	$210,000
GEN-2016-145	$210,000
GEN-2016-146	$210,000
Total Allocated Costs	**$3,000,000**

Cimarron 345/138kV 3rd xfmr **$27,000,000**

NRIS only required upgrade: No room in Cimarron for new XFMR; build new substation for 3rd XFMR at Cimarron 345kV

GEN-2016-100	$2,043,359
GEN-2016-101	$3,984,550
GEN-2016-119	$12,260,155
GEN-2016-128	$4,134,177
GEN-2016-131	$68,586
GEN-2016-148	$4,509,172
Total Allocated Costs	**$27,000,000**

Cochran - Lost Draw 115kV CKT 1 **$4,691,172**

Reconductor Cochran - Lost Draw 115kV CKT 1

GEN-2015-040	$519,532
GEN-2015-078	$387,944
GEN-2015-099	$540,633
GEN-2016-121	$703,334
GEN-2016-169	$1,971,872
GEN-2016-171	$567,857
Total Allocated Costs	**$4,691,172**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Cornville - Norge Road 138kV CKT 1		**$9,300,000**
Rebuild Cornville - Norge Road 138kV CKT 1		
GEN-2016-097	$9,300,000	
Total Allocated Costs	**$9,300,000**	

Crawfish Draw - Seminole 765kv CKT 1		**$1,300,000,000**
Build approximately 325 miles of 765kV from Crawfish Draw to Semiole		
ASGI-2016-009	$1,826,189	
GEN-2015-039	$24,053,855	
GEN-2015-040	$30,384,030	
GEN-2015-078	$30,392,125	
GEN-2015-099	$44,884,390	
GEN-2016-039	$58,426,850	
GEN-2016-077	$32,560,213	
GEN-2016-078	$58,762,816	
GEN-2016-120	$213,072,902	
GEN-2016-121	$67,632,685	
GEN-2016-123	$194,457,864	
GEN-2016-124	$97,881,475	
GEN-2016-125	$48,288,194	
GEN-2016-169	$159,565,009	
GEN-2016-171	$39,039,704	
GEN-2016-172	$118,869,361	
GEN-2016-175	$79,902,338	
Total Allocated Costs	**$1,300,000,000**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Crawfish Draw - Seminole 765kv CKT 2 **$1,300,000,000**

Build second circuit approximately 325 miles of 765kV from Crawfish Draw to Semiole

ASGI-2016-009	$1,826,189
GEN-2015-039	$24,053,855
GEN-2015-040	$30,384,030
GEN-2015-078	$30,392,125
GEN-2015-099	$44,884,390
GEN-2016-039	$58,426,850
GEN-2016-077	$32,560,213
GEN-2016-078	$58,762,816
GEN-2016-120	$213,072,902
GEN-2016-121	$67,632,685
GEN-2016-123	$194,457,864
GEN-2016-124	$97,881,475
GEN-2016-125	$48,288,194
GEN-2016-169	$159,565,009
GEN-2016-171	$39,039,704
GEN-2016-172	$118,869,361
GEN-2016-175	$79,902,338
Total Allocated Costs	**$1,300,000,000**

Crawfish Draw 345/230kv Transformer CKT 2 **$9,413,717**

Add Crawfish 345/230/13.2 Transformer circuit #2

ASGI-2016-009	$205,675
GEN-2016-039	$7,120,341
GEN-2016-077	$2,087,702
Total Allocated Costs	**$9,413,717**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Crawfish Draw 765kV Reactive Power Support **$129,226,800**

Install SVC at Crawfish Draw Substation with +600Mvar injection at 765kV

ASGI-2016-009	$181,533
GEN-2015-039	$2,391,079
GEN-2015-040	$3,020,332
GEN-2015-078	$3,021,136
GEN-2015-099	$4,461,743
GEN-2016-039	$5,807,934
GEN-2016-077	$3,236,655
GEN-2016-078	$5,841,331
GEN-2016-120	$21,180,561
GEN-2016-121	$6,723,043
GEN-2016-123	$19,330,129
GEN-2016-124	$9,729,931
GEN-2016-125	$4,800,099
GEN-2016-169	$15,861,597
GEN-2016-171	$3,880,751
GEN-2016-172	$11,816,236
GEN-2016-175	$7,942,710
Total Allocated Costs	**$129,226,800**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Crossroads - Crawfish Draw 765kv CKT 1 **$380,000,000**

Build approximately 95 miles of 765kv from Crossroads to Crawfish Draw

ASGI-2016-009	$107,451
GEN-2015-039	$4,459,858
GEN-2015-040	$5,082,351
GEN-2015-078	$5,250,819
GEN-2015-099	$10,371,639
GEN-2016-039	$5,715,642
GEN-2016-077	$4,477,020
GEN-2016-078	$11,698,118
GEN-2016-120	$7,088,043
GEN-2016-121	$19,241,944
GEN-2016-123	$142,193,458
GEN-2016-124	$71,573,888
GEN-2016-125	$35,309,785
GEN-2016-169	$31,033,490
GEN-2016-171	$7,895,299
GEN-2016-172	$15,843,179
GEN-2016-175	$2,658,016
Total Allocated Costs	**$380,000,000**

Crossroads - Tolk 345kV CKT 1 **$1,500,000**

Replace Crossroads - Tolk 345kV terminal equipment and resolve clearance issues

ASGI-2016-009	$636
GEN-2015-040	$11,286
GEN-2015-078	$9,806
GEN-2015-099	$9,546
GEN-2016-077	$18,362
GEN-2016-121	$38,229
GEN-2016-123	$793,202
GEN-2016-124	$399,263
GEN-2016-125	$196,970
GEN-2016-169	$21,340
GEN-2016-171	$1,361
Total Allocated Costs	**$1,500,000**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Dover - Henessey 138kV CKT 1			**$20,000**
Upgrade terminal Equipment: OKGE to Upgrade 800A CT to 1200A CT			
	GEN-2016-118	$20,000	
	Total Allocated Costs	**$20,000**	
El Paso - Farber 138kV CKT 1			**$500,000**
Replace terminal equipment			
	GEN-2016-173	$500,000	
	Total Allocated Costs	**$500,000**	
Elk City 230/138/13.8KV Transformer CKT 1			**$3,900,000**
Replace terminal equipment at Elk City 230/138/13.8KV Transformer			
	GEN-2015-039	$188,381	
	GEN-2016-039	$390,728	
	GEN-2016-078	$332,855	
	GEN-2016-120	$1,584,278	
	GEN-2016-172	$809,653	
	GEN-2016-175	$594,104	
	Total Allocated Costs	**$3,900,000**	
Emmons County - McIntosh County 345kV			**$122,667,737**
Build Emmons County - McIntosh County 345kV; includes costs of new Emmons Co. and new McIntosh Co. Substations			
	GEN-2016-108	$56,599,620	
	GEN-2016-130	$12,255,897	
	GEN-2016-151	$35,756,364	
	GEN-2016-152	$18,055,194	
	GEN-2016-155	$662	
	Total Allocated Costs	**$122,667,737**	
Fairfax 138/69kV Transformers CKT 1 & 2			**$5,000,000**
Upgrade the Fairfax 138/69 kV 56 MVA transformer to two 84 MVA units			
	GEN-2016-127	$2,962,207	
	GEN-2016-148	$2,037,793	
	Total Allocated Costs	**$5,000,000**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Flandreau 115kV Reactive Power Support			**$796,899**
Install up to 20MVAR capacitor bank at Flandreau 115kV			
	GEN-2016-036	$57,232	
	GEN-2016-087	$51,550	
	GEN-2016-092	$26,262	
	GEN-2016-103	$26,262	
	GEN-2016-108	$176,222	
	GEN-2016-130	$180,885	
	GEN-2016-151	$175,766	
	GEN-2016-152	$88,753	
	GEN-2016-155	$1,169	
	GEN-2016-164	$12,800	
	Total Allocated Costs	**$796,899**	
Ft. Thompson - GEN-2016-094 230kV CKT 1 & CKT 2			**$750,000**
Replace terminal equipment at Ft. Thompson 230kV			
	GEN-2016-094	$750,000	
	Total Allocated Costs	**$750,000**	
Ft. Thompson - Grand Prairie 345kV CKT 1			**$164,908,759**
Rebuild Ft. Thompson – Grand Praire 345kV			
	GEN-2016-036	$3,220,929	
	GEN-2016-087	$15,884,112	
	GEN-2016-092	$72,473,566	
	GEN-2016-103	$72,473,566	
	GEN-2016-164	$856,587	
	Total Allocated Costs	**$164,908,759**	
Ft. Thompson 345/230kV Transformer CKT 1			**$9,413,718**
Replace Ft. Thompson 345/230kV Transformer CKT 1			
	GEN-2016-092	$4,706,859	
	GEN-2016-103	$4,706,859	
	Total Allocated Costs	**$9,413,718**	
Ft. Thompson 345/230kV Transformer CKT 2			**$9,413,718**
Replace Ft. Thompson 345/230kV Transformer CKT 2			
	GEN-2016-092	$4,706,859	
	GEN-2016-103	$4,706,859	
	Total Allocated Costs	**$9,413,718**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

G13_01 - Summt 115 CKT 2			**$3,381,872**
NRIS only required upgrade: build G13_01 - Summt 115 CKT 2			
	GEN-2016-164	$3,381,872	
	Total Allocated Costs **$3,381,872**		
G13_01 - Watertown 115kV CKT 2			**$22,573,994**
NRIS only required upgrade: build G13_01 - Watertown 115kV CKT 2			
	GEN-2016-164	$22,573,994	
	Total Allocated Costs **$22,573,994**		
G16-126 Tap - Arbuckle 138kV CKT 2			**$4,500,000**
Build G16-126 Tap - Arbuckle 138kV CKT 2			
	GEN-2016-102	$1,819,163	
	GEN-2016-126	$2,680,837	
	Total Allocated Costs **$4,500,000**		
GEN-2015-039 Interconnection Costs			**$8,609,632**
See One-Line Diagram.			
	GEN-2015-039	$8,609,632	
	Total Allocated Costs **$8,609,632**		
GEN-2015-040 Interconnection Costs			**$1,237,460**
See One-Line Diagram.			
	GEN-2015-040	$1,237,460	
	Total Allocated Costs **$1,237,460**		
GEN-2015-078 Interconnection Costs			**$3,562,000**
See One-Line Diagram.			
	GEN-2015-078	$3,562,000	
	Total Allocated Costs **$3,562,000**		
GEN-2015-099 Interconnection Costs			**$4,688,000**
See One-Line Diagram.			
	GEN-2015-099	$4,688,000	
	Total Allocated Costs **$4,688,000**		

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Gen-2016-017 - Ft. Thompson 345kV CKT 1			**$39,897,280**
Rebuild Gen-2016-017 - Ft. Thompson 345kV CKT 1			
	GEN-2016-036	$107,986	
	GEN-2016-087	$330,460	
	GEN-2016-092	$19,708,698	
	GEN-2016-103	$19,708,698	
	GEN-2016-164	$41,438	
	Total Allocated Costs	**$39,897,280**	
Gen-2016-017 - Ft. Thompson 345kV CKT 2			**$43,248,906**
Build Gen-2016-017 - Ft. Thompson 345kV CKT 2			
	GEN-2016-036	$117,058	
	GEN-2016-087	$358,221	
	GEN-2016-092	$21,364,354	
	GEN-2016-103	$21,364,354	
	GEN-2016-164	$44,919	
	Total Allocated Costs	**$43,248,906**	
GEN-2016-023-Tap - Stegall 345kV CKT 2			**$43,248,906**
Build GEN-2016-023-Tap - Stegall 345kV CKT 2			
	GEN-2016-034	$7,639,891	
	GEN-2016-074	$899,987	
	GEN-2016-106	$3,641,218	
	GEN-2016-110	$30,815,750	
	GEN-2016-147	$252,060	
	Total Allocated Costs	**$43,248,906**	
GEN-2016-024 Interconnection Costs			**$1,929,855**
See One-Line Diagram.			
	GEN-2016-024	$1,929,855	
	Total Allocated Costs	**$1,929,855**	
GEN-2016-034 Interconnection Costs			**$2,531,976**
See One-Line Diagram.			
	GEN-2016-034	$2,531,976	
	Total Allocated Costs	**$2,531,976**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GEN-2016-036 Interconnection Costs			**$1,340,000**
See One-Line Diagram.			
	GEN-2016-036	$1,340,000	
	Total Allocated Costs	**$1,340,000**	
GEN-2016-039 Interconnection Costs			**$210,000**
See One-Line Diagram.			
	GEN-2016-039	$210,000	
	Total Allocated Costs	**$210,000**	
GEN-2016-072 Interconnection Costs			**$1,940,000**
See One-Line Diagram.			
	GEN-2016-072	$1,940,000	
	Total Allocated Costs	**$1,940,000**	
GEN-2016-074 Interconnection Costs			**$7,500,000**
See One-Line Diagram.			
	GEN-2016-074	$7,500,000	
	Total Allocated Costs	**$7,500,000**	
GEN-2016-077 Interconnection Costs			**$1,700,000**
See One-Line Diagram.			
	GEN-2016-077	$1,700,000	
	Total Allocated Costs	**$1,700,000**	
GEN-2016-077 Interconnection Facilities Upgrade			**TBD**
Mitigate frequency tripping (Refer to Stability Report for details)			
	GEN-2016-077	TBD	
	Total Allocated Costs	**TBD**	
GEN-2016-078 Interconnection Costs			**$1,282,250**
See One-Line Diagram.			
	GEN-2016-078	$1,282,250	
	Total Allocated Costs	**$1,282,250**	
GEN-2016-078 Interconnection Facilities Upgrade			**TBD**
Mitigate frequency tripping (Refer to Stability Report for details)			
	GEN-2016-078	TBD	
	Total Allocated Costs	**TBD**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GEN-2016-087 Interconnection Costs			**$1,565,000**
See One-Line Diagram.			
	GEN-2016-087	$1,565,000	
	Total Allocated Costs	**$1,565,000**	
GEN-2016-088 Interconnection Costs			**$1,532,553**
See One-Line Diagram.			
	GEN-2016-088	$1,532,553	
	Total Allocated Costs	**$1,532,553**	
GEN-2016-091 Interconnection Costs			**$10,343,736**
See One-Line Diagram.			
	GEN-2016-091	$10,343,736	
	Total Allocated Costs	**$10,343,736**	
GEN-2016-092 Interconnection Costs			**$3,404,096**
See One-Line Diagram.			
	GEN-2016-092	$3,404,096	
	Total Allocated Costs	**$3,404,096**	
GEN-2016-094 Interconnection Costs			**$1,960,000**
See One-Line Diagram.			
	GEN-2016-094	$1,960,000	
	Total Allocated Costs	**$1,960,000**	
GEN-2016-095 Interconnection Costs			**$10,343,736**
See One-Line Diagram.			
	GEN-2016-095	$10,343,736	
	Total Allocated Costs	**$10,343,736**	
GEN-2016-096 Interconnection Costs			**$1,700,000**
See One-Line Diagram.			
	GEN-2016-096	$1,700,000	
	Total Allocated Costs	**$1,700,000**	
GEN-2016-097 Interconnection Costs			**$7,778,750**
See One-Line Diagram.			
	GEN-2016-097	$7,778,750	
	Total Allocated Costs	**$7,778,750**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GEN-2016-100 Interconnection Costs			**$6,465,000**
See One-Line Diagram.			
	GEN-2016-100	$6,465,000	
	Total Allocated Costs	**$6,465,000**	
GEN-2016-101 Interconnection Costs			**$20,000**
See One-Line Diagram.			
	GEN-2016-101	$20,000	
	Total Allocated Costs	**$20,000**	
GEN-2016-102 Interconnection Costs			**$3,405,000**
See One-Line Diagram.			
	GEN-2016-102	$3,405,000	
	Total Allocated Costs	**$3,405,000**	
GEN-2016-103 Interconnection Costs			**$3,404,096**
See One-Line Diagram.			
	GEN-2016-103	$3,404,096	
	Total Allocated Costs	**$3,404,096**	
GEN-2016-106 Interconnection Costs			**$1,700,000**
See One-Line Diagram.			
	GEN-2016-106	$1,700,000	
	Total Allocated Costs	**$1,700,000**	
GEN-2016-108 Interconnection Costs			**$23,074,093**
See One-Line Diagram.			
	GEN-2016-108	$23,074,093	
	Total Allocated Costs	**$23,074,093**	
GEN-2016-110 Interconnection Costs			**$23,052,493**
See One-Line Diagram.			
	GEN-2016-110	$23,052,493	
	Total Allocated Costs	**$23,052,493**	
GEN-2016-111 Interconnection Costs			**$8,792,574**
See One-Line Diagram.			
	GEN-2016-111	$8,792,574	
	Total Allocated Costs	**$8,792,574**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GEN-2016-112 Interconnection Costs			**$5,371,860**
See One-Line Diagram.			
	GEN-2016-112	$5,371,860	
	Total Allocated Costs	**$5,371,860**	
GEN-2016-113 Interconnection Costs			**$5,371,860**
See One-Line Diagram.			
	GEN-2016-113	$5,371,860	
	Total Allocated Costs	**$5,371,860**	
GEN-2016-114 Interconnection Costs			**$8,792,574**
See One-Line Diagram.			
	GEN-2016-114	$8,792,574	
	Total Allocated Costs	**$8,792,574**	
GEN-2016-115 Interconnection Costs			**$1,532,553**
See One-Line Diagram.			
	GEN-2016-115	$1,532,553	
	Total Allocated Costs	**$1,532,553**	
GEN-2016-116 Interconnection Costs			
See One-Line Diagram.			
	GEN-2016-116		
	Total Allocated Costs		
GEN-2016-118 Interconnection Costs			**$5,010,000**
See One-Line Diagram.			
	GEN-2016-118	$5,010,000	
	Total Allocated Costs	**$5,010,000**	
GEN-2016-119 Interconnection Costs			**$6,465,000**
See One-Line Diagram.			
	GEN-2016-119	$6,465,000	
	Total Allocated Costs	**$6,465,000**	
GEN-2016-120 Interconnection Costs			**$16,546,802**
See One-Line Diagram.			
	GEN-2016-120	$16,546,802	
	Total Allocated Costs	**$16,546,802**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GEN-2016-121 Interconnection Costs			**$2,799,536**
See One-Line Diagram.			
	GEN-2016-121	$2,799,536	
	Total Allocated Costs	**$2,799,536**	
GEN-2016-122 Interconnection Costs			**$5,371,860**
See One-Line Diagram.			
	GEN-2016-122	$5,371,860	
	Total Allocated Costs	**$5,371,860**	
GEN-2016-123 Interconnection Costs			**$1,585,403**
See One-Line Diagram.			
	GEN-2016-123	$1,585,403	
	Total Allocated Costs	**$1,585,403**	
GEN-2016-124 Interconnection Costs			**$1,585,403**
See One-Line Diagram.			
	GEN-2016-124	$1,585,403	
	Total Allocated Costs	**$1,585,403**	
GEN-2016-125 Interconnection Costs			**$1,585,403**
See One-Line Diagram.			
	GEN-2016-125	$1,585,403	
	Total Allocated Costs	**$1,585,403**	
GEN-2016-126 Interconnection Costs			**$4,000,000**
See One-Line Diagram.			
	GEN-2016-126	$4,000,000	
	Total Allocated Costs	**$4,000,000**	
GEN-2016-127 Interconnection Costs			**$1,653,750**
See One-Line Diagram.			
	GEN-2016-127	$1,653,750	
	Total Allocated Costs	**$1,653,750**	
GEN-2016-128 Interconnection Costs			**$5,052,000**
See One-Line Diagram.			
	GEN-2016-128	$5,052,000	
	Total Allocated Costs	**$5,052,000**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GEN-2016-129 Interconnection Costs			**$5,367,500**
See One-Line Diagram.			
	GEN-2016-129	$5,367,500	
	Total Allocated Costs	**$5,367,500**	
GEN-2016-130 Interconnection Costs			**$2,853,562**
See One-Line Diagram.			
	GEN-2016-130	$2,853,562	
	Total Allocated Costs	**$2,853,562**	
GEN-2016-131 Interconnection Costs			**$0**
See One-Line Diagram.			
	GEN-2016-131	$0	
	Total Allocated Costs	**$0**	
GEN-2016-132 Interconnection Costs			**$210,000**
See One-Line Diagram.			
	GEN-2016-132	$210,000	
	Total Allocated Costs	**$210,000**	
GEN-2016-133 Interconnection Costs			**$2,270,461**
See One-Line Diagram.			
	GEN-2016-133	$2,270,461	
	Total Allocated Costs	**$2,270,461**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GEN-2016-133 through -146 Reactive Power Support			**TBD**
Install +300/-150 MVar Static Var Compensator (SVC) at the collector system facilities for GEN-2016-133, -134, -135, -136, -137,-138,-139,-140,-141,-142,-			
	GEN-2016-133	TBD	
	GEN-2016-134	TBD	
	GEN-2016-135	TBD	
	GEN-2016-136	TBD	
	GEN-2016-137	TBD	
	GEN-2016-138	TBD	
	GEN-2016-139	TBD	
	GEN-2016-140	TBD	
	GEN-2016-141	TBD	
	GEN-2016-142	TBD	
	GEN-2016-143	TBD	
	GEN-2016-144	TBD	
	GEN-2016-145	TBD	
	GEN-2016-146	TBD	
	Total Allocated Costs	**TBD**	
GEN-2016-134 Interconnection Costs			**$2,270,461**
See One-Line Diagram.			
	GEN-2016-134	$2,270,461	
	Total Allocated Costs	**$2,270,461**	
GEN-2016-135 Interconnection Costs			**$2,270,461**
See One-Line Diagram.			
	GEN-2016-135	$2,270,461	
	Total Allocated Costs	**$2,270,461**	
GEN-2016-136 Interconnection Costs			**$2,270,461**
See One-Line Diagram.			
	GEN-2016-136	$2,270,461	
	Total Allocated Costs	**$2,270,461**	
GEN-2016-137 Interconnection Costs			**$2,270,461**
See One-Line Diagram.			
	GEN-2016-137	$2,270,461	
	Total Allocated Costs	**$2,270,461**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GEN-2016-138 Interconnection Costs			**$2,270,461**
See One-Line Diagram.			
	GEN-2016-138	$2,270,461	
	Total Allocated Costs	**$2,270,461**	
GEN-2016-139 Interconnection Costs			**$2,270,461**
See One-Line Diagram.			
	GEN-2016-139	$2,270,461	
	Total Allocated Costs	**$2,270,461**	
GEN-2016-140 Interconnection Costs			**$2,270,461**
See One-Line Diagram.			
	GEN-2016-140	$2,270,461	
	Total Allocated Costs	**$2,270,461**	
GEN-2016-141 Interconnection Costs			**$2,270,461**
See One-Line Diagram.			
	GEN-2016-141	$2,270,461	
	Total Allocated Costs	**$2,270,461**	
GEN-2016-142 Interconnection Costs			**$2,270,461**
See One-Line Diagram.			
	GEN-2016-142	$2,270,461	
	Total Allocated Costs	**$2,270,461**	
GEN-2016-143 Interconnection Costs			**$2,270,461**
See One-Line Diagram.			
	GEN-2016-143	$2,270,461	
	Total Allocated Costs	**$2,270,461**	
GEN-2016-144 Interconnection Costs			**$2,270,461**
See One-Line Diagram.			
	GEN-2016-144	$2,270,461	
	Total Allocated Costs	**$2,270,461**	
GEN-2016-145 Interconnection Costs			**$2,270,461**
See One-Line Diagram.			
	GEN-2016-145	$2,270,461	
	Total Allocated Costs	**$2,270,461**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GEN-2016-146 Interconnection Costs			**$2,270,461**
See One-Line Diagram.			
	GEN-2016-146	$2,270,461	
	Total Allocated Costs	**$2,270,461**	
GEN-2016-147 Interconnection Costs			**$3,521,000**
See One-Line Diagram.			
	GEN-2016-147	$3,521,000	
	Total Allocated Costs	**$3,521,000**	
GEN-2016-148 Interconnection Costs			**$635,000**
See One-Line Diagram.			
	GEN-2016-148	$635,000	
	Total Allocated Costs	**$635,000**	
GEN-2016-149 Interconnection Costs			**$7,298,094**
See One-Line Diagram.			
	GEN-2016-149	$7,298,094	
	Total Allocated Costs	**$7,298,094**	
GEN-2016-150 Interconnection Costs			**$7,298,094**
See One-Line Diagram.			
	GEN-2016-150	$7,298,094	
	Total Allocated Costs	**$7,298,094**	
GEN-2016-151 Interconnection Costs			**$1,298,461**
See One-Line Diagram.			
	GEN-2016-151	$1,298,461	
	Total Allocated Costs	**$1,298,461**	
GEN-2016-152 Interconnection Costs			**$1,298,461**
See One-Line Diagram.			
	GEN-2016-152	$1,298,461	
	Total Allocated Costs	**$1,298,461**	
GEN-2016-153 Interconnection Costs			**$10,000**
See One-Line Diagram.			
	GEN-2016-153	$10,000	
	Total Allocated Costs	**$10,000**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GEN-2016-155 Interconnection Costs			**$0**
See One-Line Diagram.			
	GEN-2016-155	$0	
	Total Allocated Costs	**$0**	
GEN-2016-157 Interconnection Costs			**$15,002,000**
See One-Line Diagram.			
	GEN-2016-157	$15,002,000	
	Total Allocated Costs	**$15,002,000**	
GEN-2016-158 Interconnection Costs			**$197,500**
See One-Line Diagram.			
	GEN-2016-158	$197,500	
	Total Allocated Costs	**$197,500**	
GEN-2016-159 Interconnection Costs			**$6,200,000**
See One-Line Diagram.			
	GEN-2016-159	$6,200,000	
	Total Allocated Costs	**$6,200,000**	
GEN-2016-160 Interconnection Costs			**$0**
See One-Line Diagram.			
	GEN-2016-160	$0	
	Total Allocated Costs	**$0**	
GEN-2016-161 Interconnection Costs			**$0**
See One-Line Diagram.			
	GEN-2016-161	$0	
	Total Allocated Costs	**$0**	
GEN-2016-162 Interconnection Costs			**$959,269**
See One-Line Diagram.			
	GEN-2016-162	$959,269	
	Total Allocated Costs	**$959,269**	
GEN-2016-163 Interconnection Costs			**$959,269**
See One-Line Diagram.			
	GEN-2016-163	$959,269	
	Total Allocated Costs	**$959,269**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GEN-2016-164 Interconnection Costs			**$0**
See One-Line Diagram.			
	GEN-2016-164	$0	
	Total Allocated Costs	**$0**	
GEN-2016-165 Interconnection Costs			**$2,190,000**
See One-Line Diagram.			
	GEN-2016-165	$2,190,000	
	Total Allocated Costs	**$2,190,000**	
GEN-2016-166 Interconnection Costs			**$2,143,750**
See One-Line Diagram.			
	GEN-2016-166	$2,143,750	
	Total Allocated Costs	**$2,143,750**	
GEN-2016-166 Interconnection Facilities Upgrade			**TBD**
Mitigate frequency tripping (Refer to Stability Report for details)			
	GEN-2016-166	TBD	
	Total Allocated Costs	**TBD**	
GEN-2016-167 Interconnection Costs			**$6,431,250**
See One-Line Diagram.			
	GEN-2016-167	$6,431,250	
	Total Allocated Costs	**$6,431,250**	
GEN-2016-167 Interconnection Facilities Upgrade			**TBD**
Mitigate frequency tripping (Refer to Stability Report for details)			
	GEN-2016-167	TBD	
	Total Allocated Costs	**TBD**	
GEN-2016-168 Interconnection Costs			**$4,563,000**
See One-Line Diagram.			
	GEN-2016-168	$4,563,000	
	Total Allocated Costs	**$4,563,000**	
GEN-2016-168 Interconnection Facilities Upgrade			**TBD**
Mitigate frequency tripping (Refer to Stability Report for details)			
	GEN-2016-168	TBD	
	Total Allocated Costs	**TBD**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GEN-2016-169 Interconnection Costs		**$4,418,000**
See One-Line Diagram.		
GEN-2016-169	$4,418,000	
Total Allocated Costs	**$4,418,000**	
GEN-2016-171 Interconnection Costs		**$210,000**
See One-Line Diagram.		
GEN-2016-171	$210,000	
Total Allocated Costs	**$210,000**	
GEN-2016-172 Interconnection Costs		**$1,166,280**
See One-Line Diagram.		
GEN-2016-172	$1,166,280	
Total Allocated Costs	**$1,166,280**	
GEN-2016-173 Interconnection Costs		**$15,838,400**
See One-Line Diagram.		
GEN-2016-173	$15,838,400	
Total Allocated Costs	**$15,838,400**	
GEN-2016-173 Interconnection Facilities Mitigation		**TBD**
Mitigation required for transient stability unstable response for frequencey tripping		
GEN-2016-173	TBD	
Total Allocated Costs	**TBD**	
GEN-2016-174 Interconnection Costs		**$7,298,094**
See One-Line Diagram.		
GEN-2016-174	$7,298,094	
Total Allocated Costs	**$7,298,094**	
GEN-2016-175 Interconnection Costs		**$16,546,802**
See One-Line Diagram.		
GEN-2016-175	$16,546,802	
Total Allocated Costs	**$16,546,802**	
GEN-2016-176 Interconnection Costs		**$7,298,094**
See One-Line Diagram.		
GEN-2016-176	$7,298,094	
Total Allocated Costs	**$7,298,094**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GEN-2016-177 Interconnection Costs			**$1,458,215**
See One-Line Diagram.			
	GEN-2016-177	$1,458,215	
	Total Allocated Costs	**$1,458,215**	
GGS - Red Willow 345kV CKT 1			**$67,339,931**
Rebuild GGS - Red Willow 345kV CKT 1			
	GEN-2016-034	$4,188,673	
	GEN-2016-074	$7,906,737	
	GEN-2016-096	$4,274,467	
	GEN-2016-106	$27,978,698	
	GEN-2016-110	$6,920,538	
	GEN-2016-147	$1,864,563	
	GEN-2016-159	$8,659,180	
	GEN-2016-165	$5,547,074	
	Total Allocated Costs	**$67,339,931**	
Grand Island - Seward County 345kV CKT 1			**$100,000,000**
NRIS only required upgrade: Build Grand Island - Seward County 345kV CKT 1			
	GEN-2016-074	$15,418,195	
	GEN-2016-106	$19,361,249	
	GEN-2016-110	$12,347,392	
	GEN-2016-147	$1,641,399	
	GEN-2016-159	$42,745,427	
	GEN-2016-165	$8,486,338	
	Total Allocated Costs	**$100,000,000**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Grand Prairie - Antelope 345kV CKT 1 **$72,081,510**

Build Grand Prairie - Antelope 345kV CKT 1

GEN-2016-034	$1,614,761
GEN-2016-036	$54,900
GEN-2016-074	$3,086,665
GEN-2016-087	$1,312,947
GEN-2016-092	$7,838,471
GEN-2016-096	$218,868
GEN-2016-103	$7,838,471
GEN-2016-106	$7,570,029
GEN-2016-110	$2,702,926
GEN-2016-147	$717,377
GEN-2016-159	$20,122,878
GEN-2016-164	$33,028
GEN-2016-165	$18,970,186
Total Allocated Costs	**$72,081,510**

Grand Prairie - Hoskins 345kV CKT 1 **$147,692,308**

NRIS only required upgrade: Build Grand Prairie - Hoskins 345kV CKT 1

GEN-2016-074	$3,439,198
GEN-2016-106	$13,544,884
GEN-2016-110	$3,003,219
GEN-2016-147	$1,268,335
GEN-2016-159	$68,076,844
GEN-2016-165	$58,359,828
Total Allocated Costs	**$147,692,308**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

GRDA - GREC Tap 345kV CKT 1 **$411,000**

Replace terminal equipment

GEN-2016-072	$188
GEN-2016-100	$2,198
GEN-2016-101	$4,286
GEN-2016-119	$13,189
GEN-2016-127	$4,821
GEN-2016-128	$1,857
GEN-2016-133	$28,435
GEN-2016-134	$28,435
GEN-2016-135	$15,165
GEN-2016-136	$11,374
GEN-2016-137	$28,435
GEN-2016-138	$28,435
GEN-2016-139	$15,165
GEN-2016-140	$11,374
GEN-2016-141	$53,078
GEN-2016-142	$53,078
GEN-2016-143	$26,539
GEN-2016-144	$26,539
GEN-2016-145	$26,539
GEN-2016-146	$26,539
GEN-2016-148	$3,509
GEN-2016-153	$1,822
Total Allocated Costs	**$411,000**

Great Bend - South Hays 230kV CKT 1 **$26,225,037**

NRIS only required upgrade: Rebuild Great Bend - South Hays 230kV CKT 1

GEN-2016-110	$26,225,037
Total Allocated Costs	**$26,225,037**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Hanlon 230kV Reactive Power Support **$1,679,949**

Install up to 60MVAR capacitor bank at Hanlon 230kV

GEN-2016-087	$129,681
GEN-2016-092	$452,936
GEN-2016-103	$452,936
GEN-2016-108	$187,309
GEN-2016-130	$185,697
GEN-2016-151	$177,018
GEN-2016-152	$89,385
GEN-2016-155	$990
GEN-2016-164	$3,996
Total Allocated Costs	**$1,679,949**

Hardy - Webb City 138kV CKT 1 **$1,700,000**

Rebuild/Re-conductor approximately 2 miles of 138kV

GEN-2016-148	$1,700,000
Total Allocated Costs	**$1,700,000**

Heizer 69kV Reactive Power Support **$398,449**

Install up to 10MVAR capactior bank at Heizer 69kV

GEN-2016-034	$26,225
GEN-2016-074	$55,630
GEN-2016-096	$43,429
GEN-2016-106	$119,736
GEN-2016-110	$43,486
GEN-2016-147	$11,762
GEN-2016-159	$62,329
GEN-2016-165	$35,852
Total Allocated Costs	**$398,449**

Holt County - Grand Island 345kV **$159,000,000**

NRIS only required upgrade: Reconductor Holt County - Grand Island 345kV

GEN-2016-092	$79,489,863
GEN-2016-103	$79,489,863
GEN-2016-164	$20,274
Total Allocated Costs	**$159,000,000**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Hoskins - Ft. Calhoun 345kV CKT 1			**$172,307,692**
NRIS only required upgrade: Build Hoskins - Ft. Calhoun 345kV CKT 1			
	GEN-2016-074	$5,865,784	
	GEN-2016-106	$14,203,482	
	GEN-2016-110	$1,599,395	
	GEN-2016-147	$1,436,382	
	GEN-2016-159	$128,355,767	
	GEN-2016-165	$20,846,883	
	Total Allocated Costs	**$172,307,692**	
Hoyt - Jeffrey Energy Center 345kV CKT 1			**$37,000,000**
Rebuild approximately 24 miles of 345kV			
	GEN-2016-111	$8,616,681	
	GEN-2016-112	$7,164,074	
	GEN-2016-113	$5,047,415	
	GEN-2016-114	$8,844,937	
	GEN-2016-122	$7,326,893	
	Total Allocated Costs	**$37,000,000**	
Hunter - Woodring 345kV CKT 2			**$30,000,000**
Build approximately 20 miles of new 345kV from Hunter to Woodring			
	GEN-2016-072	$23,775,898	
	GEN-2016-153	$6,224,102	
	Total Allocated Costs	**$30,000,000**	
Keystone - Red Willow 345kV CKT 1			**$175,000,000**
Build Keystone - Red Willow 345kV CKT 1			
	GEN-2016-034	$20,200,894	
	GEN-2016-074	$16,221,864	
	GEN-2016-096	$8,669,539	
	GEN-2016-106	$57,961,033	
	GEN-2016-110	$32,800,050	
	GEN-2016-147	$8,167,736	
	GEN-2016-159	$18,830,286	
	GEN-2016-165	$12,148,598	
	Total Allocated Costs	**$175,000,000**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Keystone 345kV Reactive Support		**$215,378,000**
Install +100Mvar SVC at Keystone 345kV		
GEN-2016-034	$17,596,421	
GEN-2016-074	$43,716,579	
GEN-2016-096	$15,033,551	
GEN-2016-106	$90,493,817	
GEN-2016-110	$28,487,158	
GEN-2016-147	$7,826,115	
GEN-2016-159	$10,411,891	
GEN-2016-165	$1,812,468	
Total Allocated Costs	**$215,378,000**	
Lacygne - Waverly 345kV CKT 1		**$2,000,000**
Replace terminal equipment to achieve conductor element		
GEN-2016-024	$74,730	
GEN-2016-072	$213,811	
GEN-2016-100	$56,530	
GEN-2016-101	$110,233	
GEN-2016-119	$339,178	
GEN-2016-127	$81,583	
GEN-2016-128	$103,384	
GEN-2016-148	$64,649	
GEN-2016-153	$114,173	
GEN-2016-162	$399,356	
GEN-2016-163	$399,356	
GEN-2016-173	$43,018	
Total Allocated Costs	**$2,000,000**	
Leland Olds - McIntosh County 345kV		**$173,511**
Raise structures on Leland Olds - McIntosh 345kV CKT 1 & re-tap CTs at Leland Olds		
GEN-2016-108	$46,964	
GEN-2016-130	$60,066	
GEN-2016-151	$44,022	
GEN-2016-152	$22,229	
GEN-2016-155	$230	
Total Allocated Costs	**$173,511**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

LRS - Stegall 345kV CKT 1 Reroute **$12,515,657**

Reroute LRS - Stegall 345kV CKT 1 through the GEN-2016-023-Tap Substation

GEN-2016-034	$2,279,441
GEN-2016-074	$491,302
GEN-2016-106	$1,506,419
GEN-2016-110	$8,213,885
GEN-2016-147	$24,610
Total Allocated Costs	**$12,515,657**

Midpoint Station for Crawfish - Seminole 765kV CKT 1 and CKT 2 **$0**

Tap & Tie Crawfish - Seminole 765kV CKT 1 and CKT 2. Cost included in Crawfish - Seminole 765kV CKT 1&2

ASGI-2016-009	$0
GEN-2015-039	$0
GEN-2015-040	$0
GEN-2015-078	$0
GEN-2015-099	$0
GEN-2016-039	$0
GEN-2016-077	$0
GEN-2016-078	$0
GEN-2016-120	$0
GEN-2016-121	$0
GEN-2016-123	$0
GEN-2016-124	$0
GEN-2016-125	$0
GEN-2016-169	$0
GEN-2016-171	$0
GEN-2016-172	$0
GEN-2016-175	$0
Total Allocated Costs	**$0**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Mingo 115kV Reactive Power Support **$1,992,248**

Install up to 50MVAR capacitor bank at Mingo 115kV

GEN-2016-034	$168,708
GEN-2016-074	$220,129
GEN-2016-096	$116,573
GEN-2016-106	$746,109
GEN-2016-110	$277,087
GEN-2016-147	$75,458
GEN-2016-159	$233,730
GEN-2016-165	$154,455
Total Allocated Costs	**$1,992,248**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Neosho 345kV Reactive Power Support		**$15,000,000**
Build Neosho +200Mvar Capacitor Bank(s)		
	GEN-2016-024	$461,139
	GEN-2016-072	$1,319,378
	GEN-2016-100	$348,831
	GEN-2016-101	$680,220
	GEN-2016-119	$2,092,986
	GEN-2016-127	$503,429
	GEN-2016-128	$637,956
	GEN-2016-133	$199,385
	GEN-2016-134	$199,385
	GEN-2016-135	$106,339
	GEN-2016-136	$79,754
	GEN-2016-137	$199,385
	GEN-2016-138	$199,385
	GEN-2016-139	$106,339
	GEN-2016-140	$79,754
	GEN-2016-141	$372,185
	GEN-2016-142	$372,185
	GEN-2016-143	$186,093
	GEN-2016-144	$186,093
	GEN-2016-145	$186,093
	GEN-2016-146	$186,093
	GEN-2016-148	$398,932
	GEN-2016-153	$704,536
	GEN-2016-162	$2,464,335
	GEN-2016-163	$2,464,335
	GEN-2016-173	$265,457
	Total Allocated Costs	**$15,000,000**

Neset - Tioga 230kV		**$1,061,463**
Reconductor Neset - Tioga 230kV and replace terminal equipment		
	GEN-2016-108	$31,768
	GEN-2016-130	$4,778
	GEN-2016-151	$681,030
	GEN-2016-152	$343,887
	Total Allocated Costs	**$1,061,463**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

North Tulsa - Cherokee DCE Tap 138kV CKT 1 **$4,800,000**

NRIS Only Required Upgrade: Rebuild approximately 4 miles of 138kV

GEN-2016-133	$360,000
GEN-2016-134	$360,000
GEN-2016-135	$192,000
GEN-2016-136	$144,000
GEN-2016-137	$360,000
GEN-2016-138	$360,000
GEN-2016-139	$192,000
GEN-2016-140	$144,000
GEN-2016-141	$672,000
GEN-2016-142	$672,000
GEN-2016-143	$336,000
GEN-2016-144	$336,000
GEN-2016-145	$336,000
GEN-2016-146	$336,000
Total Allocated Costs	**$4,800,000**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Northwest - Spring Creek 345kV CKT 2 **$11,500,000**

Build approximately 7.5 miles of new 345kV from Northwest to Spring Creek

GEN-2016-024	$80,659
GEN-2016-072	$639,471
GEN-2016-100	$723,539
GEN-2016-101	$1,410,900
GEN-2016-119	$4,341,231
GEN-2016-127	$309,642
GEN-2016-128	$484,938
GEN-2016-133	$168,066
GEN-2016-134	$168,066
GEN-2016-135	$89,635
GEN-2016-136	$67,226
GEN-2016-137	$168,066
GEN-2016-138	$168,066
GEN-2016-139	$89,635
GEN-2016-140	$67,226
GEN-2016-141	$313,724
GEN-2016-142	$313,724
GEN-2016-143	$156,862
GEN-2016-144	$156,862
GEN-2016-145	$156,862
GEN-2016-146	$156,862
GEN-2016-148	$244,413
GEN-2016-153	$209,508
GEN-2016-162	$369,209
GEN-2016-163	$369,209
GEN-2016-173	$76,398
Total Allocated Costs	**$11,500,000**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

NPPD Flowgate Mitigation **TBD**

Potential Mitigation for NPPD Flowgates Limit. TBD in the Facilities Study with NPPD.

GEN-2016-034	TBD
GEN-2016-036	TBD
GEN-2016-074	TBD
GEN-2016-087	TBD
GEN-2016-092	TBD
GEN-2016-096	TBD
GEN-2016-103	TBD
GEN-2016-106	TBD
GEN-2016-110	TBD
GEN-2016-147	TBD
GEN-2016-159	TBD
GEN-2016-164	TBD
GEN-2016-165	TBD
Total Allocated Costs	**TBD**

Owasso - Catossa 138kV CKT 1 **$10,000,000**

NRIS Only Required Upgrade: Rebuild approximately 10 miles of 138kV

GEN-2016-133	$750,000
GEN-2016-134	$750,000
GEN-2016-135	$400,000
GEN-2016-136	$300,000
GEN-2016-137	$750,000
GEN-2016-138	$750,000
GEN-2016-139	$400,000
GEN-2016-140	$300,000
GEN-2016-141	$1,400,000
GEN-2016-142	$1,400,000
GEN-2016-143	$700,000
GEN-2016-144	$700,000
GEN-2016-145	$700,000
GEN-2016-146	$700,000
Total Allocated Costs	**$10,000,000**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

PH Run 115kV Reactive Power Support **$1,195,348**

Install up to 30MVAR capacitor bank at PH Run 115kV

GEN-2016-034	$103,188
GEN-2016-074	$131,963
GEN-2016-096	$65,778
GEN-2016-106	$456,363
GEN-2016-110	$169,318
GEN-2016-147	$46,131
GEN-2016-159	$132,239
GEN-2016-165	$90,369
Total Allocated Costs	**$1,195,348**

Pittsburg - Seminole 345kV CKT 1 **$45,530,000**

Reconductor Pittsburg-Seminole 345 kV Ckt 1

ASGI-2016-009	$63,115
GEN-2015-039	$906,079
GEN-2015-040	$1,051,817
GEN-2015-078	$1,051,817
GEN-2015-099	$1,546,425
GEN-2016-039	$2,130,876
GEN-2016-077	$1,129,729
GEN-2016-078	$2,111,894
GEN-2016-120	$7,710,174
GEN-2016-121	$2,323,924
GEN-2016-123	$6,514,627
GEN-2016-124	$3,279,175
GEN-2016-125	$1,617,726
GEN-2016-169	$5,492,912
GEN-2016-171	$1,347,400
GEN-2016-172	$4,360,994
GEN-2016-175	$2,891,315
Total Allocated Costs	**$45,530,000**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Post Rock 345/230/13kV Transformer CKT 2 **$9,413,718**

NRIS only required upgrade: Build Post Rock 345/230/13kV Transformer CKT 2

GEN-2016-074	$2,126,229
GEN-2016-106	$3,988,883
GEN-2016-110	$2,315,299
GEN-2016-147	$368,853
GEN-2016-165	$614,453
Total Allocated Costs	**$9,413,718**

Red Willow - Caprock 345kV CKT 1 **$275,000,000**

Build Red Willow - Caprock 345kV CKT 1

GEN-2016-034	$25,147,243
GEN-2016-074	$26,089,957
GEN-2016-096	$10,928,704
GEN-2016-106	$110,115,208
GEN-2016-110	$41,232,415
GEN-2016-147	$11,231,287
GEN-2016-159	$29,872,221
GEN-2016-165	$20,382,965
Total Allocated Costs	**$275,000,000**

Red Willow - Mingo 345kV CKT 1 **$67,188,964**

Rebuild Red Willow - Mingo 345kV CKT 1

GEN-2016-034	$5,172,236
GEN-2016-074	$7,836,003
GEN-2016-096	$5,247,818
GEN-2016-106	$23,000,343
GEN-2016-110	$8,521,303
GEN-2016-147	$2,312,158
GEN-2016-159	$9,421,935
GEN-2016-165	$5,677,169
Total Allocated Costs	**$67,188,964**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Redington - Spring Creek 345kV CKT 1 **$52,500,000**

Build approximately 35 miles of new 345kV from Redington to Spring Creek

GEN-2016-024	$724,307
GEN-2016-072	$11,109,219
GEN-2016-100	$1,559,010
GEN-2016-101	$3,040,069
GEN-2016-119	$9,354,057
GEN-2016-127	$1,603,435
GEN-2016-128	$9,267,799
GEN-2016-133	$280,770
GEN-2016-134	$280,770
GEN-2016-135	$149,744
GEN-2016-136	$112,308
GEN-2016-137	$280,770
GEN-2016-138	$280,770
GEN-2016-139	$149,744
GEN-2016-140	$112,308
GEN-2016-141	$524,104
GEN-2016-142	$524,104
GEN-2016-143	$262,052
GEN-2016-144	$262,052
GEN-2016-145	$262,052
GEN-2016-146	$262,052
GEN-2016-148	$1,318,460
GEN-2016-153	$3,168,227
GEN-2016-162	$3,472,603
GEN-2016-163	$3,472,603
GEN-2016-173	$666,609
Total Allocated Costs	**$52,500,000**

Remington - ASGI-2017-008 Tap 138kV CKT 1 **$2,500,000**

AECI Upgrade Remington-Shidler 138 kV line to 1192.5 ACSR at 100 C

GEN-2016-127	$1,484,790
GEN-2016-148	$1,015,210
Total Allocated Costs	**$2,500,000**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Remington - Fairfax 138kV CKT 1			**$6,700,000**
Upgrade Remington-Fairfax 138 kV line to 1590 ACSR at 100 C			
	GEN-2016-072	$139,556	
	GEN-2016-100	$11,242	
	GEN-2016-101	$21,922	
	GEN-2016-119	$67,452	
	GEN-2016-127	$3,761,039	
	GEN-2016-128	$47,272	
	GEN-2016-148	$2,571,574	
	GEN-2016-173	$79,943	
	Total Allocated Costs	**$6,700,000**	

Renfrow - Renfrow 138kV CKT 1			**$1,700,000**
Rebuild/Re-conductor approximately 2 miles of 138kV			
	GEN-2016-072	$1,700,000	
	Total Allocated Costs	**$1,700,000**	

Renfrow - Wakita 138kV CKT 1			**$14,500,000**
Rebuild/Re-conductor approximately 17 miles of 138kV			
	GEN-2016-072	$14,500,000	
	Total Allocated Costs	**$14,500,000**	

Reno County 345/115/13kV Transformer CKT 3			**$20,000,000**
Add 3rd xfmr at Reno Sub			
	GEN-2016-024	$160,850	
	GEN-2016-111	$5,123,978	
	GEN-2016-112	$2,417,230	
	GEN-2016-113	$1,703,049	
	GEN-2016-114	$5,259,713	
	GEN-2016-122	$2,472,167	
	GEN-2016-153	$698,966	
	GEN-2016-162	$1,037,796	
	GEN-2016-163	$1,037,796	
	GEN-2016-173	$88,454	
	Total Allocated Costs	**$20,000,000**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Sand Springs - Sheffield 138kV CKT 1 **$1,000,000**

NRIS Only Required Upgrade: Rebuild approximately 1 mile of 138kV

GEN-2016-127	$61,237
GEN-2016-128	$16,169
GEN-2016-133	$66,810
GEN-2016-134	$66,810
GEN-2016-135	$35,632
GEN-2016-136	$26,724
GEN-2016-137	$66,810
GEN-2016-138	$66,810
GEN-2016-139	$35,632
GEN-2016-140	$26,724
GEN-2016-141	$124,712
GEN-2016-142	$124,712
GEN-2016-143	$62,356
GEN-2016-144	$62,356
GEN-2016-145	$62,356
GEN-2016-146	$62,356
GEN-2016-148	$31,794
Total Allocated Costs	**$1,000,000**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Sheffield - Wekiwa 138kV CKT 1		$9,000,000
NRIS Only Required Upgrade: Rebuild approximately 7.5 miles of 138kV		
	GEN-2016-127	$551,132
	GEN-2016-128	$145,518
	GEN-2016-133	$601,291
	GEN-2016-134	$601,291
	GEN-2016-135	$320,688
	GEN-2016-136	$240,516
	GEN-2016-137	$601,291
	GEN-2016-138	$601,291
	GEN-2016-139	$320,688
	GEN-2016-140	$240,516
	GEN-2016-141	$1,122,409
	GEN-2016-142	$1,122,409
	GEN-2016-143	$561,205
	GEN-2016-144	$561,205
	GEN-2016-145	$561,205
	GEN-2016-146	$561,205
	GEN-2016-148	$286,142
	Total Allocated Costs	**$9,000,000**

Sheldon - Monolith 115 kV Ckt 1		$1,273,506
NRIS only required upgrade: Uprate Sheldon - Monolith 115 kV Ckt 1 (NTC #200477; UID #71967)		
	GEN-2016-074	$282,837
	GEN-2016-106	$150,846
	GEN-2016-147	$6,285
	GEN-2016-159	$833,538
	Total Allocated Costs	**$1,273,506**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

SILOAM CITY - SILOAM SPRINGS 161KV CKT 1 **$1,900,000**

NRIS only required upgrade: Rebuild AEP line, estimated with $915,000 per mile

GEN-2016-127	$120,059
GEN-2016-133	$133,496
GEN-2016-134	$133,496
GEN-2016-135	$71,198
GEN-2016-136	$53,398
GEN-2016-137	$133,496
GEN-2016-138	$133,496
GEN-2016-139	$71,198
GEN-2016-140	$53,398
GEN-2016-141	$249,192
GEN-2016-142	$249,192
GEN-2016-143	$124,596
GEN-2016-144	$124,596
GEN-2016-145	$124,596
GEN-2016-146	$124,596
Total Allocated Costs	**$1,900,000**

SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1 **$414,600**

NRIS only required upgrade: Upgrade terminal equipment for SILOAM CITY - SILOAM SPRINGS TAP 161KV CKT 1

GEN-2016-127	$19,926
GEN-2016-133	$29,601
GEN-2016-134	$29,601
GEN-2016-135	$15,787
GEN-2016-136	$11,840
GEN-2016-137	$29,601
GEN-2016-138	$29,601
GEN-2016-139	$15,787
GEN-2016-140	$11,840
GEN-2016-141	$55,254
GEN-2016-142	$55,254
GEN-2016-143	$27,627
GEN-2016-144	$27,627
GEN-2016-145	$27,627
GEN-2016-146	$27,627
Total Allocated Costs	**$414,600**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2		**$4,075,100**
NRIS only required upgrade: Add second transformer at SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 2		
	GEN-2016-127	$195,851
	GEN-2016-133	$290,944
	GEN-2016-134	$290,944
	GEN-2016-135	$155,170
	GEN-2016-136	$116,377
	GEN-2016-137	$290,944
	GEN-2016-138	$290,944
	GEN-2016-139	$155,170
	GEN-2016-140	$116,377
	GEN-2016-141	$543,095
	GEN-2016-142	$543,095
	GEN-2016-143	$271,547
	GEN-2016-144	$271,547
	GEN-2016-145	$271,547
	GEN-2016-146	$271,547
	Total Allocated Costs	**$4,075,100**
Tande 345/230kV Transformer CKT 2		**$9,413,718**
Build Tande 345/230kV Transformer CKT 2		
	GEN-2016-151	$6,255,168
	GEN-2016-152	$3,158,550
	Total Allocated Costs	**$9,413,718**
Tolk 345/230/13kV Transformer CKT 3		**$15,000,000**
Build third 345/230/13kV transformer at Tolk		
	GEN-2015-039	$1,333,972
	GEN-2015-040	$902,772
	GEN-2015-078	$883,604
	GEN-2015-099	$1,009,106
	GEN-2016-077	$1,009,432
	GEN-2016-078	$4,182,534
	GEN-2016-121	$1,309,878
	GEN-2016-169	$3,376,895
	GEN-2016-171	$991,806
	Total Allocated Costs	**$15,000,000**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Tulsa North - Wekiwa 345kV CKT 1 **$22,000,000**

Rebuild/Re-conductor approximately 17.5 miles of 345kV

GEN-2016-133	$1,650,000
GEN-2016-134	$1,650,000
GEN-2016-135	$880,000
GEN-2016-136	$660,000
GEN-2016-137	$1,650,000
GEN-2016-138	$1,650,000
GEN-2016-139	$880,000
GEN-2016-140	$660,000
GEN-2016-141	$3,080,000
GEN-2016-142	$3,080,000
GEN-2016-143	$1,540,000
GEN-2016-144	$1,540,000
GEN-2016-145	$1,540,000
GEN-2016-146	$1,540,000
Total Allocated Costs	**$22,000,000**

Tulsa North 345/138kV Transformer CKT 2 **$15,000,000**

Install second 345/138kV transformer

GEN-2016-133	$1,125,000
GEN-2016-134	$1,125,000
GEN-2016-135	$600,000
GEN-2016-136	$450,000
GEN-2016-137	$1,125,000
GEN-2016-138	$1,125,000
GEN-2016-139	$600,000
GEN-2016-140	$450,000
GEN-2016-141	$2,100,000
GEN-2016-142	$2,100,000
GEN-2016-143	$1,050,000
GEN-2016-144	$1,050,000
GEN-2016-145	$1,050,000
GEN-2016-146	$1,050,000
Total Allocated Costs	**$15,000,000**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Tulsa North 345kV Reactive Power Support **$40,000,000**

Install +300/-150Mvar Static Var Compensator (SVC) and associated step-up transformer

GEN-2016-133	$3,000,000
GEN-2016-134	$3,000,000
GEN-2016-135	$1,600,000
GEN-2016-136	$1,200,000
GEN-2016-137	$3,000,000
GEN-2016-138	$3,000,000
GEN-2016-139	$1,600,000
GEN-2016-140	$1,200,000
GEN-2016-141	$5,600,000
GEN-2016-142	$5,600,000
GEN-2016-143	$2,800,000
GEN-2016-144	$2,800,000
GEN-2016-145	$2,800,000
GEN-2016-146	$2,800,000
Total Allocated Costs	**$40,000,000**

Tupelo - Tupleo Tap 138kV CKT 1 **$757,500**

NRIS only required upgrade: Build approximately 1.3 miles of circuit 138kV from Tupelo to Tupelo Tap and replace CT

GEN-2016-118	$757,500
Total Allocated Costs	**$757,500**

Viola - Buffalo Flats 345kV CKT 1 **$52,500,000**

Build approximately 35 miles of new 345kV from Viola to Buffalo Flats

GEN-2016-072	$18,183,100
GEN-2016-100	$1,334,012
GEN-2016-101	$2,601,323
GEN-2016-119	$8,004,071
GEN-2016-127	$2,091,469
GEN-2016-128	$4,920,829
GEN-2016-148	$1,657,852
GEN-2016-153	$13,639,899
GEN-2016-173	$67,445
Total Allocated Costs	**$52,500,000**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Webb City - Shidler (WFEC) 138kV CKT 1			**$11,000,000**
Rebuild/Re-conductor approximately 13 miles of 138kV			
	GEN-2016-148	$11,000,000	
	Total Allocated Costs	**$11,000,000**	
Webb City Tap - Shidler (WFEC) 138kV CKT 1			**$2,200,000**
Rebuild/Re-conductor approximately 2.5 miles of 138kV			
	GEN-2016-148	$2,200,000	
	Total Allocated Costs	**$2,200,000**	
West Tie 115/69/13.8 kV Transformer CKT 1			**TBD**
Mitigation requires TCEC review and feedback			
	ASGI-2016-010	TBD	
	Total Allocated Costs	**TBD**	
West Tie 115/69/13.8 kV Transformer CKT 2			**TBD**
Mitigation requires TCEC review and feedback			
	ASGI-2016-010	TBD	
	Total Allocated Costs	**TBD**	
Wolf Creek - Neosho 345kV CKT 1			**$117,126,900**
NRIS Only Required Upgrade: Build approximately 95 miles of Wolf Creek – Neosho 345kV CKT 1			
	GEN-2016-024	$12,141,076	
	GEN-2016-127	$8,810,138	
	GEN-2016-128	$16,350,083	
	GEN-2016-162	$33,843,345	
	GEN-2016-163	$33,843,345	
	GEN-2016-173	$12,138,913	
	Total Allocated Costs	**$117,126,900**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Wolf Creek - Waverly 345kV CKT 1 **$1,000,000**

Replace terminal equipment

GEN-2016-024	$37,365
GEN-2016-072	$106,906
GEN-2016-100	$28,265
GEN-2016-101	$55,116
GEN-2016-119	$169,589
GEN-2016-127	$40,791
GEN-2016-128	$51,692
GEN-2016-148	$32,324
GEN-2016-153	$57,087
GEN-2016-162	$199,678
GEN-2016-163	$199,678
GEN-2016-173	$21,509
Total Allocated Costs	**$1,000,000**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Woodring - Redington 345kV CKT 2 **$30,000,000**

Build approximately 20 miles of new 345kV from Woodring to Redington

GEN-2016-024	$481,738
GEN-2016-072	$7,255,645
GEN-2016-100	$47,877
GEN-2016-101	$93,360
GEN-2016-119	$287,262
GEN-2016-127	$1,402,855
GEN-2016-128	$6,120,638
GEN-2016-133	$461,140
GEN-2016-134	$461,140
GEN-2016-135	$245,941
GEN-2016-136	$184,456
GEN-2016-137	$461,140
GEN-2016-138	$461,140
GEN-2016-139	$245,941
GEN-2016-140	$184,456
GEN-2016-141	$860,794
GEN-2016-142	$860,794
GEN-2016-143	$430,397
GEN-2016-144	$430,397
GEN-2016-145	$430,397
GEN-2016-146	$430,397
GEN-2016-148	$1,131,665
GEN-2016-153	$2,008,219
GEN-2016-162	$2,276,979
GEN-2016-163	$2,276,979
GEN-2016-173	$468,255
Total Allocated Costs	**$30,000,000**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

11.7 G-T: THERMAL POWER FLOW ANALYSIS (CONSTRAINTS REQUIRING TRANSMISSION REINFORCEMENT)

Posted as a separate file

Legend:

Column	Definition
Solution	Solution Method
Group	Model Case Identification: • ##ALL: ERIS-HVER • 00: ERIS-LVER • ##NR or 00NR: NRIS
Scenario	Upgrade Scenario Identification
Season	Model Year and Season
Source	Gen ID producing the TDF above the limit for the constraint
Monitored Element	Monitored Bus Identification
Rate A	Planning Term Normal Rating
Rate B	Planning Term Emergency Rating
TDF	Transfer Distribution Factor for the Source
TC%LOADING	Post-transfer, loading percent for system intact or contingency
Contingency	Contingency Description

11.8 G-V: VOLTAGE POWER FLOW ANALYSIS (CONSTRAINTS REQUIRING TRANSMISSION REINFORCEMENT)

Available upon request

Legend:

Column	Definition
Solution	Solution Method
Group	Model Case Identification: • ##ALL: ERIS-HVER • 00: ERIS-LVER • ##NR or 00NR: NRIS
Scenario	Upgrade Scenario Identification
Season	Model Year and Season
Source	Gen ID producing the TDF above the limit for the constraint
Monitored Element	Monitored Bus Identification
BC Voltage (pu)	Pre-transfer, post-contingency voltage
TC Voltage (pu)	Post-transfer, post-contingency voltage
Voltage Differ (pu)	TC Voltage - BC Voltage
VINIT (pu)	Post-transfer, pre-contingency (system intact) voltage
VMIN (pu)	Lower Voltage Limit
VMAX (pu)	Upper Voltage Limit
TDF	Transfer Distribution Factor for the Source
Contingency	Contingency Description

11.9 H-T: THERMAL POWER FLOW ANALYSIS (OTHER CONSTRAINTS NOT REQUIRING TRANSMISSION REINFORCEMENT)

Available upon request

11.10 H-T-AS: AFFECTED SYSTEM THERMAL POWER FLOW ANALYSIS (CONSTRAINTS FOR POTENTIAL UPGRADES)

Available upon request

11.11 H-V-AS: AFFECTED SYSTEM VOLTAGE POWER FLOW ANALYSIS (CONSTRAINTS FOR POTENTIAL UPGRADES)

Available upon request

11.12 I: POWER FLOW ANALYSIS (CONSTRAINTS FROM MULTI-CONTINGENCIES)

Available upon request

11.13 J: DYNAMIC STABILITY ANALYSIS REPORTS

J1: GROUP 1 DYNAMIC STABILITY ANALYSIS REPORT

S&C ELECTRIC COMPANY
Excellence Through Innovation

DISIS-2016-002 (GROUP 01)

LITTLE ROCK, AR

SOUTHWEST POWER POOL

DEFINITIVE INTERCONNECTION SYSTEM IMPACT STUDY

S&C PROJECT NUMBER: 12651

DOCUMENT NUMBER: E-857

REVISION: 0

FINAL REPORT

CONFIDENTIAL

APRIL 18, 2018

REPORT REVISION HISTORY:

REV	DATE	PREPARED BY	REVIEWED BY	APPROVED BY	DESCRIPTION
A	04/9/2018	MFK	ME	SK	Preliminary report issued.
0	04/18/2018	MFK	ME	SK	Final Report

AUTHORS:

Prepared By:

M. Fareed Kandlawala
Assistant Manager – Consulting and Analytical Services
S&C Electric Company

Reviewed By:

Mohamed Elkhatib, Ph.D.
Project Engineer
S&C Electric Company

Approved By:

Saeed Kamalinia, Ph.D.
Manager – Consulting and Analytical Services
S&C Electric Company

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1. Executive Summary

S&C Electric Company (S&C) has performed a Definitive Interconnection System Impact Study, DISIS-2016-002 (Group 1), in response to a request through Southwest Power Pool (SPP) Tariff. Group 1 consists of two (2) new interconnection requests (GEN-2016-118, and GEN-2016-131).

S&C has performed dynamic stability analysis for Group 1 under Cluster scenarios. The cluster studies were performed using three (3) cluster base cases (2017 Winter Peak (WP), 2018 Summer Peak (SP), and 2026 SP) provided by SPP. In the cluster studies, all two new interconnection requests and prior-queued projects were studied at 100% of nameplate MW capacity.

The dynamics stability analysis demonstrated that, except for 1 contingency, the system remains stable under all studied contingencies and all interconnection requests projects remain connected during and after all the tested contingencies. For fault FLT-23, it was observed that interconnection request GEN-2016-118 was tripped due to its overvoltage protection in the 3 peak cases, 2017 WP, 2018 SP, and 2026 SP. It is worthy to note that FLT-23 is a prior outage fault with system adjustment, i.e. a TPL-001-4 P6 event. To mitigate that issue, the reactive power level of GEN-2016-118 was set to 0 MVAR in the prior outage power flow case and its active power output was reduced to 120 MW. GEN-2016-131 is represented in PSS/E as a user written model which requires the user to set the reactive power. Implementing these changes enabled GEN-2016-118 to ride through fault FLT-23 successfully. This request may require an operational guideline to be developed for the outage of the CRESENT4 138 kV to TWNLAKE4 138 kV line.

S&C has performed a short-circuit analysis for the 2018 Summer Peak and 2026 Summer Peak cases of Group 1 and reported short circuit results at all buses up to five (5) levels away from the Point of Interconnection (POI) of the study projects.

2. Introduction

S&C has performed a Definitive Interconnection System Impact Study, DISIS-2016-002 (Group 1), in response to a request through the SPP Tariff. Group 1 consist of two (2) new interconnection requests listed in Table 1 and twenty-nine (29) previously queued projects listed in Table 2.

Table 1: Group 1 Generation Interconnection Requests

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2016-118	288	Vestas 2.0MW	Dover Switchyard 138 kV (520882)
GEN-2016-131	202.5 (2.5MW uprate to GEN-2007-043)	GE 1.6MW	Minco Substation 345 kV (514801)

Table 2: Prior Queued Projects

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2001-014	94.5	Suzlon S88 2.1MW	Ft Supply 138 kV (520920)
GEN-2001-037	102	GE 1.5MW	FPL Moreland Tap 138 kV (515785)
GEN-2005-008	120	GE 1.5MW	Woodward 138 kV (514785)
GEN-2006-024S	18.9	Suzlon S88 2.1MW	Buffalo Bear 69kV (521120)
GEN-2006-046	132	Mitsubishi 92m 2.4MW	Dewey 138 kV (514787)
GEN-2007-021/GEN-2014-002	209.43	GE 1.79MW	Tatonga 345 kV (515407)
GEN-2007-043	200	GE 1.6	Minco 345 kV (514801)
GEN-2007-044/GEN-2014-003	315.04	GE 1.79MW	Tatonga 345 kV (515407)
GEN-2007-050	170.2	Siemens 93m 2.3MW	Woodward EHV 138 kV (515376)
GEN-2007-062	424.2	Vestas 2.0/3.3MW, GE 2.4MW	Woodward EHV 345 kV (515375)
GEN-2008-003	101.2	Siemens 93m 2.3MW	Woodward 138 kV (515376)
GEN-2008-044/GEN-2010-011	227.5	Siemens 2.3/3.0MW	Tatonga 345 kV (515407)
GEN-2010-040	298.5	Mitsubishi 102m 2.4MW, REpower MM92 2.05MW	Cimarron 345 kV (514901)

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2011-010/GEN-2014-005	106.47	GE 1.6MW	Minco 345 kV (514801)
GEN-2011-019	174	Vestas V100 2.0MW	Woodward 345 kV (515375)
GEN-2011-020	165.6	GE 2.4MW	Woodward 345 kV (515375)
GEN-2011-054	300	Vestas V100 2.0MW	Cimarron 345 kV (514901)
GEN-2014-020	99.1	Gamesa G114 2.0/2.1MW	Tuttle 138 kV (583899)
GEN-2014-056	249.18	GE 1.79/2.3MW	Minco 345 kV (514801)
GEN-2015-029	161	GE 2.3MW	Tatonga 345 kV (515407)
GEN-2015-048	200	Vestas V110 VCSS 2.0MW	Cleo Corner 138 kV (514778)
GEN-2015-057	100.05	GE 1.79/2.0/2.3MW	Minco 345 kV (514801)
GEN-2015-093	250	GE 2.0MW	Gracemont – Lawton Eastside 345 kV (515800)
GEN-2015-095	176	Vestas V110 VCSS 2.0MW	DeGrasse 138 kV (560066)
GEN-2016-003	248.4	Vestas GS V126 3.45MW	Tap on Hitchland (523097) – Woodward (515375) 345 kV, ckt 1&2 (G16-003-TAP, 560071)
GEN-2016-020	150	Vestas V110 VCSS 2.0MW	Mooreland 138 kV (520999)
GEN-2016-045	499.1	GE 2.3MW	Mathewson 345 kV (515497)
GEN-2016-047	Uprate of 8MW SP/24MW WP (Total 118MW SP/134MW WP)	BDAX 71-340ER 67.4MW	Mustang 69kV (514860, 514861)
GEN-2016-057	499.1	GE 2.3MW	Mathewson 345 kV (515497)

3. Transmission System and Study Area

Group 1 will be connected to the Woodward Area. For the dynamic stability studies, the following areas were monitored in the analysis:

- American Electric Power West (AEPW, Area #520)
- Oklahoma Gas & Electric (OKGE, Area #524)
- West Farm Electric Cooperative (WFEC, Area #525)
- Southwestern Public Service (SPS, Area #526)
- Midwest Energy (MIDW, Area #531)
- Sunflower Electric Power Corporation (SUNC, Area #534)
- Westar Energy, Inc. (WERE, Area #536)

4. Power Flow Base Cases

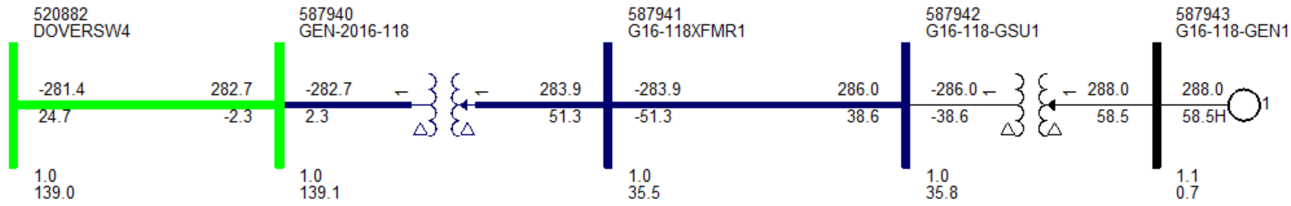
DISIS-2016-002 (Group 1) and prior-queued projects were modeled as aggregated generating units in the base cases from SPP.

Cluster Scenario Base Cases

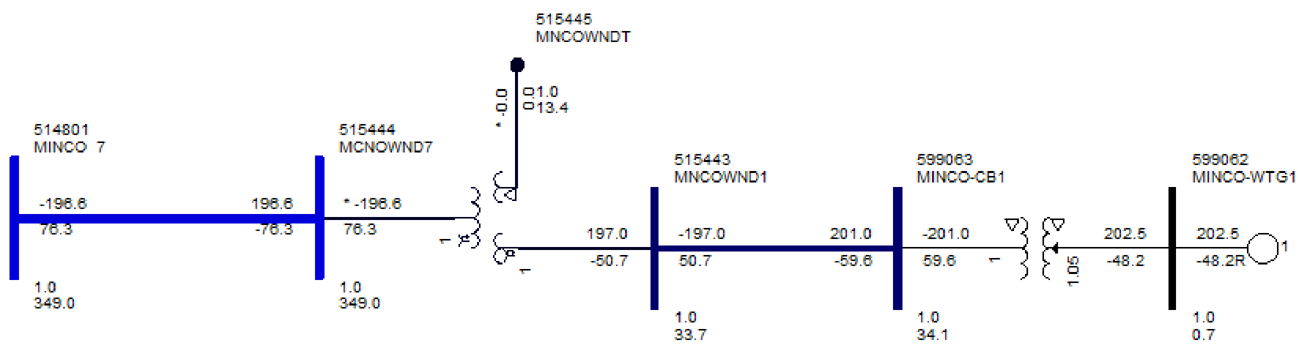
- **MDWG16-17WP_DIS1602_G01_Base.sav** – 2017 Winter Peak Cluster Base Case for Group 1. New interconnection requests and prior queued projects at 100% output power.
- **MDWG16-18SP_DIS1602_G01.sav** – 2018 Summer Peak Cluster Base Case for Group 1. New interconnection requests and prior queued projects at 100% output power.
- **MDWG16-26SP_DIS1602_G01.sav** – 2026 Summer Peak Cluster Base Case for Group 1. New interconnection requests and prior queued projects at 100% output power.

5. Power Flow Model

SPP's base case power flow models were built in PSS/E 33.0.7. S&C created one-line diagrams depicted in Figure 1 for each interconnection request.



(a) Interconnection request GEN-2016-118



(b) Interconnection request GEN-2016-131

Figure 1: One-line Diagrams of the Interconnection Request Projects

6. Dynamic Stability Analysis

6.1. Assumptions

Dynamic stability analysis was performed for all the SPP contingencies listed in Appendix A. Three-phase faults were simulated as bolted faults, while single-line-to-ground faults were simulated under the assumption that a single-line-to-ground fault will cause a 40% drop in the positive-sequence voltage at the fault location.

6.2. Stability Criteria

Dynamic stability studies were performed to ensure system stability following critical faults on the system. The system is considered stable if the following conditions are met:

(1) Disturbances including three-phase and single-phase to ground faults, should not cause synchronous and asynchronous plants to disconnect from the transmission grid.

(2) The angular positions of synchronous machine rotor become constant following an aperiodic system disturbance.

(3) Voltage magnitudes and frequencies at terminals of asynchronous generators should not exceed magnitudes and durations that will cause protection elements to operate. Furthermore, the response after the disturbance needs to be studied at the terminals of the machine to ensure that there are no sustained oscillations in power output, speed, frequency, etc.

(4) Voltage magnitudes and angles after the disturbance should settle to a constant and acceptable operating level. Frequencies should settle to the acceptable range within nominal 60 Hz power frequency.

In addition, performance of the transmission system is measured against the SPP Disturbance Criteria Requirements on Angular oscillations and Transient Voltage Recovery, detailed in Appendix B. Dynamic stability plots for all the Cluster scenarios are provided in Appendix C. Dynamic data for all study interconnection requests for Group 1 is provided in Appendix D.

6.3. DYNAMIC STABILITY RESULTS

The dynamic stability study was performed for the three base case scenarios; 2017 WP, 2018 SP, and 2026 SP. Initially, the base case dynamic data was analyzed and stable initial runs were obtained. Then, the study was performed for all the SPP contingencies listed in Appendix A. Time-domain simulations were performed to evaluate the dynamic performance of the system under identified contingencies. System dynamic voltage recovery and post-disturbance steady state performance under identified contingencies were also checked against SPP voltage recovery criteria. Additionally, simulation logs were scanned to identify any tripped generators during simulations.

Detailed plots of dynamic stability results for each contingency and each peak season are given in Appendices C-1 to C-3. For the 2018 SP and 2026 SP cases, oscillations were observed for the generators in the area close to bus MOORLND4 (520999) for some of the studied contingencies. These oscillations were mitigated by setting the reactive power injection of generator G15-048-GEN1 at bus #584893 to 10 MVAR in the power flow case. G15-048-GEN1 is a user written model that requires the user to set the reactive power output. The dynamic stability studies for the three (3) study cases were repeated after implementing that change and the results demonstrate that, except for 1 contingency, the system remains stable under each studied contingencies and all studied interconnection projects remained online during and after the contingency. For fault FLT-23, it was observed that interconnection request GEN-2016-118 was tripped by its overvoltage protection due to its terminal voltage exceeding 1.25 p.u. during voltage recovery period once the fault was cleared. This issue was observed with all three (3) study scenarios; 2017 WP, 2018 SP, and 2026 SP. It is worthy to note that FLT-23 is a prior outage fault, i.e. a TPL-001-4 P6 event, which is implemented as follows: in pre-contingency, the line connecting CRESENT4 138 kV (515377) and TWNLAKE4 138 kV (521073) buses is taken out of service and system adjustments are made, and then a 3-phase fault is applied on the line connecting DOVERSW4 138 kV (520882) to HENESEY4 138 kV (514774) buses, near DOVERSW4 bus.

To mitigate the tripping of GEN-2016-118 for fault FLT-23, first, its reactive power output was reduced in the prior outage power flow case. Initially, the reactive power output of GEN-2016-118 was 58.5 MVAR. However, reducing the reactive power output to 0 MVAR, while maintaining the active power output of the interconnection request at 288 MW, resulted in voltage issues in the power flow case and a valid steady state case could not be obtained. Therefore, reducing the active power output of GEN-2016-118 in the prior outage case was necessary. Different values for active and reactive power levels for GEN-2016-118 were tested, including reactive power injection and absorption scenarios. Ultimately, setting the reactive power level to 0 MVAR and reducing the active power output to 120 MW, enabled GEN-2016-118 to ride through fault FLT-23 successfully. It is noted that in the new case, the POI voltage was 1.0097 p.u. for the 17WP case, 0.9973 p.u. for the 18SP case and 1.0018 p.u. for the 26SP case. This may require an operational guideline to be developed for the outage of the CRESENT4 138 kV to TWNLAKE 138 kV line.

Figure 2 highlights the performance of GEN-2016-118 under fault FLT-23 after curtailing its active power output to 120 MW and setting its reactive power output to 0 MVAR in the prior outage power flow case. Detailed plots of the dynamic stability results under fault FLT-23 for each peak season are given in Appendices C-1-1, C-2-1 to C-3-1, respectively.

Table 3 below summarizes the dynamic stability results.

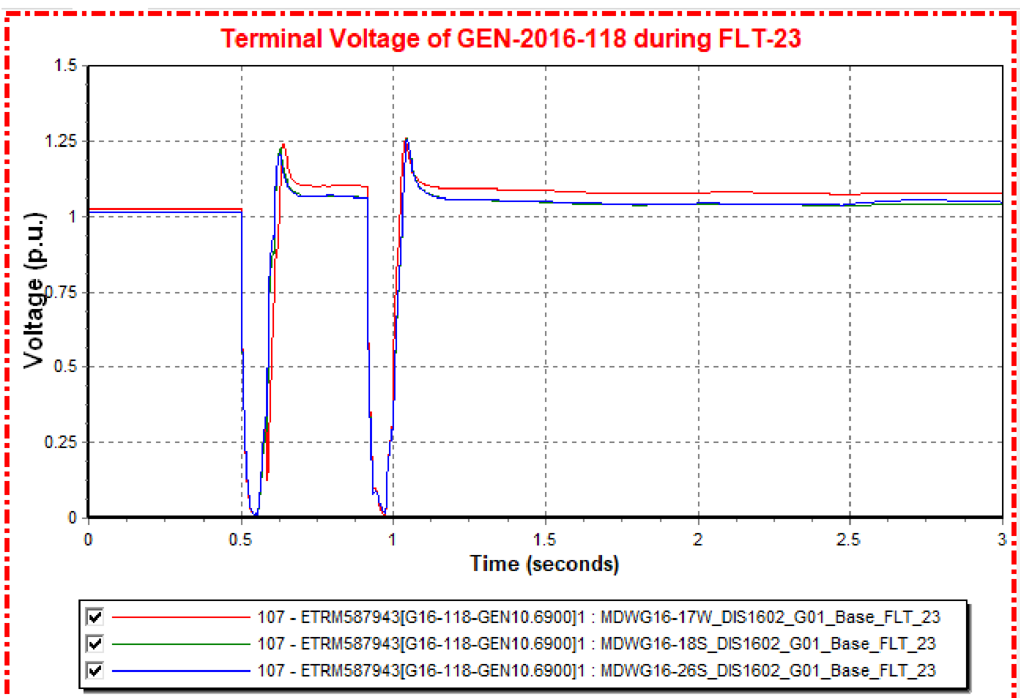


Figure 2: Terminal Voltage of GEN-2016-118 during fault FLT-23 with suggested remedial actions.

Table 3: Group 1 Dynamic Stability Results
(YES = STABLE, NO = UNSTABLE)

Cont. No.	Cont. Name	17WP Case	18SP Case	26SP Case	Cont. No.	Cont. Name	17WP Case	18SP Case	26SP Case
1	FLT1-3PH	YES	YES	YES	26	FLT26-3PH	YES	YES	YES
2	FLT2-3PH	YES	YES	YES	27	FLT27-3PH	YES	YES	YES
3	FLT3-3PH	YES	YES	YES	28	FLT28-3PH	YES	YES	YES
4	FLT4-3PH	YES	YES	YES	29	FLT29-3PH	YES	YES	YES
5	FLT5-3PH	YES	YES	YES	30	FLT30-3PH	YES	YES	YES
6	FLT6-3PH	YES	YES	YES	31	FLT31-3PH	YES	YES	YES
7	FLT7-3PH	YES	YES	YES	32	FLT32-3PH	YES	YES	YES
8	FLT8-3PH	YES	YES	YES	33	FLT33-3PH	YES	YES	YES
9	FLT9-3PH	YES	YES	YES	34	FLT34-SB	YES	YES	YES
10	FLT10-SB	YES	YES	YES	35	FLT35-SB	YES	YES	YES
11	FLT11-SB	YES	YES	YES	36	FLT36-SB	YES	YES	YES
12	FLT12-SB	YES	YES	YES	37	FLT37-SB	YES	YES	YES
13	FLT13-SB	YES	YES	YES	38	FLT38-SB	YES	YES	YES
14	FLT14-PO	YES	YES	YES	39	FLT39-SB	YES	YES	YES
15	FLT15-PO	YES	YES	YES	43	FLT40-SB	YES	YES	YES
16	FLT16-PO	YES	YES	YES	44	FLT41-PO	YES	YES	YES
17	FLT17-PO	YES	YES	YES	45	FLT42-PO	YES	YES	YES
18	FLT18-PO	YES	YES	YES	46	FLT43-PO	YES	YES	YES
19	FLT19-PO	YES	YES	YES	47	FLT44-PO	YES	YES	YES
20	FLT20-PO	YES	YES	YES	48	FLT45-PO	YES	YES	YES
21	FLT21-PO	YES	YES	YES	49	FLT46-PO	YES	YES	YES
22	FLT22-PO	YES	YES	YES	50	FLT47-PO	YES	YES	YES
23	FLT23-PO[1]	YES	YES	YES	51	FLT48-PO	YES	YES	YES
24	FLT24-3PH	YES	YES	YES	52	FLT49-PO	YES	YES	YES
25	FLT25-3PH	YES	YES	YES					

[1] FLT23-PO resulted in the tripping of GEN-2016-118 in the original cases and required mitigation measures.

7. Short-Circuit Study

A short-circuit study has been performed on the power flow models for the 2018 SP, and 2026 SP seasons for each generator using the Cluster Scenario model. Short-circuit analysis includes applying a 3-phase fault on buses up to 5 levels away from the POI of each interconnection request project. PSS/E "Automatic Sequence Fault Calculation (ASCC)" fault analysis module was used for short-circuit analysis. The results of the short-circuit analysis have been recorded for all the buses up to five levels away from the point of interconnection of each interconnection request project. Summary tables for the results of the short-circuit study are provided in Appendix E.

8. Conclusions and Recommendations

Analysis of Group 1 dynamic simulation results showed that, except for 1 contingency, the system remained stable under all studied contingencies and all interconnection requests projects remained connected during and after the contingency.

For fault FLT-23, it was observed that interconnection request GEN-2016-118 was tripped by its overvoltage protection in all three (3) study scenarios; 2017 WP, 2018 SP, and 2026 SP. It is worthy to note that FLT-23 is a prior outage fault, i.e. TPL-001-4 P6 event. To mitigate that issue, the reactive power level of GEN-2016-118 was set to 0 MVAR in the prior outage power flow case and its active power output was reduced to 120 MW. Implementing these changes, enabled GEN-2016-118 to ride through fault FLT-23 successfully. This mitigation may require an operational guideline to be developed for this outage.

A short-circuit study has been performed on the power flow models for the 2018 Summer Peak Season and 2026 Summer Peak Season for each generator using the Cluster Scenario model. A 3-phase fault is applied on buses up to 5 levels away from the POI of each interconnection request project and the results of the study have been presented.

APPENDIX A

SPP GROUP 1 FAULT DEFINITIONS

Table 4 Group 1 Fault Definitions

Cont. No.	Cont. Name	Description
1	FLT1-3PH	3 phase fault on DOVERSW4 138 kV (520882) to OKEENE 4 138 kV (521016) line CKT 1, near DOVERSW4. a. Apply fault at the DOVERSW4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT2-3PH	3 phase fault on DOVERSW4 138 kV (520882) to DOVERSW2 69 kV (520881) to DVRTERT 13.8 kV (521166) transformer CKT 1, near DOVERSW4. a. Apply fault at the DOVERSW4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
3	FLT3-3PH	3 phase fault on DOVERSW4 138 kV (520882) to DOVER 138 kV (520879) line CKT 1, near DOVERSW4. a. Apply fault at the DOVERSW4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT4-3PH	3 phase fault on DOVERSW4 138 kV (520882) to NKNGFSH 138 kV (520603) line CKT 1, near DOVERSW4. a. Apply fault at the DOVERSW4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
5	FLT5-3PH	3 phase fault on DOVERSW4 138 kV (520882) to HENESEY4 138 kV (514774) line CKT 1, near DOVERSW4. a. Apply fault at the DOVERSW4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT6-3PH	3 phase fault on OKEENE 4 138 kV (521016) to OKEENE 2 69 kV (521015) to OKENTERT 13.8 kV (521173) transformer CKT 1, near OKEENE 4. a. Apply fault at the OKEENE 4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line.

7	FLT7-3PH	3 phase fault on CRESENT4 138 kV (515377) to TWNLAKE4 138 kV (521073) line CKT 1, near TWNLAKE4. a. Apply fault at the TWNLAKE4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
8	FLT8-3PH	3 phase fault on CEDRDAL4 138 kV (520848) to PIC4 138 kV (520425) line CKT 1, near CEDRDAL4. a. Apply fault at the CEDRDAL4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
9	FLT9-3PH	3 phase fault on TWNLAKE4 138 kV (521073) to CASHION4 138 kV (520847) line CKT 1, near TWNLAKE4. a. Apply fault at the TWNLAKE4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT10-SB	**Stuck Breaker at DOVERSW4 (520882)** a. Apply single phase fault at the DOVERSW4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - DOVERSW4 138 kV (520882) to DOVERSW2 69 kV (520881) to DVRTERT 13.8 kV (521166) transformer CKT 1 - DOVERSW4 138 kV (520882) to OKEENE 4 138 kV (521016) line CKT 1
11	FLT11-SB	**Stuck Breaker at DOVERSW4 (520882)** a. Apply single phase fault at the DOVERSW4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - DOVERSW4 138 kV (520882) to DOVER 138 kV (520879) line CKT 1 - DOVERSW4 138 kV (520882) to NKNGFSH 138 kV (520603) line CKT 1
12	FLT12-SB	**Stuck Breaker at DOVERSW4 (520882)** a. Apply single phase fault at the DOVERSW4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - DOVERSW4 138 kV (520882) to DOVERSW2 69 kV (520881) to DVRTERT 13.8 kV (521166) transformer CKT 1 - DOVERSW4 138 kV (520882) to HENESEY4 138 kV (514774) line CKT 1
13	FLT13-SB	**Stuck Breaker at DOVERSW4 (520882)** a. Apply single phase fault at the DOVERSW4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - DOVERSW4 138 kV (520882) to OKEENE 4 138 kV (521016) line CKT 1 - DOVERSW4 138 kV (520882) to HENESEY4 138 kV (514774) line CKT 1

14	FLT14-PO	**Prior Outage of DOVERSW4 138 kV (520882) to DOVERSW2 69 kV (520881) to DVRTERT 13.8 kV (521166) transformer CKT 1;** 3 phase fault on DOVERSW4 138 kV (520882) to OKEENE 4 138 kV (521016) line CKT 1, near DOVERSW4. a. Apply fault at the DOVERSW4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
15	FLT15-PO	**Prior Outage of DOVERSW4 138 kV (520882) to DOVER 138 kV (520879) line CKT 1;** 3 phase fault on DOVERSW4 138 kV (520882) to NKNGFSH 138 kV (520603) line CKT 1, near DOVERSW4. a. Apply fault at the DOVERSW4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT16-PO	**Prior Outage of DOVERSW4 138 kV (520882) to OKEENE 4 138 kV (521016) line CKT 1;** 3 phase fault on DOVERSW4 138 kV (520882) to HENESEY4 138 kV (514774) line CKT 1, near DOVERSW4. a. Apply fault at the DOVERSW4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
17	FLT17-PO	**Prior Outage of DOVERSW4 138 kV (520882) to OKEENE 4 138 kV (521016) line CKT 1;** 3 phase fault on DOVERSW4 138 kV (520882) to DOVERSW2 69 kV (520881) to DVRTERT 13.8 kV (521166) transformer CKT 1, near DOVERSW4. a. Apply fault at the DOVERSW4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
18	FLT18-PO	**Prior Outage of DOVERSW4 138 kV (520882) to NKNGFSH 138 kV (520603) line CKT 1;** 3 phase fault on DOVERSW4 138 kV (520882) to DOVER 138 kV (520879) line CKT 1, near DOVERSW4. a. Apply fault at the DOVERSW4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

19	FLT19-PO	**Prior Outage of DOVERSW4 138 kV (520882) to HENESEY4 138 kV (514774) line CKT 1;** 3 phase fault on DOVERSW4 138 kV (520882) to OKEENE 4 138 kV (521016) line CKT 1, near DOVERSW4. a. Apply fault at the DOVERSW4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT20-PO	**Prior Outage of WOODRNG4 138 kV (514714) to WOODRNG7 345 kV (514715) to WOODRNG1 13.8 kV (515770) transformer CKT 1;** 3 phase fault on CRESENT4 138 kV (515377) to TWNLAKE4 138 kV (521073) line CKT 1, near TWNLAKE4. a. Apply fault at the TWNLAKE4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
21	FLT21-PO	**Prior Outage of CRESENT4 138 kV (515377) to TWNLAKE4 138 kV (521073) line CKT 1;** 3 phase fault on DOVERSW4 138 kV (520882) to DOVER 138 kV (520879) line CKT 1, near DOVERSW4. a. Apply fault at the DOVERSW4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
22	FLT22-PO	**Prior Outage of CRESENT4 138 kV (515377) to TWNLAKE4 138 kV (521073) line CKT 1;** 3 phase fault on DOVERSW4 138 kV (520882) to NKNGFSH 138 kV (520603) line CKT 1, near DOVERSW4. a. Apply fault at the DOVERSW4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
23	FLT23-PO	**Prior Outage of CRESENT4 138 kV (515377) to TWNLAKE4 138 kV (521073) line CKT 1;** 3 phase fault on DOVERSW4 138 kV (520882) to HENESEY4 138 kV (514774) line CKT 1, near DOVERSW4. a. Apply fault at the DOVERSW4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

24	FLT24-3PH	3 phase fault on MINCO 345 kV (514801) to GRACMNT7 345 kV (515800) line CKT 1, near MINCO. a. Apply fault at the MINCO 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
25	FLT25-3PH	3 phase fault on MINCO 345 kV (514801) to CIMARON7 345 kV (514901) line CKT 1, near MINCO. a. Apply fault at the MINCO 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
26	FLT26-3PH	3 phase fault on GRACMNT7 345 kV (515800) to G16-037-TAP 345 kV (560078) line CKT 1, near GRACMNT7. a. Apply fault at the GRACMNT7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
27	FLT27-3PH	3 phase fault on GRACMNT7 345 kV (515800) to GRACMNT4 138 kV (515802) to GRCMNT11 13.8 kV (515801) transformer CKT 1, near GRACMNT7. a. Apply fault at the GRACMNT7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
28	FLT28-3PH	3 phase fault on GRACMNT7 345 kV (515800) to G16-091-TAP 345 kV (587744) line CKT 1, near GRACMNT7. a. Apply fault at the GRACMNT7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
29	FLT29-3PH	3 phase fault on CIMARON7 345 kV (514901) to DRAPER 7 345 kV (514934) line CKT 1, near CIMARON7. a. Apply fault at the CIMARON7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
30	FLT30-3PH	3 phase fault on CIMARON7 345 kV (514901) to NORTWST7 345 kV (514880) line CKT 1, near CIMARON7. a. Apply fault at the CIMARON7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

31	FLT31-3PH	3 phase fault on CIMARON7 345 kV (514901) to MATHWSN7 345 kV (515497) line CKT 1, near CIMARON7. a. Apply fault at the CIMARON7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
32	FLT32-3PH	3 phase fault on NORTWST7 345 kV (514880) to MATHWSN7 345 kV (515497) line CKT 1, near NORTWST7. a. Apply fault at the NORTWST7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
33	FLT33-3PH	3 phase fault on NORTWST7 345 kV (514880) to SPRNGCK7 345 kV (514881) line CKT 1, near NORTWST7. a. Apply fault at the NORTWST7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
34	FLT34-SB	**Stuck Breaker at CIMARON7 (514901)** a. Apply single phase fault at the CIMARON7 345 kV bus. b. Clear fault after 16 cycles and trip the following elements. - CIMARON7 345 kV (514901) to MATHWSN7 345 kV (515497) line CKT 1 - CIMARON7 345 kV (514901) to MATHWSN7 345 kV (515497) line CKT 2
35	FLT35-SB	**Stuck Breaker at CIMARON7 (514901)** a. Apply single phase fault at the CIMARON7 345 kV bus. b. Clear fault after 16 cycles and trip the following elements. - CIMARON7 345 kV (514901) to CIMARON4 138 kV (514898) to CIMARO11 13.8 kV (515714) transformer CKT 1 - CIMARON7 345 kV (514901) to CIMARON4 138 kV (514898) to CIMARO21 13.8 kV (515715) transformer CKT 1
36	FLT36-SB	**Stuck Breaker at CIMARON7 (514901)** a. Apply single phase fault at the CIMARON7 345 kV bus. b. Clear fault after 16 cycles and trip the following elements. - CIMARON7 345 kV (514901) to DRAPER 7 345 kV (514934) line CKT 1 - CIMARON7 345 kV (514901) to NORTWST7 345 kV (514880) line CKT 1
37	FLT37-SB	**Stuck Breaker at NORTWST7 (514880)** a. Apply single phase fault at the NORTWST7 345 kV bus. b. Clear fault after 16 cycles and trip the following elements. - CIMARON7 345 kV (514901) to NORTWST7 345 kV (514880) line CKT 1 - NORTWST7 345 kV (514880) to MATHWSN7 345 kV (515497) line CKT 1

38	FLT38-SB	**Stuck Breaker at NORTWST7 (514880)** a. Apply single phase fault at the NORTWST7 345 kV bus. b. Clear fault after 16 cycles and trip the following elements. - NORTWST7 345 kV (514880) to NORTWST4 138 kV (514879) to NORTWS31 13.8 kV (515743) transformer CKT 1 - NORTWST7 345 kV (514880) to NORTWST4 138 kV (514879) to NORTWS21 13.8 kV (515742) transformer CKT 1
39	FLT39-SB	**Stuck Breaker at GRACMNT7 (515800)** a. Apply single phase fault at the GRACMNT7 345 kV bus. b. Clear fault after 16 cycles and trip the following elements. - GRACMNT7 345 kV (515800) to G16-037-TAP 345 kV (560078) line CKT 1 - GRACMNT7 345 kV (515800) to G16-091-TAP 345 kV (587744) line CKT 1
40	FLT40-SB	**Stuck Breaker at GRACMNT7 (515800)** a. Apply single phase fault at the GRACMNT7 345 kV bus. b. Clear fault after 16 cycles and trip the following elements. - GRACMNT7 345 kV (515800) to GRACMNT4 138 kV (515802) to GRCMNT11 13.8 kV (515801) transformer CKT 1 - GRACMNT7 345 kV (515800) to G16-091-TAP 345 kV (587744) line CKT 1
41	FLT41-PO	**Prior Outage of CIMARON7 345 kV (514901) to DRAPER 7 345 kV (514934) line CKT 1;** 3 phase fault on MINCO 345 kV (514801) to GRACMNT7 345 kV (515800) line CKT 1, near MINCO. a. Apply fault at the MINCO 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
42	FLT42-PO	**Prior Outage of CIMARON7 345 kV (514901) to DRAPER 7 345 kV (514934) line CKT 1;** 3 phase fault on CIMARON7 345 kV (514901) to NORTWST7 345 kV (514880) line CKT 1, near CIMARON7. a. Apply fault at the CIMARON7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

43	FLT43-PO	**Prior Outage of GRACMNT7 345 kV (515800) to G16-091-TAP 345 kV (587744) line CKT 1;** 3 phase fault on GRACMNT7 345 kV (515800) to G16-037-TAP 345 kV (560078) line CKT 1, near GRACMNT7. a. Apply fault at the GRACMNT7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT44-PO	**Prior Outage of GRACMNT7 345 kV (515800) to G16-091-TAP 345 kV (587744) line CKT 1;** 3 phase fault on GRACMNT7 345 kV (515800) to GRACMNT4 138 kV (515802) to GRCMNT11 13.8 kV (515801) transformer CKT 1, near GRACMNT7. a. Apply fault at the GRACMNT7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
45	FLT45-PO	**Prior Outage of CIMARON7 345 kV (514901) to CIMARON4 138 kV (514898) to CIMARO11 13.8 kV (515714) transformer CKT 1;** 3 phase fault on CIMARON7 345 kV (514901) to CIMARON4 138 kV (514898) to CIMARO21 13.8 kV (515715) transformer CKT 1, near CIMARON7. a. Apply fault at the CIMARON7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
46	FLT46-PO	**Prior Outage of NORTWST7 345 kV (514880) to MATHWSN7 345 kV (515497) line CKT 1;** 3 phase fault on CIMARON7 345 kV (514901) to DRAPER 7 345 kV (514934) line CKT 1, near CIMARON7. a. Apply fault at the CIMARON7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
47	FLT47-PO	**Prior Outage of NORTWST7 345 kV (514880) to MATHWSN7 345 kV (515497) line CKT 1;** 3 phase fault on CIMARON7 345 kV (514901) to NORTWST7 345 kV (514880) line CKT 1, near CIMARON7. a. Apply fault at the CIMARON7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

48	FLT48-PO	**Prior Outage of NORTWST7 345 kV (514880) to MATHWSN7 345 kV (515497) line CKT 1;** 3 phase fault on CIMARON7 345 kV (514901) to MATHWSN7 345 kV (515497) line CKT 1, near CIMARON7. a. Apply fault at the CIMARON7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
49	FLT49-PO	**Prior Outage of CIMARON7 345 kV (514901) to MATHWSN7 345 kV (515497) line CKT 1;** 3 phase fault on CIMARON7 345 kV (514901) to MATHWSN7 345 kV (515497) line CKT 2, near CIMARON7. a. Apply fault at the CIMARON7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
50	FLT50-PO	**Prior Outage of MINCO 345 kV (514801) to CIMARON7 345 kV (514901) line CKT 1;** 3 phase fault on GRACMNT7 345 kV (515800) to GRACMNT4 138 kV (515802) to GRCMNT11 13.8 kV (515801) transformer CKT 1, near GRACMNT7. a. Apply fault at the GRACMNT7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
51	FLT51-PO	**Prior Outage of MINCO 345 kV (514801) to CIMARON7 345 kV (514901) line CKT 1;** 3 phase fault on GRACMNT7 345 kV (515800) to G16-037-TAP 345 kV (560078) line CKT 1, near GRACMNT7. a. Apply fault at the GRACMNT7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
52	FLT52-PO	**Prior Outage of MINCO 345 kV (514801) to CIMARON7 345 kV (514901) line CKT 1;** 3 phase fault on GRACMNT7 345 kV (515800) to G16-091-TAP 345 kV (587744) line CKT 1, near GRACMNT7. a. Apply fault at the GRACMNT7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

APPENDIX B

SOUTHWEST POWER POOL DISTURBANCE PERFORMANCE REQUIREMENTS (SUBMITTED IN A SEPARATE FILE)

APPENDIX C

DYNAMIC STABILITY PLOTS FOR CLUSTER SCENARIO (SUBMITTED IN SEPARATE FILES FROM APPENDIX C-1 TO C-3 WHICH WILL BE AVAILABLE UPON REQUEST FROM SPP)

C-1 Group 1 Cluster Dynamic Stability Plots For 2017 Winter Peak Case

C-1-1 FLT-23 Dynamic Stability Plots For 2017 Winter Peak Case

C-2 Group 1 Cluster Dynamic Stability Plots For 2018 Summer Peak Case

C-2-1 FLT-23 Dynamic Stability Plots For 2018 Summer Peak Case

C-3 Group 1 Cluster Dynamic Stability Plots For 2026 Summer Peak Case

C-3-1 FLT-23 Dynamic Stability Plots For 2026 Summer Peak Case

Each contingency consists of seventy-one (71) subplots:

- Subplot #1 is the system phase angle channels in the snapshot file provided by SPP.
- Subplot #2 to Subplot #52 are results for fifty-one (51) generators in the scope of study.
- Subplots #53 to Subplot #61 are frequencies at the POI buses in the scope of study.
- Subplots #62 to Subplot #71 are voltages at the POI buses in the scope of study.

APPENDIX D

DYNAMIC DATA OF INTERCONNECT GENERATORS (SUBMITTED IN A SEPARATE FILE WHICH WILL BE AVAILABLE UPON REQUEST FROM SPP)

APPENDIX E

SHORT-CIRCUIT STUDY RESULTS

Table 5 GROUP 1 18SP Short-Circuit Study Results

Bus No	Bus Name	Short Circuit Current (A)	Bus No	Bus Name	Short Circuit Current (A)
MDWG16-18S_DIS1602_G01					
GEN-2016-118					
514708	OTTER 4 138.00	9781.3	520847	CASHION4 138.00	5577.2
514709	FRMNTAP4 138.00	18822.8	520848	CEDRDAL4 138.00	5543.1
514710	WAUKOMI4 138.00	10546.7	520879	DOVER 4 138.00	6747.4
514711	WAUKOTP4 138.00	16177.7	520882	DOVERSW4 138.00	9836.5
514714	WOODRNG4 138.00	20167.1	520957	IODINE 4 138.00	7235.0
514731	SO4TH 4 138.00	15882.7	520996	MORLND1 13.800	20969.1
514733	MARSHL 4 138.00	8491.6	520997	MORLND2 18.000	78794.3
514774	HENESEY4 138.00	8918.9	520998	MORLND3 18.000	82433.9
514788	GLASMTN4 138.00	5293.8	520999	MOORLND4 138.00	20031.1
514790	IMO 4 138.00	12276.5	521016	OKEENE 4 138.00	5123.4
514815	BRECKNR4 138.00	14304.3	521037	REEDING2 138.00	4734.6
514827	CTNWOOD4 138.00	18038.0	521065	TALOGA 4 138.00	7662.8
514829	PINE ST4 138.00	12217.0	521073	TWNLAKE4 138.00	7315.8
514907	ARCADIA4 138.00	41200.4	560066	G15-095T 138.00	7650.9
515373	LBRTYLK4 138.00	14183.4	560077	G16-032-TAP 345.00	4189.3
515377	CRESENT4 138.00	8077.5	587140	GEN-2016-020345.00	4512.0
515785	WINDFRM4 138.00	19603.7	587940	GEN-2016-118138.00	7602.8
520425	PIC4 138.00	7959.3	587941	G16-118XFMR134.500	28951.8
520500	BEARCAT 138.00	15816.2	587942	G16-118-GSU134.500	29476.5
520600	EKNGFSH3 138.00	5202.5	587943	G16-118-GEN10.6900	1749567.5
520603	NKNGFSH 138.00	6115.5			

GEN-2016-131					
509745	CLARKSV7 345.00	18905.4	515939	MNCWND47 345.00	6636.4
509782	R.S.S.-7 345.00	29252.5	515940	MNCO4L11 34.500	27240.6
510907	PITTSB-7 345.00	13210.9	515942	MNCO4C11 34.500	26025.0
510911	VALIANT7 345.00	13038.0	525832	TUCO_INT 7345.00	10958.2
510925	KIOWA 7 345.00	12983.3	539801	THISTLE7 345.00	16611.1
511456	O.K.U.-7 345.00	5040.0	560071	G16-003-TAP 345.00	15437.0
511468	L.E.S.-7 345.00	12699.9	560078	G16-037-TAP 345.00	7725.7
511553	CHISHOLM7 345.00	6152.5	560084	G16-061-TAP 345.00	15916.4
511565	OKLAUN HVDC7345.00	5026.2	584060	GEN-2015-057345.00	8306.3
511568	TERRYRD7 345.00	9730.5	584700	GEN-2015-029345.00	10239.7
511571	RUSHSPR7 345.00	6287.8	584701	G15-029XFMR134.500	20686.9
514715	WOODRNG7 345.00	19180.4	584951	G15-057XFMR134.500	16121.9
514801	MINCO 7 345.00	17540.7	584952	G15-057-GSU134.500	15927.3
514803	SOONER 7 345.00	24982.5	584953	G15-057-GEN10.6900	569959.2
514809	JOHNCO 7 345.00	9666.9	584954	G15-057-GEN20.6900	131345.5
514880	NORTWST7 345.00	32699.4	584955	G15-057-GEN30.6900	102948.6
514881	SPRNGCK7 345.00	23349.2	585080	GEN-2015-071345.00	5676.4
514882	SPGCK1&2 13.800	113131.9	585081	G15-071XFMR134.500	27590.0
514883	SPGCK3&4 13.800	77954.1	585270	GEN-2015-093345.00	9778.0
514901	CIMARON7 345.00	33306.8	585271	G15-093XFMR134.500	30347.1
514908	ARCADIA7 345.00	25795.0	585272	G15-093-GSU134.500	29693.5
514909	REDBUD 7 345.00	24620.7	585273	G15-093-GEN10.6900	1022234.7
514934	DRAPER 7 345.00	20941.0	585274	G15-093-GEN20.6900	921274.4
515041	SEMINL2G 17.100	188123.9	587230	GEN-2016-037345.00	7034.6
515042	SEMINL3G 20.900	183176.3	587231	G16-037XFMR134.500	42902.8
515045	SEMINOL7 345.00	25994.1	587232	G16-037-GSU134.500	41939.2

515136	SUNNYSD7 345.00	10636.9	587300	G16-045-SUB1345.00	1767.7
515223	MUSKOG4G 18.000	221585.8	587301	G16-045XFMR134.500	16651.0
515224	MUSKOGE7 345.00	27206.9	587302	G16-045-GSU134.500	16644.2
515225	MUSKOG5G 18.000	218172.6	587304	G16-045-SUB2345.00	1722.0
515226	MUSKOG6G 24.000	181905.9	587305	G16-045XFMR234.500	16380.5
515235	PECANCK7 345.00	20424.3	587306	G16-045-GSU234.500	16372.9
515302	FTSMITH7 345.00	9693.4	587380	G16-057-SUB1345.00	1740.6
515375	WWRDEHV7 345.00	19983.1	587381	G16-057XFMR134.500	16473.3
515407	TATONGA7 345.00	16706.2	587382	G16-057-GSU134.500	16466.2
515422	C-RIVER7 345.00	9287.5	587384	G16-057-SUB2345.00	1663.3
515444	MCNOWND7 345.00	17489.1	587385	G16-057XFMR234.500	16013.2
515448	CRSRDSW7 345.00	11807.3	587386	G16-057-GSU234.500	16008.2
515458	BORDER 7345.00	5497.2	587460	GEN-2016-068345.00	6647.3
515476	HUNTERS7 345.00	13747.6	587740	GEN-2016-091345.00	12846.9
515497	MATHWSN7 345.00	32274.7	587741	G16-091XFMR134.500	30082.0
515549	MNCWND37 345.00	12047.6	587742	G16-091-GSU134.500	28440.8
515582	SLNGWND7 345.00	7785.2	587744	G16-091-TAP 345.00	14409.9
515585	MAMTHPW7 345.00	13309.4	587770	GEN-2016-095345.00	10719.5
515599	G07621119-20345.00	13660.4	587771	G16-095XFMR134.500	31236.5
515600	KNGFSHR7 345.00	11652.0	587772	G16-095-GSU134.500	30328.8
515605	CANADN7 345.00	12070.8	587800	GEN-2016-100345.00	11981.4
515610	FSHRTAP7 345.00	17088.9	587804	G16-100-TAP 345.00	16241.8
515800	GRACMNT7 345.00	16657.7	587810	GEN-2016-101345.00	12051.8
515875	REDNGTN7 345.00	18444.4	587950	GEN-2016-119345.00	10267.2
515877	REDDIRT7 345.00	18121.7	588190	GEN-2016-128345.00	8083.0
515878	RDDIRT11 34.500	24083.9	599891	OKLAUN 7 345.00	4367.2
515879	RDDIRT21 34.500	25450.5			

Table 6 GROUP 1 26SP Short-Circuit Study Results

Bus No	Bus Name	Short Circuit Current (A)	Bus No	Bus Name	Short Circuit Current (A)
MDWG16-26S_DIS1602_G01					
GEN-2016-118					
514708	OTTER 4 138.00	9781.1	520847	CASHION4 138.00	5577.9
514709	FRMNTAP4 138.00	18803.1	520848	CEDRDAL4 138.00	5574.9
514710	WAUKOMI4 138.00	10562.2	520879	DOVER 4 138.00	6762.0
514711	WAUKOTP4 138.00	16175.0	520882	DOVERSW4 138.00	9903.7
514714	WOODRNG4 138.00	20135.9	520957	IODINE 4 138.00	7353.6
514731	SO4TH 4 138.00	15878.3	520996	MORLND1 13.800	40703.1
514733	MARSHL 4 138.00	8486.3	520997	MORLND2 18.000	79234.5
514774	HENESEY4 138.00	8956.2	520998	MORLND3 18.000	82880.8
514788	GLASMTN4 138.00	5308.3	520999	MOORLND4 138.00	21076.8
514790	IMO 4 138.00	12276.2	521016	OKEENE 4 138.00	5142.1
514815	BRECKNR4 138.00	14313.6	521037	REEDING2 138.00	4737.7
514827	CTNWOOD4 138.00	17957.2	521065	TALOGA 4 138.00	7689.8
514829	PINE ST4 138.00	12168.8	521073	TWNLAKE4 138.00	7316.3
514907	ARCADIA4 138.00	40766.6	560066	G15-095T 138.00	7678.6
515373	LBRTYLK4 138.00	14099.8	560077	G16-032-TAP 345.00	4180.6
515377	CRESENT4 138.00	8065.5	587140	GEN-2016-020345.00	4611.1
515785	WINDFRM4 138.00	20587.1	587940	GEN-2016-118138.00	7628.8
520425	PIC4 138.00	8064.4	587941	G16-118XFMR134.500	28974.2
520500	BEARCAT 138.00	16416.0	587942	G16-118-GSU134.500	29499.3
520600	EKNGFSH3 138.00	5212.6	587943	G16-118-GEN10.6900	1750362.8
520603	NKNGFSH 138.00	6134.3			

GEN-2016-131					
509745	CLARKSV7 345.00	18734.9	515939	MNCWND47 345.00	6621.3
509782	R.S.S.-7 345.00	29055.3	515940	MNCO4L11 34.500	27157.8
510907	PITTSB-7 345.00	13138.4	515942	MNCO4C11 34.500	25947.3
510911	VALIANT7 345.00	12919.4	525832	TUCO_INT 7345.00	13095.9
510925	KIOWA 7 345.00	12912.0	539801	THISTLE7 345.00	16626.2
511456	O.K.U.-7 345.00	5089.5	560071	G16-003-TAP 345.00	15427.8
511468	L.E.S.-7 345.00	12808.8	560078	G16-037-TAP 345.00	7736.8
511553	CHISHOLM7 345.00	6159.1	560084	G16-061-TAP 345.00	15877.1
511565	OKLAUN HVDC7345.00	5075.4	584060	GEN-2015-057345.00	8291.2
511568	TERRYRD7 345.00	9738.6	584700	GEN-2015-029345.00	10209.4
511571	RUSHSPR7 345.00	6276.9	584701	G15-029XFMR134.500	20609.1
514715	WOODRNG7 345.00	19142.5	584951	G15-057XFMR134.500	16068.3
514801	MINCO 7 345.00	17558.7	584952	G15-057-GSU134.500	15874.5
514803	SOONER 7 345.00	24915.2	584953	G15-057-GEN10.6900	568163.3
514809	JOHNCO 7 345.00	9620.8	584954	G15-057-GEN20.6900	130911.8
514880	NORTWST7 345.00	32503.3	584955	G15-057-GEN30.6900	102605.3
514881	SPRNGCK7 345.00	23234.5	585080	GEN-2015-071345.00	5681.3
514882	SPGCK1&2 13.800	113091.7	585081	G15-071XFMR134.500	27575.5
514883	SPGCK3&4 13.800	77930.4	585270	GEN-2015-093345.00	9815.8
514901	CIMARON7 345.00	33138.0	585271	G15-093XFMR134.500	30296.4
514908	ARCADIA7 345.00	25791.0	585272	G15-093-GSU134.500	29644.0
514909	REDBUD 7 345.00	24888.6	585273	G15-093-GEN10.6900	1020100.6
514934	DRAPER 7 345.00	20771.5	585274	G15-093-GEN20.6900	919257.9
515041	SEMINL2G 17.100	187401.7	587230	GEN-2016-037345.00	7041.6
515042	SEMINL3G 20.900	182646.5	587231	G16-037XFMR134.500	42873.9
515045	SEMINOL7 345.00	25834.3	587232	G16-037-GSU134.500	41914.3

515136	SUNNYSD7 345.00	10603.3	587300	G16-045-SUB1345.00	1761.8
515223	MUSKOG4G 18.000	221103.9	587301	G16-045XFMR134.500	16600.0
515224	MUSKOGE7 345.00	26979.8	587302	G16-045-GSU134.500	16593.3
515225	MUSKOG5G 18.000	217575.9	587304	G16-045-SUB2345.00	1716.2
515226	MUSKOG6G 24.000	181496.5	587305	G16-045XFMR234.500	16330.6
515235	PECANCK7 345.00	20283.4	587306	G16-045-GSU234.500	16323.1
515302	FTSMITH7 345.00	9355.0	587380	G16-057-SUB1345.00	1734.7
515375	WWRDEHV7 345.00	19969.1	587381	G16-057XFMR134.500	16422.9
515407	TATONGA7 345.00	16659.7	587382	G16-057-GSU134.500	16416.0
515422	C-RIVER7 345.00	9242.3	587384	G16-057-SUB2345.00	1657.8
515444	MCNOWND7 345.00	17506.8	587385	G16-057XFMR234.500	15964.9
515448	CRSRDSW7 345.00	11771.8	587386	G16-057-GSU234.500	15960.0
515458	BORDER 7345.00	5530.4	587460	GEN-2016-068345.00	6630.6
515476	HUNTERS7 345.00	13732.4	587740	GEN-2016-091345.00	12930.4
515497	MATHWSN7 345.00	32124.0	587741	G16-091XFMR134.500	30034.8
515549	MNCWND37 345.00	12039.0	587742	G16-091-GSU134.500	28396.4
515582	SLNGWND7 345.00	7761.2	587744	G16-091-TAP 345.00	14522.9
515585	MAMTHPW7 345.00	13271.1	587770	GEN-2016-095345.00	10767.9
515599	G07621119-20345.00	13646.6	587771	G16-095XFMR134.500	31186.3
515600	KNGFSHR7 345.00	11601.0	587772	G16-095-GSU134.500	30283.5
515605	CANADN7 345.00	12015.6	587800	GEN-2016-100345.00	11944.9
515610	FSHRTAP7 345.00	17009.5	587804	G16-100-TAP 345.00	16191.4
515800	GRACMNT7 345.00	16823.2	587810	GEN-2016-101345.00	12015.3
515875	REDNGTN7 345.00	18385.9	587950	GEN-2016-119345.00	10239.2
515877	REDDIRT7 345.00	18064.3	588190	GEN-2016-128345.00	8062.8
515878	RDDIRT11 34.500	24027.3	599891	OKLAUN 7 345.00	4366.3
515879	RDDIRT21 34.500	25394.0			

J2: GROUP 2 DYNAMIC STABILITY ANALYSIS REPORT

Smart Solutions, Practical Results

SPP DISIS-2016-002
System Impact Study

PREPARED FOR: Southwest Power Pool (SPP)

REPORT DATE: April 19, 2018

PREPARED BY:

Bryan Rushing
brushing@quanta-technology.com
(636) 288-2946

Rajesh Pudhota
rpudhota@quanta-technology.com
(636) 288-5443

David Takach
dtakach@quanta-technology.com
(330) 423-3105

QUANTA TECHNOLOGY, LLC
4020 WESTCHASE BOULEVARD, SUITE 300, RALEIGH, NC 27607 USA
Oakland | Chicago | Boston | Toronto
www.Quanta-Technology.com
Quanta Technology, LLC is a wholly-owned subsidiary of Quanta Services, Inc. (NYSE: PWR)

Report Contributors:

- Bryan Rushing
- Rajesh Pudhota
- David Takach

EXECUTIVE SUMMARY

Definitive Impact Study Interconnection Customers have requested a generator interconnection study through the Southwest Power Pool (SPP) Tariff for their respective interconnection requests. This report delineates the study results for DISIS-2016-002 Cluster Group 2, Hitchland Area, whose generation interconnection requests are shown in the table below:

Request	Size (MW)	Generator Model	Point of Interconnection
ASGI-2016-010	90	GE 2.5 MW (588482)	TCEC Western Tie 115kV (522960)
GEN-2016-161	167.4 (3.02MW uprate of GEN-2003-020/GEN-2016-070)	GE 1.62 MW (523941, 523942 id 1&2)	Martin 115kV (523928)

The greatest increase in fault current due to Cluster Group 2 is at Western Tie 115/ 69/13.2 kV transformer tertiary (20.2%) for both the 2018SP and 2026S cases.

The percent increase in the fault currents at the ASGI-2016-010 POI (Bus 522950) are 19.2% and 19.3%, respectively, for the 2018SP and 2026SSP cases. The percent increase in the fault currents at the GEN-2016-161 POI (Bus 523928) as a contribution of the existing wind project are 13.5% and 13.4%, respectively, for the 2018SP and 2026SSP cases.

Average percent increase in faults currents within 5 levels from each POI is 2.3% and 2.2% in the 2018SP and 2026SP cases, respectively.

Initial results indicate that reactor banks on the 345kV system with proximity to the Woodward EHV station may need to be switched out of service under system conditions of high wind generation in the Hitchland area. The following reactors were initialized at 0 Mvar:

- Beaver County - Badger 345kV
- Woodward - GEN-2016-003-Tap 345kV
- Woodward 345kV (located on Transformer Tertiaries)
- Woodward - Thistle 345kV
- Thistle - GEN-2016-005-Tap 345kV
- Buffalo - Thistle 345kV
- Buffalo - Wichita 345kV

After the addition of Cluster Group 2, all units monitored had acceptable response, neither pulling out, tripping, nor exhibiting undamped variations for all contingencies simulated, with the exception of the following:

- Contingency FLT07-3PH: 3 phase fault on the Hitchland-Hansford 115 kV line
- Contingency FLT10-3PH: 3 phase fault on the Hitchland-Potter County 345 kV line

- Contingency FLT13-3PH: 3 phase fault on the Finney-Holcomb 345 kV line
- Contingency FLT18-3PH: 3 phase fault on the Potter County 345/230/13.2 kV transformer

The above faults were simulated with the DISIS-2016-002 Group 2 requests removed from the model and the results compared. This comparison determined the observed issues to be pre-existing and not intensified by the study requests.

Contingency FLT07-3PH trips machine 1 at the bus 523201, EXCELN4-WTG1 on under-voltage for the 2018SP and 2026SP cases.

Contingency FL10-3PH, trips DeWind wind turbines G06-044GEN1A for the 2017WP case, the NOVUS_WND for the 2018SP case, and trips the G06_044GEN2A for the 2026SP case by the RELUNS under-speed relay. This contingency also trips wind turbines NOVUS_WND and G06_44GEN2B for the 2026SP case by the G59REL over-frequency relay. These are previously known issues.

FLT13-3PH and FLT18-3PH for the 2017WP case initially caused a sustained, widespread, low frequency oscillation observed in Oklahoma, but the switching off-line the reactor banks on the 345 kV system near Woodward EHV station has significantly improved system damping mitigating the low frequency oscillations previously found for FLT13-3PH and FLT18-3PH in the 2017WP case.

TABLE OF CONTENTS

List of Figures

List of Tables

1 INTRODUCTION

Definitive Impact Study Interconnection Customers have requested a generator interconnection study through the Southwest Power Pool (SPP) Tariff for their respective interconnection requests. This report delineates the study results for DISIS-2016-002 Cluster Group 2, Hitchland Area, whose generation interconnection requests are shown in Table 1:

Table 1 – SPP Cluster Group 2 Generation Interconnection Requests

Request	Size (MW)	Generator Model	Point of Interconnection
ASGI-2016-010	90	GE 2.5 MW (588482)	TCEC Western Tie 115kV, 522960)
GEN-2016-161	167.4 (3.02MW uprate of GEN-2003-020/GEN-2016-070)	GE 1.62 MW (523941, 523942 id 1&2)	Martin 115kV (523928)

Figures 1 and 2 are one-lines for generation interconnection queues ASGI-2016-010 and GEN-2016-161, respectively.

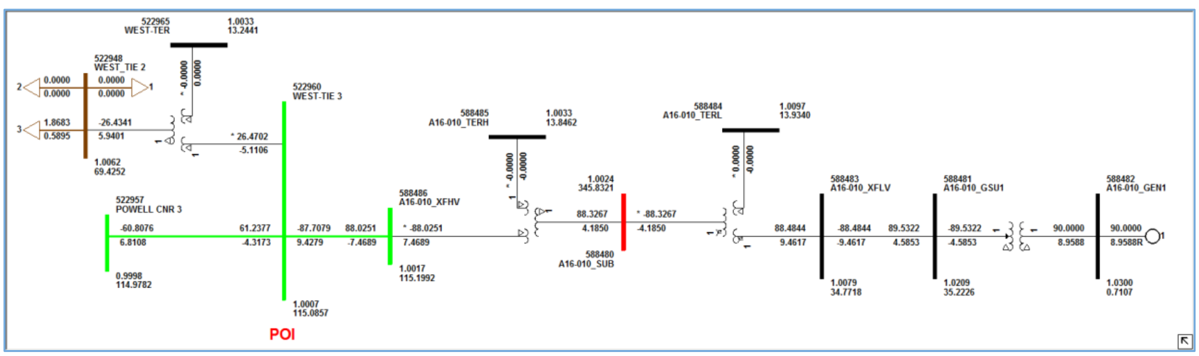


Figure 1 - ASGI-2016-010 one-line diagram

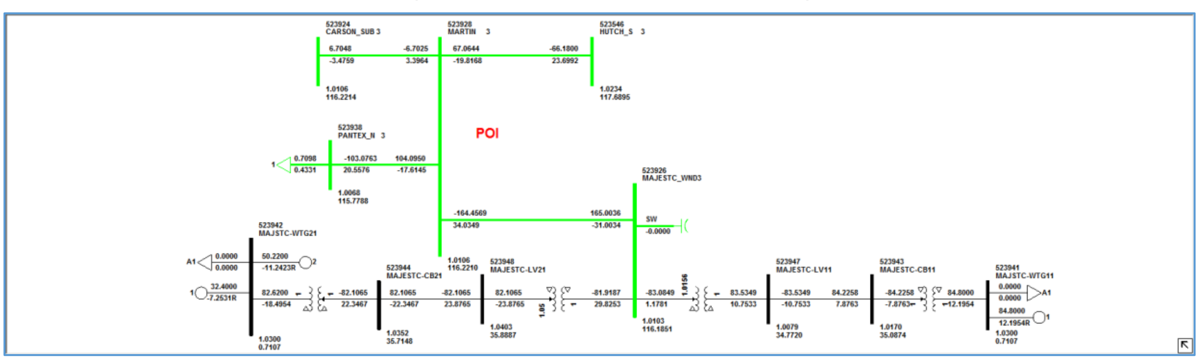


Figure 2 - GEN-2016-161 one-line diagram

2 METHODOLOGY

2.1 Study Assumptions

1. Quanta Technology ("The Consultant") was provided with three saved cases for this study:
    a) 2107 Winter Peak Case (2017WP)
    b) 2018 Summer Peak case (2018SP)
    c) 2026 Summer Peak case (2026SP)
2. Each case has been built with generation within the SPP footprint displaced by the new generation interconnection request(s) listed in Table 1.
3. The three study cases will also contain the prior queued project requests listed in Table 2. As illustrated in Figure 1 and 2, these queued projects are represented in the power flow as equivalent machines at the buses shown. Each such machine has an appropriately sized equivalent transformer up to the 34.5 kV level and an equivalent 34.5 kV lines to the substation bus. This representation was provided as a part of the power flow case.
4. Each saved case was built and tested using PSSE version 33.7.
5. The contingencies are described in the fault definitions listed in Table 3.
6. There should not be any special modeling required of line relays in these cases, except for the special modeling related to the wind-turbine tripping.
7. SPP provided the power flow cases with all prior queued projects in the model. All study and previous queued information is considered CONFIDENTIAL.
8. The study was performed in accordance with "Southwest Power Pool Disturbance Performance Requirements" (Appendix A as appended to the scope).

Table 2 – SPP Cluster Group 2 Prior Queued Requests

Request	Size (MW	Wind Turbine Model	Point of Interconnection
Llano Estacado (White Deer)	80	Mitsubishi MHI 1000A 1MW	Llano Wind 115kV (523815)
Carson	10	Wind	Martin 115kV (523928)
Dumas 19th Street	20	Suzlon S64 1MW	Dumas 19th Street 115kV (523318)
Etter	20	Suzlon S64 1MW	Etter 115kV (523256)
Moore E	27.5	Suzlon S64 0.75/1.0MW	Moore East 115kV (523308)
Sherman	20	Suzlon S64 1MW	Sherman 115kV (523168)
Spearman	10	WT1 1MW	Spearman 69kV (523185)
TC-Texas County	20	Suzlon S64 1MW	Texas County 115kV (523090)

Request	Size (MW	Wind Turbine Model	Point of Interconnection
GEN-2002-008	240	GE 1.5MW	Hitchland 345kV (523097)
GEN-2002-009	79.8	Suzlon S88 2.1MW	Hansford 115kV (523195)
GEN-2002-022	239.2	Siemens 93m 2.3MW	Bushland 230kV (524267)
GEN-2003-020/GEN-2016-070	164.4	GE 1.5/1.6 MW	Martin Switching Station 115kV (523928)
GEN-2006-020S	20	DeWind D8.2 2.0MW	DWS Frisco 115kV (523160)
GEN-2006-044	370	DeWind D9.2 2.0MW	Hitchland 345kV (523097)
GEN-2007-046	200	Vestas V100/V110 2.0MW	Hitchland 115kV (523093)
GEN-2008-047	299.2	GE 1.7MW	Beaver County 345kV (515554)
GEN-2008-051	322	Siemens 93m 2.3MW	Potter County 345kV (523961)
GEN-2010-001	299.7	GE 1.85MW	Beaver County 345kV (515554)
GEN-2010-014	358.8	Siemens 101m 2.3MW	Hitchland 345kV (523097)
ASGI-2011-002	20	DeWind D8.2 2.0MW	Herring 115kV (523359)
GEN-2011-014	198	Vestas V117 GridStreamer 3.3MW	Tap Hitchland - Woodward Dbl Ckt (GEN-2011-014 Tap) 345kV (560000)
GEN-2011-022	299	Siemens 93m 2.3MW	Hitchland 345kV (523097)
ASGI-2013-001	11.5	Siemens 2.3MW	PanTex South 115kV(523945)
GEN-2013-030	299	Siemens 2.3MW	Beaver County 345kV (515554)
GEN-2014-037	200	Vestas V110 VCSS 2.0MW	Tap Hitchland - Beaver County Dbl Ckt (Optima) 345kV (560010)
GEN-2015-082	200	GE 2.0MW	Tap on Woodward (515375) to Beaver (515554) 345kV (G11-14-TAP, 560000)

Table 3 – Contingency List

Contingency Number	Contingency Name	Description
1	FLT01-3PH	3 phase fault on the Martin (523928) to Hutchinson South (523546) 115kV line ckt1, near Martin. a. Apply fault at the Martin bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT02-3PH	3 phase fault on the Martin (523928) to Pantex North (523938) 115kV line ckt1, near Martin. a. Apply fault at the Martin bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
3	FLT03-3PH	3 phase fault on the Hutchinson South (523546) to Riverview (523377) 115kV line ckt1, near Hutchinson South. a. Apply fault at the Hutchinson South bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
4	FLT04-3PH	3 phase fault on the Hutchinson North (523544) to Blackhawk Station (523344) 115kV line ckt1, near Hutchinson South. a. Apply fault at the Hutchinson South bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
5	FLT05-3PH	3 phase fault on the Pringle (523267) 230kV to Pringle (523266) 115kV/(523265) 13.2kV transformer ckt1, near Potter County 345kV. a. Apply fault at the Pringle 230kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
6	FLT06-3PH	3 phase fault on the Texas County (523090) to Hitchland (523093) 115kV line ckt1, near Texas County. a. Apply fault at the Texas County bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
7	FLT07-3PH	3 phase fault on the Hitchland (523093) to Hansford (523195) 115kV line ckt1, near Hitchland. a. Apply fault at the Hitchland bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
8	FLT08-3PH	3 phase fault on the Hansford (523195) to Spearman (523186) 115kV line ckt1, near Hansford. a. Apply fault at the Hansford bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault

9	FLT09-3PH (17W only)	3 phase fault on the Hitchland (523097) to Finney (523853) 345kV line ckt1, near Hitchland. a. Apply fault at the Hitchland 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT10-3PH	3 phase fault on the Hitchland (523097) to Potter County (523961) 345kV line ckt1, near Hitchland. a. Apply fault at the Hitchland 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
11	FLT11-3PH	3 phase fault on the Hitchland (523097) 345kV to Hitchland (523095) 230kV/(523091) 13.2kV transformer ckt1, near Hitchland 345kV. a. Apply fault at the Hitchland 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
12	FLT12-3PH	3 phase fault on the Hitchland (523095) 230kV to Hitchland (523093) 115kV/(523092) 13.2kV transformer ckt1, near Hitchland 230kV. a. Apply fault at the Hitchland 230kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
13	FLT13-3PH	3 phase fault on the Finney (523853) to Holcomb (531449) 345kV line ckt1, near Finney. a. Apply fault at the Finney 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
14	FLT14-3PH	3 phase fault on the Holcomb (531449) to Setab (531465) 345kV line ckt1, near Holcomb. a. Apply fault at the Holcomb 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
15	FLT15-3PH	3 phase fault on the Holcomb (531449) to Buckner (531501) 345kV line ckt1, near Holcomb. a. Apply fault at the Holcomb 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT16-3PH	3 phase fault on the Holcomb (531449) 345kV to Holcomb (531448) 115kV/(531450) 13.8kV transformer ckt1, near Holcomb 345kV. a. Apply fault at the Holcomb 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
17	FLT17-3PH	3 phase fault on the Finney (523853) to Lamar (599950) 345kV line ckt1, near Finney. a. Apply fault at the Finney 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
18	FLT18-3PH	3 phase fault on the Potter County (523961) 345kV to Potter County (523959) 230kV/(523957) 13.2kV transformer ckt1, near Potter County 345kV.

		a. Apply fault at the Potter County 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
19	FLT19-3PH	3 phase fault on the Hitchland (523095) to Ochiltree (523155) 230kV line ckt1, near Hitchland. a. Apply fault at the Hitchland 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
21	FLT21-3PH	3 phase fault on the Hitchland (523095) to Moore County (523309) 230kV line ckt1, near Hitchland. a. Apply fault at the Hitchland 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
23	FLT23-3PH	3 phase fault on the Harrington (523979) to Potter County (523959) 230kV line ckt1, near Harrington. a. Apply fault at the Harrington 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
25	FLT25-3PH	3 phase fault on the Potter County (523959) to Moore County (523309) 230kV line ckt1, near Potter County. a. Apply fault at the Potter 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
27	FLT27-3PH	3 phase fault on the Hutchison South (523546) 115 kV to Hutchison (523551) 230kV/(523541) 13.2kV transformer ckt1, near Hutchison South 115kV. a. Apply fault at the Hutchison South 115kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
28	FLT28-3PH	3 phase fault on the Hutchison South (523546) 115 kV to Hutchison (523543) 69kV/(523542) 13.2kV transformer ckt1, near Hutchison South 115kV. a. Apply fault at the Hutchison South 115kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer
29	FLT29-3PH	3 phase fault on the Hutchison South (523546) to Gray County (523636) 115kV line ckt1, near Hutchison South. a. Apply fault at the Hutchison South 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
30	FLT30-3PH	3 phase fault on the Pantex South (523945) to Highland Tap (523931) to Asarco Tap (524018) 115kV line ckt1, near Pantex South. a. Apply fault at the Pantex South 115V bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
31	FLT31-3PH	3 phase fault on the Nichols (524044) to Amarillo South (524415) 230kV line ckt1, near Nichols. a. Apply fault at the Nichols 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

		c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
32	FLT32-3PH	3 phase fault on the Harrington West (523977) to Rolling Hills (524010) 230kV line ckt1, near Harrington West. a. Apply fault at the Harrington West 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
33	FLT33-3PH	3 phase fault on the Harrington (523978) to Nichols (524044) 230kV line ckt2, near Harrington. a. Apply fault at the Harrington 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
34	FLT34-3PH	3 phase fault on the Harrington West (523977) to Nichols (524044) 230kV line ckt1, near Harrington West. a. Apply fault at the Harrington West 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
35	FLT35-3PH	3 phase fault on the Harrington West (523977) to East Plant (524163) 230kV line ckt1, near Harrington West. a. Apply fault at the Harrington West 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
36	FLT36-3PH	Prior outage on the Martin Switching Station (523928) to Hutchison South (523546) 115kV. 3 phase fault on the Martin Switching Station (523928) to Pantex North (523938) 115kV line ckt1, near Martin Switching Station. a. Apply fault at the Martin Switching Station 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
37	FLT37-3PH	Prior outage on the Martin Switching Station (523928) to Pantex North (523938) 115kV. 3 phase fault on the Martin Switching Station (523928) to Hutchison South (523546) 115kV line ckt1, near Martin Switching Station. a. Apply fault at the Martin Switching Station 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
38	FLT38-1PH	Martin Switching Station Stuck Breaker 115kV. a. Apply single phase fault at the Martin Switching Station (523928) to Hutchison South (523546) 115kV line ckt1, near Martin Switching Station. b. Wait 16 cycles, and then drop Martin Switching Station (523928) to Hutchison South (523546) 115kV ckt1. c. Martin Switching Station (523928) to Carson (523546) 115kV ckt1. d. Trip Carson (523923) unit 1, disconnect buses 523923 and 523924 and remove fault.
39	FLT39-1PH	Single phase fault with stuck breaker at Nichols (524044) 230kV.

		a. Apply fault at the Nichols 230kV bus. b. Clear fault after 16 cycles by trip the following elements. c. Nichols (524044) – Harrington (523978) 230kV ckt1.
40	FLT40-3PH	3 phase fault on the West-Tie (522960) 115 kV to West-Tie (522948) 69kV/(522965) 13.2kV transformer ckt1, near West-Tie 115kV. a. Apply fault at the West-Tie 115kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
41	FLT41-3PH	3 phase fault on the West-Tie (522960) to Powell Corner (522957) 115kV line ckt1, near West-Tie. a. Apply fault at the West-Tie 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
42	FLT42-3PH	3 phase fault on the West-Tie (522948) to Thrash (522921) 69kV line ckt1, near West-Tie. a. Apply fault at the West-Tie 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
43	FLT43-3PH	3 phase fault on the Powell Corner (522957) to Hovey (522954) 115kV line ckt1, near Powell Corner. a. Apply fault at the Powell Corner 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT44-3PH	3 phase fault on the Hovey (522954) 115 kV to Hovey (523001) 69kV/(522955) 13.2kV transformer ckt1, near Hovey. a. Apply fault at the Hovey 115kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
45	FLT45-3PH	3 phase fault on the Powell Corner (522957) 115 kV to Powell Corner (522929) 69kV/(522956) 13.2kV transformer ckt1, near Powell Corner. a. Apply fault at the Powell Corner 115kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.

3 RESULTS

3.1 Short-circuit analysis

The three-phase fault currents for the 2018SP and 2026S cases as calculated by PSSE are shown in Table 4 and Table 5, respectively. The greatest increase is at Western Tie 115/69/13.2 kV transformer tertiary (20.2%) for both the 2018SP and 2026S cases. The percent increase in the fault currents at the ASGI-2016-010 POI (Bus 522950) are 19.2% and 19.3%, respectively, for the 2018SP and 2026SSP cases. The percent increase in the fault currents at the GEN-2016-161 POI (Bus 523928) as a contribution of the existing wind project are 13.5% and 13.4%, respectively, for the 2018SP and 2026SSP cases. Average percent increase in faults currents within 5 levels from each POI is 2.3% and 2.2% in the 2018SP and 2026SP cases, respectively.

Table 4 - Fault current 2018SP case

Bus Number	Bus Name	Base Voltage (kV)	Without Study Units (amps)	With Study Units (amps)	Difference (amps)	Difference (%)
522905	STURGIS 2	69.0	1680.7	1770.2	89.5	5.3
522912	Y TAP 3	115.0	4462.1	4793.8	331.7	7.4
522917	ADAMS-T 2	69.0	1874.7	1891.7	17.0	0.9
522921	THRASH 2	69.0	3206.9	3571.3	364.4	11.4
522927	JEFFERSON 2	69.0	2045.3	2069.5	24.3	1.2
522929	POWELL CNR 2	69.0	3641.4	3926.8	285.4	7.8
522944	STURGIS-T 2	69.0	3010.2	3298.5	288.3	9.6
522948	WEST_TIE 2	69.0	3287.9	3681.2	393.3	12.0
522950	THRALL 2	69.0	1516.8	1564.7	47.9	3.2
522954	HOVEY 3	115.0	3199.4	3452.6	253.2	7.9
522955	HOVEY 1	12.5	5871.3	5919.4	48.1	0.8
522956	POWELL CNR 1	12.5	5172.9	5270.9	98.0	1.9
522957	POWELL CNR 3	115.0	3605.4	3996.1	390.7	10.8
522960	WEST-TIE 3	115.0	2293.0	2736.5	443.5	19.3
522965	WEST-TER	13.2	23341.5	28056.2	4714.7	20.2
523001	TC-HOVEY 2	69.0	5837.0	6154.3	317.3	5.4
523006	TC-ELKHART 2	69.0	1363.2	1418.6	55.4	4.1
523032	TC-KEYES 2	69.0	1190.2	1232.3	42.0	3.5
523044	TC-ELKHRT_T2	69.0	2705.5	2931.6	226.1	8.4
523051	TC-EVAREG 2	69.0	2480.0	2651.2	171.2	6.9
523065	TC-THOMPSON2	69.0	6306.7	6610.3	303.6	4.8
523072	TC-SEABOARD2	69.0	5938.8	6188.3	249.5	4.2
523079	TC-GUYMON_N2	69.0	6263.9	6553.5	289.5	4.6
523085	TC-TXCN_TR11	13.2	5720.4	5758.5	38.1	0.7

Bus Number	Bus Name	Base Voltage (kV)	Without Study Units (amps)	With Study Units (amps)	Difference (amps)	Difference (%)
523086	TC-TXCN_TR21	13.2	5721.6	5759.7	38.1	0.7
523087	TC-TXCOUNTY1	34.5	2795.8	2809.0	13.2	0.5
523089	TC-TXCOUNTY2	69.0	8069.0	8416.1	347.1	4.3
523090	TEXAS_CNTY 3	115.0	7979.0	8363.0	384.0	4.8
523092	HITCHLD_TR11	13.2	21861.3	21920.2	58.8	0.3
523093	HITCHLAND 3	115.0	17549.1	17844.6	295.6	1.7
523095	HITCHLAND 6	230.0	14749.1	14864.2	115.1	0.8
523098	HITCHLD_TR41	13.2	21861.3	21920.2	58.8	0.3
523099	TC-WHITING 3	115.0	2369.7	2533.4	163.6	6.9
523106	TXPHSF 3	115.0	4169.0	4236.3	67.3	1.6
523113	TC-MCMURRY 3	115.0	6189.6	6400.4	210.9	3.4
523142	TC-AGGIE 3	115.0	4000.5	4041.7	41.2	1.0
523160	FRISCO_WND 3	115.0	7014.7	7043.2	28.6	0.4
523174	GOODWELLWND3	115.0	6582.2	6609.7	27.5	0.4
523184	SPEARMN_TR11	13.2	5191.7	5193.3	1.6	0.0
523185	SPEARMAN 2	69.0	4154.7	4160.0	5.3	0.1
523186	SPEARMAN 3	115.0	8665.1	8703.2	38.1	0.4
523195	HANSFORD 3	115.0	10238.2	10311.4	73.2	0.7
523203	SPEARMNSUB 3	115.0	6075.0	6096.6	21.6	0.4
523265	PRINGLE_TR 1	13.2	9413.2	9418.2	5.0	0.1
523266	PRINGLE 3	115.0	10545.6	10594.8	49.2	0.5
523267	PRINGLE 6	230.0	4245.8	4255.9	10.1	0.2
523304	MOORE_W 3	115.0	11718.2	11745.1	26.8	0.2
523339	FAIN 3	115.0	5238.6	5246.7	8.1	0.2
523342	BLKHAWK_TR21	13.2	6052.4	6055.1	2.8	0.0
523344	BLKHAWK_W 3	115.0	11734.4	11806.9	72.5	0.6
523346	BLKHAWK_E 3	115.0	11734.4	11806.9	72.5	0.6
523352	HERRING_TP 3	115.0	7304.2	7333.6	29.4	0.4
523354	HERRING 1	34.5	4077.8	4078.6	0.8	0.0
523359	HERRING 3	115.0	5151.6	5165.5	13.9	0.3
523366	RB-SNEED 3	115.0	6747.3	6766.7	19.4	0.3
523376	RIVERVIEW 2	69.0	8545.8	8576.6	30.8	0.4
523377	RIVERVIEW 3	115.0	13157.3	13311.6	154.2	1.2
523403	CRMWA_#1 3	115.0	6307.8	6338.4	30.6	0.5
523404	CRMWA_#1TP 3	115.0	7507.9	7551.3	43.4	0.6
523405	CRMWA_#2 3	115.0	7427.8	7470.0	42.3	0.6
523410	CRMWA_#4 3	115.0	9678.7	9724.1	45.4	0.5

Bus Number	Bus Name	Base Voltage (kV)	Without Study Units (amps)	With Study Units (amps)	Difference (amps)	Difference (%)
523413	INDUSTRIAL 2	69.0	8103.1	8131.6	28.5	0.4
523421	HUBER_GEN 2	69.0	6658.7	6677.7	19.0	0.3
523431	SIDRICHARD 2	69.0	6803.1	6822.8	19.7	0.3
523445	BLACKHAWK 2	69.0	11867.9	11919.5	51.6	0.4
523461	BLACKHAWK1 1	13.8	63156.2	63249.4	93.2	0.1
523462	BLACKHAWK2 1	13.8	61434.7	61527.6	92.9	0.2
523470	CPCOKER 3	115.0	11635.0	11706.3	71.3	0.6
523478	Q_RYTON_TP 3	115.0	11221.1	11287.1	66.0	0.6
523484	CAMEX/TRNSP2	69.0	8429.3	8461.9	32.5	0.4
523485	CAMX/AGR TP3	115.0	13692.9	13924.7	231.8	1.7
523486	CAMEX/AGRM 3	115.0	12645.1	12842.8	197.7	1.6
523492	FRITCH 3	115.0	6924.2	6959.3	35.1	0.5
523498	PHILLPREF1 2	69.0	9058.9	9090.8	31.9	0.4
523505	PHILLPREF2 2	69.0	9285.8	9319.2	33.4	0.4
523512	SPRINGCREEK2	69.0	1530.1	1530.4	0.2	0.0
523516	W_BORGER_TP3	115.0	12126.8	12284.3	157.5	1.3
523518	W_BORGER 3	115.0	9584.2	9682.4	98.2	1.0
523526	WEATHERLY 2	69.0	7928.8	7956.9	28.2	0.4
523543	HUTCHISON 2	69.0	9006.4	9044.9	38.5	0.4
523544	HUTCH_N 3	115.0	15302.4	15608.5	306.1	2.0
523546	HUTCH_S 3	115.0	15302.4	15608.5	306.1	2.0
523602	BURNETT 2	69.0	4378.8	4387.9	9.0	0.2
523609	ROXANA 2	69.0	2632.1	2633.5	1.4	0.1
523616	DAMRON 2	69.0	3358.7	3361.0	2.4	0.1
523623	CRMWA#22 2	69.0	7923.8	7953.8	30.0	0.4
523634	GRAYCO_TR1 1	13.2	5196.4	5197.5	1.0	0.0
523635	GRAY_CNTY 2	69.0	6028.5	6036.2	7.7	0.1
523636	GRAY_CNTY 3	115.0	3888.0	3899.5	11.5	0.3
523646	CRMWA#21 2	69.0	2304.2	2305.3	1.1	0.0
523647	CRMWA#23TP 2	69.0	2314.5	2315.6	1.1	0.0
523649	CRMWA#23 2	69.0	1418.8	1419.2	0.4	0.0
523653	KITE 2	69.0	4273.3	4277.2	3.8	0.1
523817	MIDSTRM_TP 3	115.0	6705.1	6710.3	5.2	0.1
523923	CARSON_SUB 1	13.8	6669.5	6707.9	38.4	0.6
523924	CARSON_SUB 3	115.0	5977.6	6699.1	721.5	12.1
523926	MAJESTC_WND3	115.0	5758.4	6670.0	911.7	15.8
523928	MARTIN 3	115.0	6604.9	7498.4	893.5	13.5

Bus Number	Bus Name	Base Voltage (kV)	Without Study Units (amps)	With Study Units (amps)	Difference (amps)	Difference (%)
523931	HIGHLAND_TP3	115.0	11043.3	11389.7	346.4	3.1
523933	PANTEX_S 1	12.5	10689.4	10778.3	88.8	0.8
523934	PANTEXWND 1	34.5	1515.2	1519.4	4.2	0.3
523935	PANTEXWNDCC1	34.5	1334.5	1337.7	3.2	0.2
523938	PANTEX_N 3	115.0	6929.4	7522.9	593.5	8.6
523945	PANTEX_S 3	115.0	7566.1	8044.4	478.4	6.3
523972	HARRNGTON2 1	24.0	113606.9	113810.8	203.9	0.2
523977	HARRNG_WST 6	230.0	25988.5	26174.0	185.5	0.7
523978	HARRNG_MID 6	230.0	25988.5	26174.0	185.5	0.7
523979	HARRNG_EST 6	230.0	25988.5	26174.0	185.5	0.7
524007	ROLLHILLS 3	115.0	19268.3	19359.2	90.9	0.5
524010	ROLLHILLS 6	230.0	19297.4	19395.8	98.3	0.5
524016	ASARCO 3	115.0	26205.3	26488.0	282.6	1.1
524018	ASARCO_TP 3	115.0	28269.7	28640.1	370.4	1.3
524021	NICHOLS_1 1	13.8	83570.0	83651.1	81.1	0.1
524022	NICHOLS_2 1	13.8	83380.0	83462.5	82.5	0.1
524023	NICHOLS_3 1	22.0	95158.5	95259.2	100.7	0.1
524042	NICHOLS_TR21	13.2	24298.2	24325.3	27.0	0.1
524043	NICHOLS 3	115.0	30242.2	30622.9	380.7	1.3
524044	NICHOLS 6	230.0	25238.6	25423.6	185.0	0.7
524058	WHITAKER 3	115.0	21798.4	21952.4	153.9	0.7
524065	HIGHLAND 3	115.0	5897.4	5994.7	97.3	1.6
524079	CONWAY 3	115.0	4994.4	5000.7	6.3	0.1
524163	EAST_PLANT 6	230.0	13648.9	13704.9	56.0	0.4
524365	RANDALL 6	230.0	14384.7	14441.6	56.9	0.4
524410	AMA_SO_TR1 1	13.2	13910.8	13912.6	1.8	0.0
524414	AMA_SOUTH 3	115.0	16606.1	16651.3	45.2	0.3
524415	AMA_SOUTH 6	230.0	13509.9	13557.2	47.3	0.3
539672	E-LIBER3	115.0	4993.2	5003.8	10.6	0.2
560050	G15-031-TAP	230.0	9224.2	9229.0	4.8	0.1

Table 5– Fault current 2026SP case

Bus Number	Bus Name	Base Voltage (kV)	Without Study Units (amps)	With Study Units (amps)	Difference (amps)	Difference (%)
522905	STURGIS 2	69.0	1680.8	1770.3	89.5	5.3
522912	Y TAP 3	115.0	4463.7	4795.3	331.7	7.4
522917	ADAMS-T 2	69.0	1874.8	1891.8	17.0	0.9
522921	THRASH 2	69.0	3207.4	3571.8	364.4	11.4
522927	JEFFERSON 2	69.0	2045.4	2069.7	24.2	1.2
522929	POWELL CNR 2	69.0	3642.0	3927.4	285.3	7.8
522944	STURGIS-T 2	69.0	3010.6	3298.9	288.2	9.6
522948	WEST_TIE 2	69.0	3288.5	3681.7	393.2	12.0
522950	THRALL 2	69.0	1516.9	1564.8	47.9	3.2
522954	HOVEY 3	115.0	3200.2	3453.4	253.2	7.9
522955	HOVEY 1	12.5	5871.6	5919.7	48.1	0.8
522956	POWELL CNR 1	12.5	5173.1	5271.1	98.0	1.9
522957	POWELL CNR 3	115.0	3606.5	3997.2	390.7	10.8
522960	WEST-TIE 3	115.0	2293.4	2736.9	443.5	19.3
522965	WEST-TER	13.2	23346.4	28061.3	4714.9	20.2
523001	TC-HOVEY 2	69.0	5838.6	6155.8	317.2	5.4
523006	TC-ELKHART 2	69.0	1363.3	1418.7	55.4	4.1
523032	TC-KEYES 2	69.0	1190.3	1232.3	42.0	3.5
523044	TC-ELKHRT_T2	69.0	2705.9	2931.9	226.1	8.4
523051	TC-EVAREG 2	69.0	2480.3	2651.5	171.1	6.9
523065	TC-THOMPSON2	69.0	6308.6	6612.1	303.5	4.8
523072	TC-SEABOARD2	69.0	5940.5	6189.9	249.4	4.2
523079	TC-GUYMON_N2	69.0	6265.8	6555.2	289.4	4.6
523085	TC-TXCN_TR11	13.2	5720.7	5758.8	38.1	0.7
523086	TC-TXCN_TR21	13.2	5721.9	5760.0	38.0	0.7
523087	TC-TXCOUNTY1	34.5	2796.0	2809.2	13.2	0.5
523089	TC-TXCOUNTY2	69.0	8072.1	8419.1	347.0	4.3
523090	TEXAS_CNTY 3	115.0	7984.2	8368.2	384.0	4.8
523092	HITCHLD_TR11	13.2	21863.1	21921.8	58.7	0.3
523093	HITCHLAND 3	115.0	17558.9	17854.1	295.3	1.7
523095	HITCHLAND 6	230.0	14761.6	14876.5	114.9	0.8
523098	HITCHLD_TR41	13.2	21863.1	21921.8	58.7	0.3
523099	TC-WHITING 3	115.0	2370.2	2533.8	163.6	6.9
523106	TXPHSF 3	115.0	4174.2	4241.5	67.2	1.6
523113	TC-MCMURRY 3	115.0	6192.5	6403.3	210.8	3.4
523142	TC-AGGIE 3	115.0	4001.2	4042.4	41.1	1.0

Bus Number	Bus Name	Base Voltage (kV)	Without Study Units (amps)	With Study Units (amps)	Difference (amps)	Difference (%)
523160	FRISCO_WND 3	115.0	7015.7	7044.3	28.5	0.4
523174	GOODWELLWND3	115.0	6583.2	6610.6	27.4	0.4
523184	SPEARMN_TR11	13.2	5191.8	5193.4	1.6	0.0
523185	SPEARMAN 2	69.0	4154.9	4160.2	5.3	0.1
523186	SPEARMAN 3	115.0	8666.8	8704.7	37.9	0.4
523195	HANSFORD 3	115.0	10240.8	10313.8	73.1	0.7
523203	SPEARMNSUB 3	115.0	6075.9	6097.4	21.5	0.4
523265	PRINGLE_TR 1	13.2	9413.5	9418.4	4.9	0.1
523266	PRINGLE 3	115.0	10548.3	10597.0	48.7	0.5
523267	PRINGLE 6	230.0	4246.5	4256.5	10.0	0.2
523304	MOORE_W 3	115.0	11720.3	11747.0	26.7	0.2
523339	FAIN 3	115.0	5239.1	5247.3	8.2	0.2
523342	BLKHAWK_TR21	13.2	6052.5	6055.2	2.7	0.0
523344	BLKHAWK_W 3	115.0	11738.5	11810.1	71.6	0.6
523346	BLKHAWK_E 3	115.0	11738.5	11810.1	71.6	0.6
523352	HERRING_TP 3	115.0	7305.7	7334.8	29.0	0.4
523354	HERRING 1	34.5	4077.9	4078.6	0.8	0.0
523359	HERRING 3	115.0	5152.3	5166.1	13.8	0.3
523366	RB-SNEED 3	115.0	6748.4	6767.5	19.2	0.3
523376	RIVERVIEW 2	69.0	8547.5	8577.9	30.4	0.4
523377	RIVERVIEW 3	115.0	13165.2	13317.8	152.6	1.2
523403	CRMWA_#1 3	115.0	6309.0	6339.3	30.3	0.5
523404	CRMWA_#1TP 3	115.0	7509.5	7552.5	43.0	0.6
523405	CRMWA_#2 3	115.0	7429.3	7471.2	41.9	0.6
523410	CRMWA_#4 3	115.0	9680.5	9726.1	45.6	0.5
523413	INDUSTRIAL 2	69.0	8104.7	8132.9	28.2	0.3
523421	HUBER_GEN 2	69.0	6659.8	6678.6	18.8	0.3
523431	SIDRICHARD 2	69.0	6804.2	6823.7	19.5	0.3
523445	BLACKHAWK 2	69.0	11870.8	11921.8	51.0	0.4
523461	BLACKHAWK1 1	13.8	63161.2	63253.4	92.2	0.1
523462	BLACKHAWK2 1	13.8	61439.7	61531.6	91.8	0.1
523470	CPCOKER 3	115.0	11639.1	11709.5	70.4	0.6
523478	Q_RYTON_TP 3	115.0	11224.9	11290.1	65.2	0.6
523484	CAMEX/TRNSP2	69.0	8431.1	8463.3	32.2	0.4
523485	CAMX/AGR TP3	115.0	13706.0	13935.3	229.3	1.7
523486	CAMEX/AGRM 3	115.0	12656.4	12851.9	195.5	1.5
523492	FRITCH 3	115.0	6925.3	6960.2	34.9	0.5

Bus Number	Bus Name	Base Voltage (kV)	Without Study Units (amps)	With Study Units (amps)	Difference (amps)	Difference (%)
523498	PHILLPREF1 2	69.0	9060.7	9092.2	31.5	0.3
523505	PHILLPREF2 2	69.0	9287.7	9320.7	33.0	0.4
523512	SPRINGCREEK2	69.0	1530.2	1530.4	0.2	0.0
523516	W_BORGER_TP3	115.0	12135.5	12291.2	155.7	1.3
523518	W_BORGER 3	115.0	9589.7	9686.8	97.0	1.0
523526	WEATHERLY 2	69.0	7930.4	7958.2	27.8	0.4
523543	HUTCHISON 2	69.0	9008.5	9046.5	38.1	0.4
523544	HUTCH_N 3	115.0	15319.5	15622.5	302.9	2.0
523546	HUTCH_S 3	115.0	15319.5	15622.5	302.9	2.0
523602	BURNETT 2	69.0	4379.5	4388.4	8.9	0.2
523609	ROXANA 2	69.0	2632.2	2633.6	1.4	0.1
523616	DAMRON 2	69.0	3358.8	3361.1	2.3	0.1
523623	CRMWA#22 2	69.0	7925.5	7955.1	29.6	0.4
523634	GRAYCO_TR1 1	13.2	5196.5	5197.5	1.0	0.0
523635	GRAY_CNTY 2	69.0	6028.9	6036.5	7.6	0.1
523636	GRAY_CNTY 3	115.0	3888.7	3900.0	11.3	0.3
523646	CRMWA#21 2	69.0	2304.3	2305.4	1.1	0.0
523647	CRMWA#23TP 2	69.0	2314.5	2315.7	1.1	0.0
523649	CRMWA#23 2	69.0	1418.8	1419.3	0.4	0.0
523653	KITE 2	69.0	4273.6	4277.4	3.8	0.1
523817	MIDSTRM_TP 3	115.0	6705.4	6710.7	5.3	0.1
523923	CARSON_SUB 1	13.8	6672.6	6710.4	37.9	0.6
523924	CARSON_SUB 3	115.0	6039.7	6762.0	722.2	12.0
523926	MAJESTC_WND3	115.0	5813.7	6727.4	913.7	15.7
523928	MARTIN 3	115.0	6678.0	7573.8	895.8	13.4
523931	HIGHLAND_TP3	115.0	11062.3	11414.6	352.3	3.2
523933	PANTEX_S 1	12.5	10701.2	10789.8	88.6	0.8
523934	PANTEXWND 1	34.5	1515.8	1519.9	4.1	0.3
523935	PANTEXWNDCC1	34.5	1335.0	1338.2	3.2	0.2
523938	PANTEX_N 3	115.0	7012.7	7613.3	600.6	8.6
523945	PANTEX_S 3	115.0	7646.5	8132.2	485.6	6.4
523972	HARRNGTON2 1	24.0	113639.5	113843.6	204.1	0.2
523977	HARRNG_WST 6	230.0	26017.9	26203.9	186.0	0.7
523978	HARRNG_MID 6	230.0	26017.9	26203.9	186.0	0.7
523979	HARRNG_EST 6	230.0	26017.9	26203.9	186.0	0.7
524007	ROLLHILLS 3	115.0	19278.9	19370.7	91.8	0.5
524010	ROLLHILLS 6	230.0	19316.1	19414.6	98.6	0.5

Bus Number	Bus Name	Base Voltage (kV)	Without Study Units (amps)	With Study Units (amps)	Difference (amps)	Difference (%)
524016	ASARCO 3	115.0	26225.4	26511.9	286.5	1.1
524018	ASARCO_TP 3	115.0	28293.7	28668.6	374.9	1.3
524021	NICHOLS_1 1	13.8	83575.4	83657.3	81.9	0.1
524022	NICHOLS_2 1	13.8	83385.6	83468.8	83.3	0.1
524023	NICHOLS_3 1	22.0	95173.8	95274.5	100.7	0.1
524042	NICHOLS_TR21	13.2	24300.1	24327.3	27.3	0.1
524043	NICHOLS 3	115.0	30267.9	30653.1	385.2	1.3
524044	NICHOLS 6	230.0	25266.3	25451.8	185.5	0.7
524058	WHITAKER 3	115.0	21812.1	21967.6	155.6	0.7
524065	HIGHLAND 3	115.0	5904.1	6003.3	99.3	1.7
524079	CONWAY 3	115.0	4995.6	5001.9	6.4	0.1
524163	EAST_PLANT 6	230.0	13657.4	13713.6	56.2	0.4
524365	RANDALL 6	230.0	14399.9	14457.0	57.1	0.4
524410	AMA_SO_TR1 1	13.2	13912.2	13914.0	1.8	0.0
524414	AMA_SOUTH 3	115.0	16617.0	16662.5	45.5	0.3
524415	AMA_SOUTH 6	230.0	13527.1	13574.5	47.4	0.4
539672	E-LIBER3	115.0	5041.9	5052.5	10.6	0.2
560050	G15-031-TAP	230.0	9290.5	9295.2	4.8	0.1

3.2 Stability analysis

Dynamic data associated the Cluster Group 2 machines is shown in Appendix A.

Plots of the dynamic response of the study unit for the faults described in Table 3 are included in Appendix B of this report. This Appendix is subdivided into parts for 2017W, 2018S and 2026S peak load conditions. Appendix B, provided as a separate document, plots the rotor angles, of the machines in the monitored areas (numbers 520, 524, 525, 526, 531, 534 and 536) as well as the their speed, electrical power output, reactive power output. In addition, plots of POI bus voltages for the study queues as well as prior queues are included. There were no material differences between the 2017WP, 2018SP and 2026SP simulations.

All units monitored had acceptable response, neither pulling out, tripping, nor exhibiting undamped variations, with the exception for the following contingencies described in Sections 3.2.1, 3.2.2, and 3.2.3 for the 2017WP, 2018SP, and 2026SP cases, respectively. With the exception of the observed unit trips, these contingencies each exhibited an acceptable system response. In accordance with SPP requirements, contingencies that result in a prior queue project tripping off-line; the contingency shall be re-run with the prior queued project's voltage and frequency tripping disabled. Actions taken to disable tripping are included in the Tables. With the tripping disabled these contingencies each exhibited an acceptable system response.

Section 3.2.4 and 3.2.5 contain plots of the responses of the study project ASGI-2016-101 and GEN-2016-161, respectively, for three-phase faults on their associated POI's. Table 6 summarizes transient stability analysis results for all contingencies simulated.

Table 6 – Summary of transient stability results

Fault	2017WP	2018SP	2026SP
FLT01-3PH	Stable	Stable	Stable
FLT02-3PH	Stable	Stable	Stable
FLT03-3PH	Stable, lightly damped	Stable, lightly damped	Stable, lightly damped
FLT04-3PH	Stable, lightly damped	Stable	Stable, lightly damped
FLT05-3PH	Stable, lightly damped	Stable, lightly damped	Stable, lightly damped
FLT06-3PH	Stable, lightly damped	Stable	Stable, lightly damped
FLT07-3PH	Stable	Stable	Stable
FLT08-3PH	Stable	Stable	Stable
FLT09-3PH	Stable	N/A	N/A
FLT10-3PH	Stable	Stable	Stable
FLT11-3PH	Stable	Stable	Stable
FLT12-3PH	Stable	Stable	Stable
FLT13-3PH	Stable	Stable	Stable
FLT14-3PH	Stable, lightly damped	Stable, lightly damped	Stable, lightly damped
FLT15-3PH	Stable, lightly damped	Stable	Stable
FLT16-3PH	Stable	Stable	Stable
FLT17-3PH	Stable	Stable	Stable
FLT18-3PH	Stable	Stable	Stable
FLT19-3PH	Stable	Stable	Stable
FLT21-3PH	Stable	Stable	Stable
FLT23-3PH	Stable	Stable	Stable
FLT25-3PH	Stable	Stable	Stable
FLT27-3PH	Stable	Stable, lightly damped	Stable
FLT28-3PH	Stable	Stable, lightly damped	Stable
FLT29-3PH	Stable	Stable, lightly damped	Stable
FLT30-3PH	Stable	Stable	Stable
FLT31-3PH	Stable	Stable	Stable
FLT32-3PH	Stable	Stable	Stable
FLT33-3PH	Stable	Stable	Stable

Fault	2017WP	2018SP	2026SP
FLT34-3PH	Stable	Stable	Stable
FLT35-3PH	Stable	Stable	Stable
FLT36-3PH	Stable	Stable	Stable
FLT37-3PH	Stable	Stable	Stable
FLT38-1PH	Stable	Stable	Stable
FLT39-1PH	Stable	Stable	Stable
FLT40-3PH	Stable, lightly damped	Stable, lightly damped	Stable, lightly damped
FLT41-3PH	Stable, lightly damped	Stable, lightly damped	Stable, lightly damped
FLT42-3PH	Stable	Stable	Stable, lightly damped
FLT43-3PH	Stable	Stable	Stable
FLT44-3PH	Stable	Stable	Stable
FLT45-3PH	Stable	Stable	Stable

3.2.1 Contingencies that cause tripping for the 2017WP case

Table 7 indicates the contingency (FLT10-3PH) that causes tripping, the machine that is tripped, and the action taken to disable the tripping.

Table 7 – Contingency that causes tripping on the 2017WP case.

Fault	Fault Definition	Units Tripped	Action Taken to Disable Tripping
FLT10-3PH	3 phase fault on the Hitchland (523097) to Potter County (523961) 345kV line ckt1, near Hitchland. a. Apply fault at the Hitchland 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	MACHINE 1 AT BUS 579373 [G06-044GEN1A4.1600]	1) Defeat operation of PSSE power imbalance tripping 2) Defeat operation of RELUNS under-speed relay

Figure 3 is the plot of the response of this machine when tripping is disabled and its response appears to be stable.

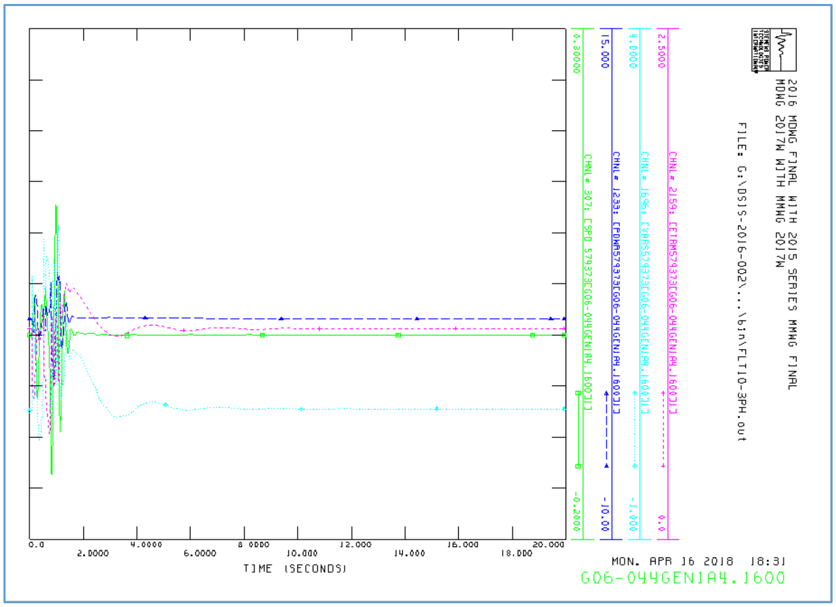


Figure 3 - Response of MACHINE 1 at 579373 [G06-044GEN1A4.1600] to FLT10-3PH with tripping disabled, 2017WP

3.2.2 Contingencies that cause tripping for the 2018SP case

Table 8 indicates the contingencies (FLT07-3PH and FLT10-3PH) that cause tripping, the machines that are tripped, and the action taken to disable the tripping.

Table 8 - Contingencies that cause tripping in the 2018SP case.

Fault	Fault Definition	Units Tripped	Action Taken to Disable Tripping
FLT07-3PH	3 phase fault on the Hitchland (523093) to Hansford (523195) 115kV line ckt1, near Hitchland. a. Apply fault at the Hitchland bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	MACHINE 1 AT BUS 523201 [EXCELN4-WTG10.6000]	1) Defeat operation of PSSE power imbalance tripping 2) Defeat operation of VGTPAT relay
FLT10-3PH	3 phase fault on the Hitchland (523097) to Potter County (523961) 345kV line ckt1, near Hitchland. a. Apply fault at the Hitchland 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	MACHINE 1 AT BUS 523107 [NOVUS_WND 14.1600]	1) Defeat operation of PSSE power imbalance tripping 2) Defeat operation of RELUNS under-speed relay

Figures 4 and 5 are plots of the response of these machines when tripping is disabled and their response appears to be stable. The response to FLT07-3PH of GEN-2002-009, EXCELN4-WTG10.600, modeled as a generic Type II WTG (WT2G1) appears to be highly oscillatory, but then stabilizes. The response to FLT10-3PH of GEN-2006-044, NOVUS_WND 14.1600, modeled as a DeWind synchronous WTG (GENSAL) appears to momentarily lose synchronism and would be expected to trip under such conditions.

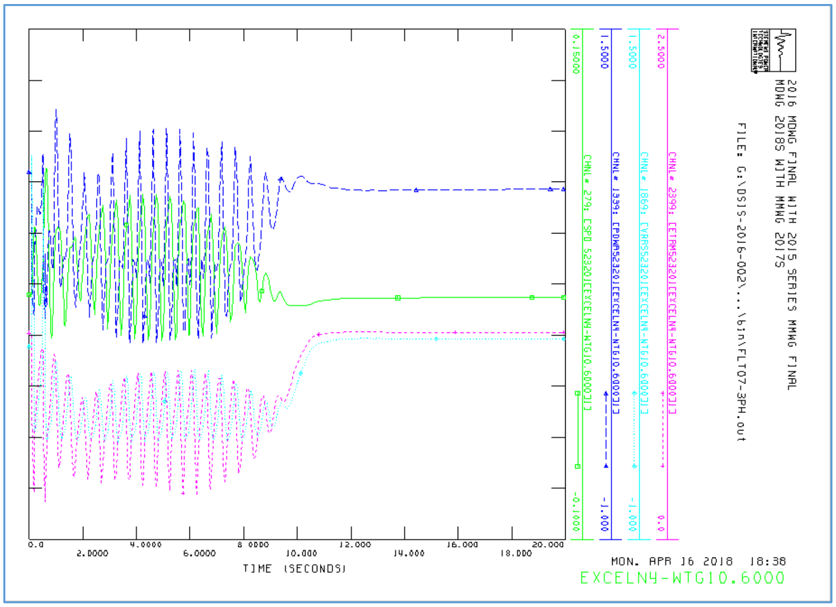


Figure 4 - Response of MACHINE 1 at BUS 523201 [EXCELN4-WTG10.6000] to FLT07-3PH with tripping disabled, 2018SP

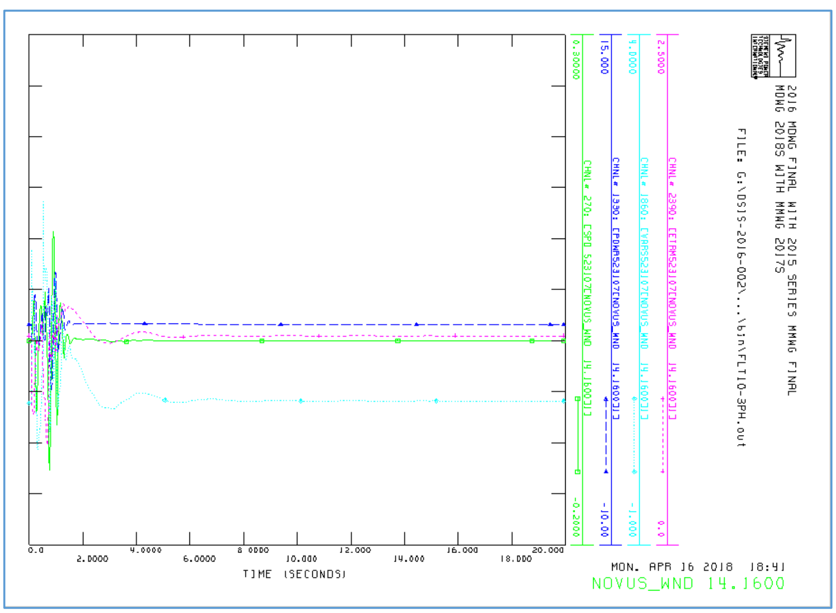


Figure 5 - Response of MACHINE 1 at BUS 523107 [NOVUS_WND 14.1600] to FLT10-3PH with tripping disabled, 2018SP

3.2.3 Contingencies that cause tripping for the 2026SP case

Table 9 indicates the contingencies (FLT07-3PH and FLT10-3PH) that cause tripping, the machines that are tripped, and the action taken to disable the tripping.

Table 9 - Contingencies that cause tripping in the 2026SP case.

Fault	Fault Definition	Units Tripped	Action Taken to Disable Tripping
FLT07-3PH	3 phase fault on the Hitchland (523093) to Hansford (523195) 115kV line ckt1, near Hitchland. a. Apply fault at the Hitchland bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault	MACHINE 1 AT BUS 523201 [EXCELN4-WTG10.6000]	1) Defeat operation of PSSE power imbalance tripping 2) Defeat operation of VGTPAT relay
FLT10-3PH	3 phase fault on the Hitchland (523097) to Potter County (523961) 345kV line ckt1, near Hitchland. a. Apply fault at the Hitchland 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	MACHINE 1 AT BUS 579380 [G06-044GEN2B4.1600] MACHINE 1 AT BUS 579376 [G06-044GEN2A4.1600] MACHINE 1 AT BUS 523107 [NOVUS_WND 14.1600]	1) Defeat operation of PSSE power imbalance tripping 2) Defeat operation of G59REL over-frequency relay 3) Defeat operation of RELUNS under-speed relay

Figures 6, 7, 8, and 9 are plots of the responses of these machines when tripping is disabled and their responses appear to be stable. The response to FLT07-3PH of GEN-2002-009, EXCELN4-WTG10.600, modeled as a generic Type II WTG (WT2G1) appears to be highly oscillatory, but then stabilizes. The response to FLT10-3PH of G06-044GEN2B4.1600, G06-044GEN2A4.1600, & NOVUS_WND 14.1600, modeled as DeWind synchronous WTGs (GENSAL) appears to each momentarily lose synchronism and would be expected to trip under such conditions.

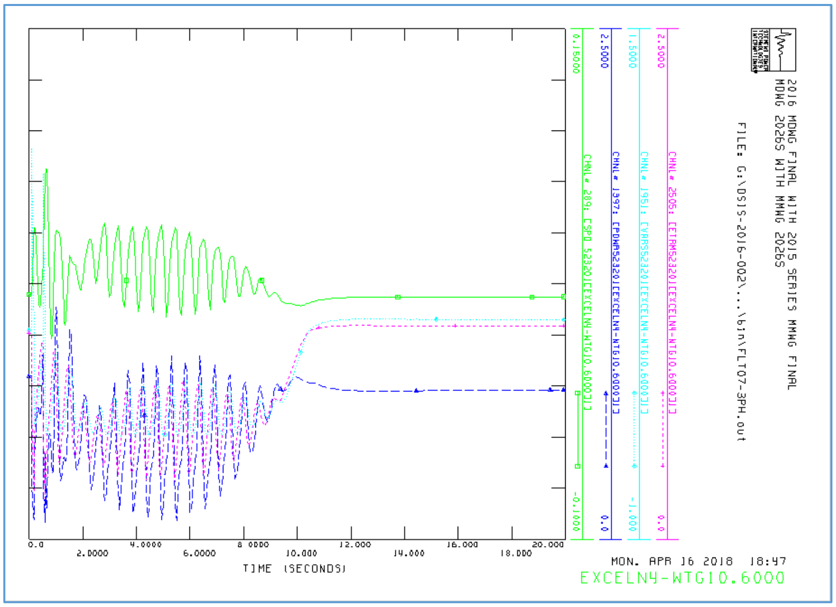


Figure 6 - Response of MACHINE 1 at BUS 523201 [EXCELN4-WTG10.6000] to FLT07-3PH with tripping disabled, 2026SP

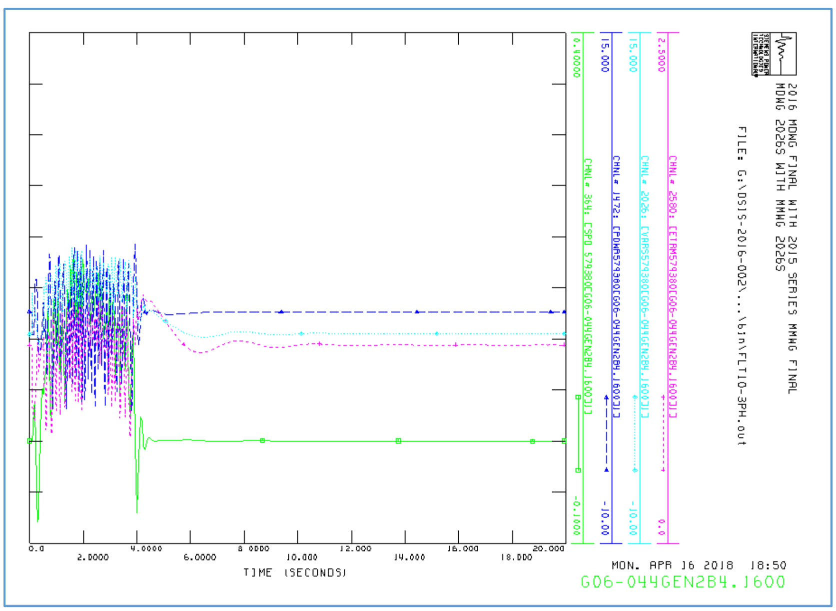


Figure 7 - Response of MACHINE 1 at BUS 579380 [G06-044GEN2B4.1600] to FLT10-3PH with tripping disabled, 2026SP

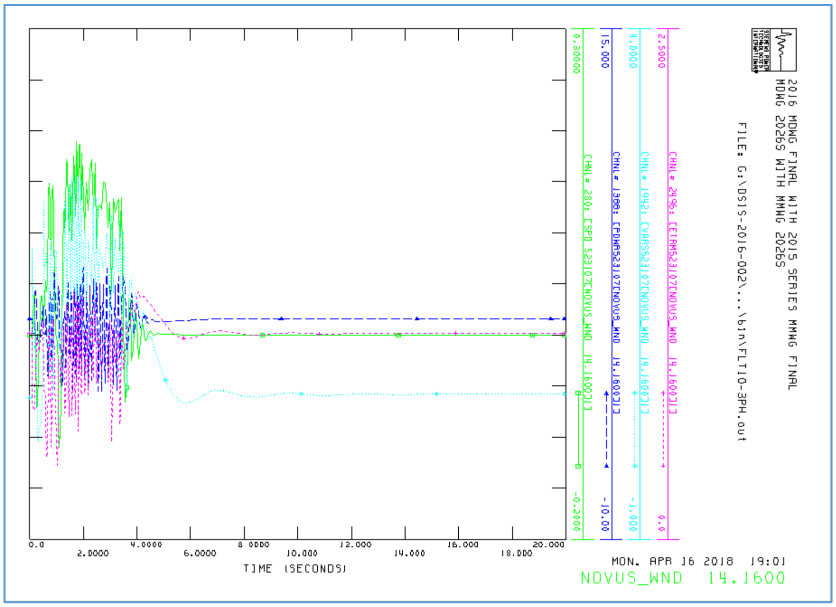


Figure 8 - Response of MACHINE 1 at BUS 523107 [NOVUS_WND 14.1600]to FLT10-3PH with tripping disabled, 2026SP

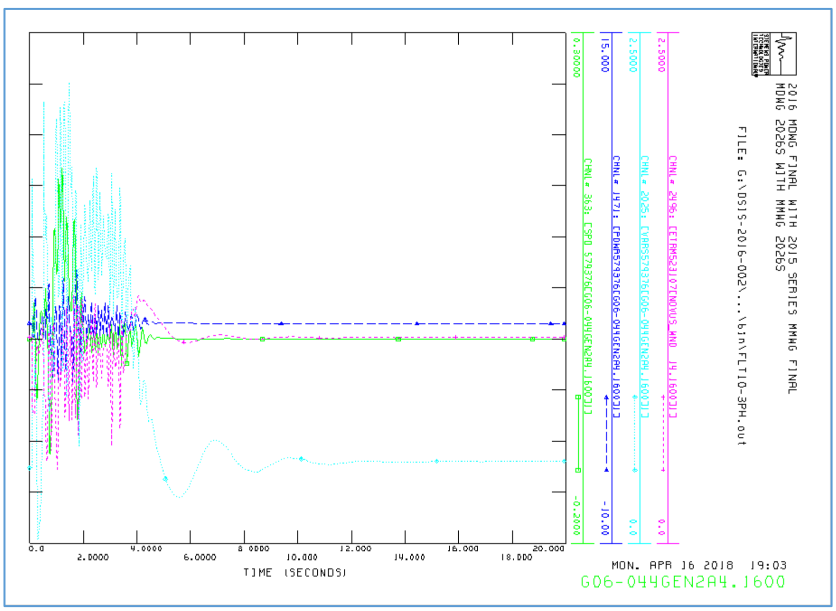


Figure 9 - Response of MACHINE 1 at BUS 579376 [G06-044GEN2A4.1600] to FLT10-3PH with tripping disabled, 2026SP

3.2.4 Response of project ASGI-2016-010 for fault on project POI (FLT41-3PH) for 2017WP, 2018SP, and 2026SP cases

Figures 10, 11, and 12 are plots of the response of study project ASGI-2016-010 for cases 2017WP, 2018SP, and 2026SP, respectively for fault FLT41-3PH a 3 phase fault on the West-Tie (522960) to Powell Corner (522957) 115kV line ckt1, near the POI West-Tie. The responses appear to be typical for a GE WTG.

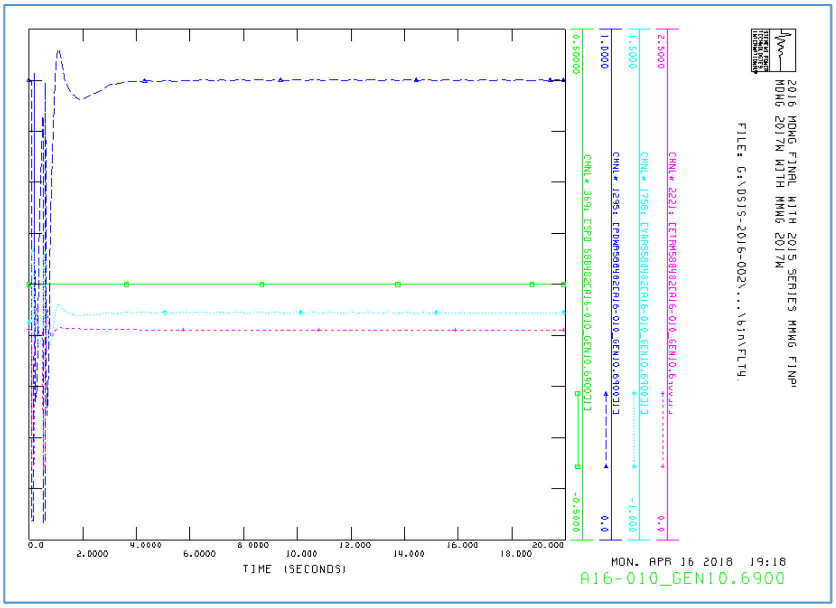


Figure 10 - Response of MACHINE 1 at BUS 588482 [A16-010_GEN10.6900] to FLT41-3PH, 2017WP

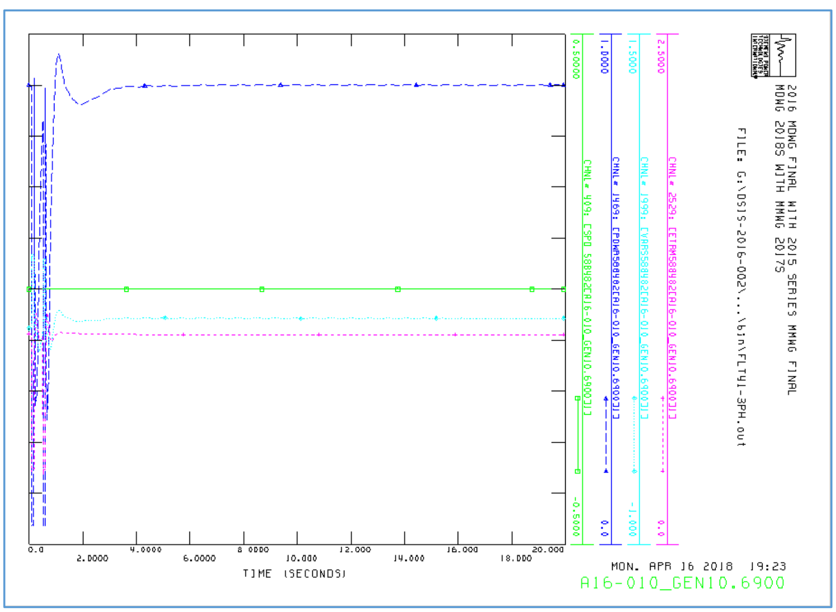


Figure 11 - Response of MACHINE 1 at BUS 588482 [A16-010_GEN10.6900] to FLT41-3PH, 2018SP

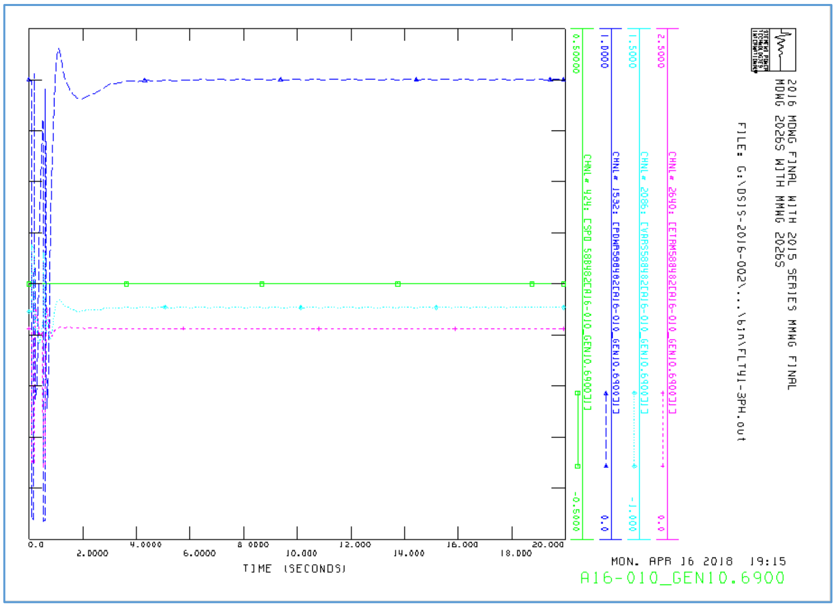


Figure 12 - Response of MACHINE 1 at BUS 588482 [A16-010_GEN10.6900] to FLT41-3PH, 2026SP

3.2.5 Response of project GEN-2016-161 for fault on project POI (FLT01-3PH) for 2017WP, 2018SP, and 2026SP cases

Figures 13, 14, and 15 are plots of the response of study project GEN-2016-161 for case 2017WP. Figures 16, 17, and 18 are plots of the response of study project GEN-2016-161 for case 2018SP. Figures 19, 20, and 21 are plots of the response of study project for case 2026SP. All responses are for fault FLT01-3PH, 3 phase fault on the Martin (523928) to Hutchinson South (523546) 115kV line ckt1, near the POI Martin, and their responses appear to be typical for a GE WTG.

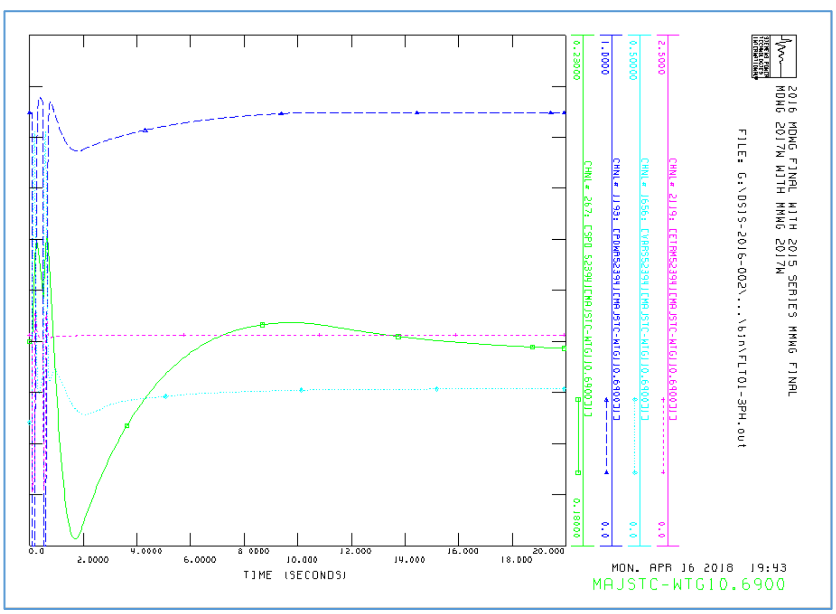


Figure 13 - Response of MACHINE 1 at BUS 523941 [MAJSTC-WTG10.6900] to FLT01-3PH, 2017WP

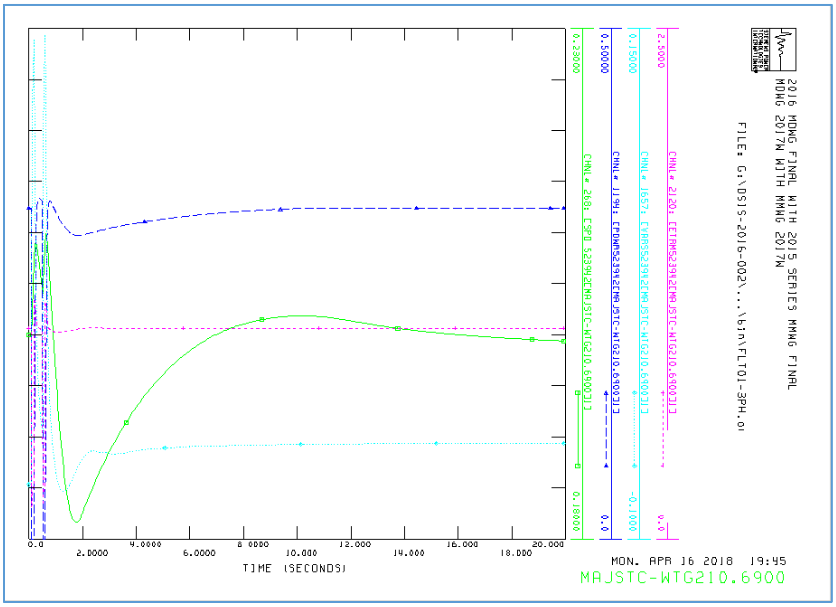


Figure 14 - Response of MACHINE 1 at BUS 523942 [MAJSTC-WTG210.6900] to FLT01-3PH, 2017WP

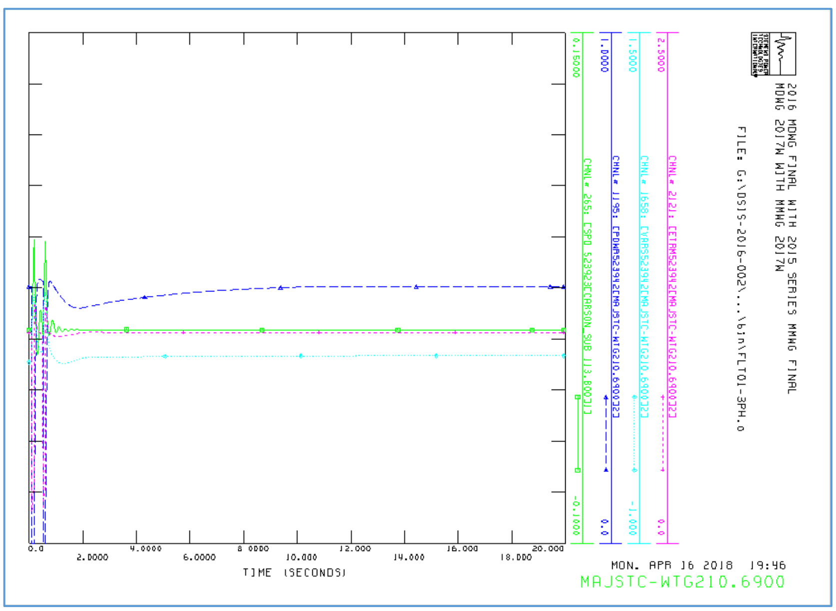


Figure 15 - Response of MACHINE 2 at BUS 523942 [MAJSTC-WTG210.6900] to FLT01-3PH, 2017WP

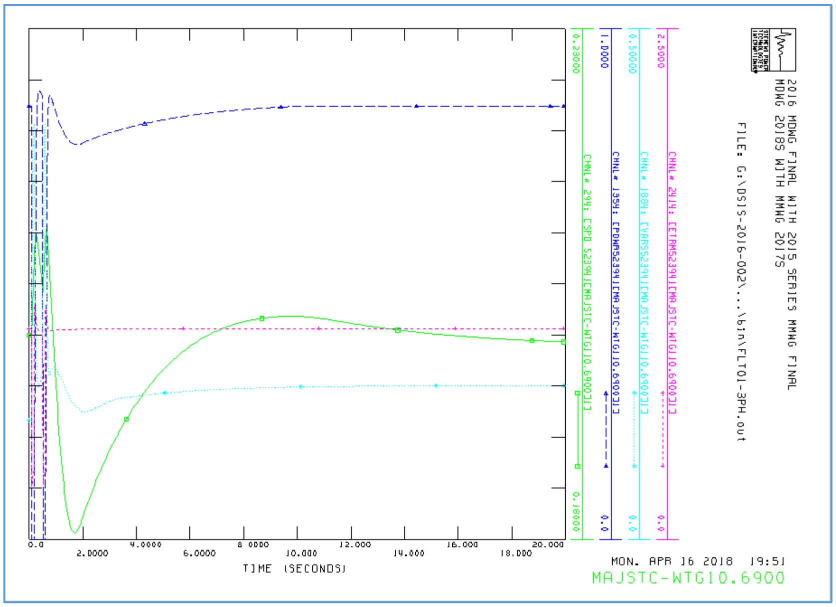


Figure 16 - Response of MACHINE 1 at BUS 523941 [MAJSTC-WTG10.6900] to FLT01-3PH, 2018SP

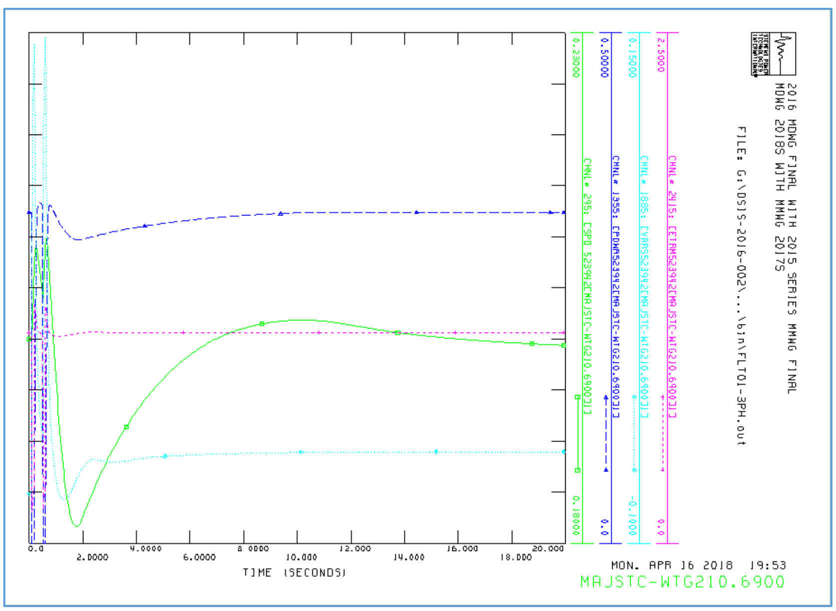


Figure 17 - Response of MACHINE 1 at BUS 523942 [MAJSTC-WTG210.6900] to FLT01-3PH, 2018SP

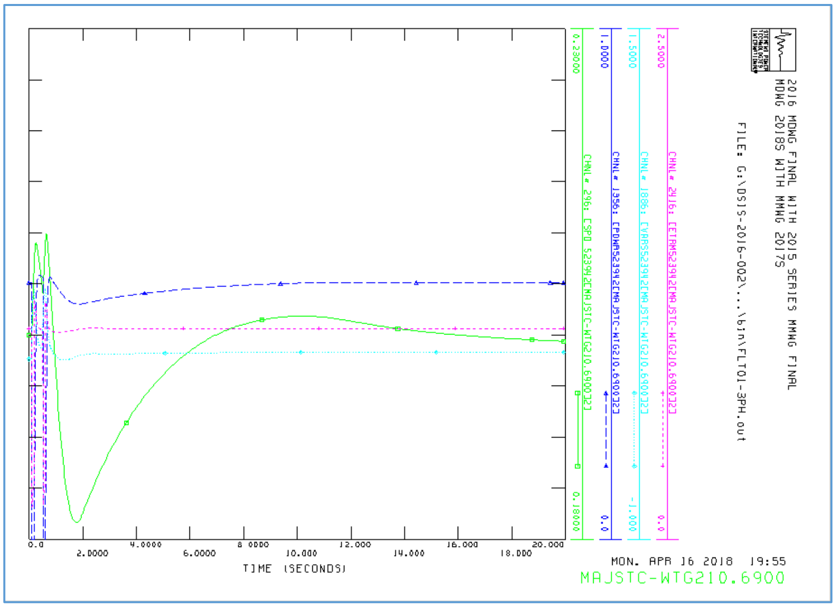


Figure 18 - Response of MACHINE 2 at BUS 523942 [MAJSTC-WTG210.6900] to FLT01-3PH, 2018SP

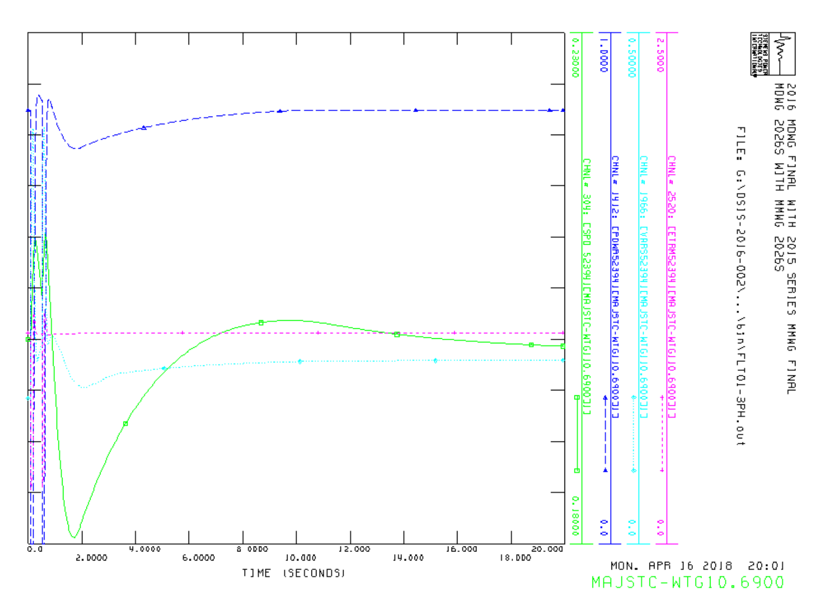


Figure 19 - Response of MACHINE 1 at BUS 523941 [MAJSTC-WTG10.6900] to FLT01-3PH, 2026SP

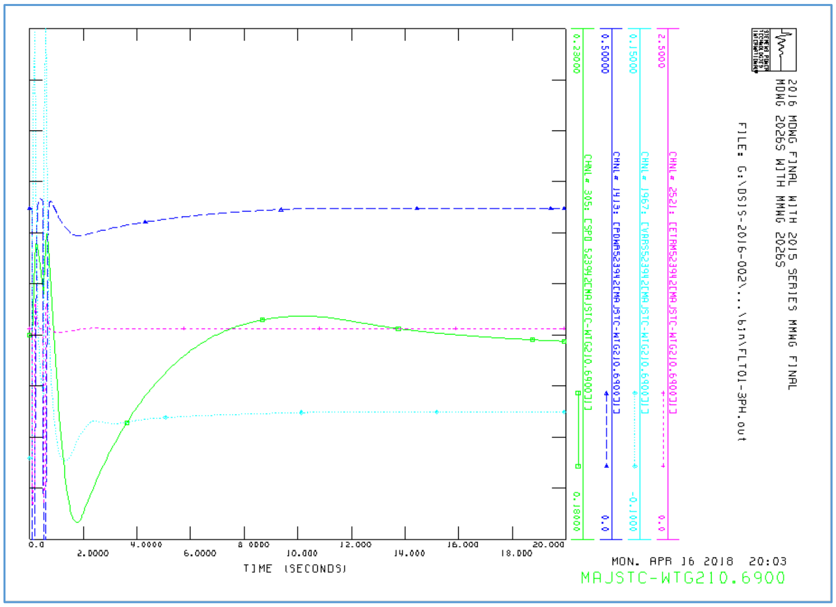


Figure 20 - Response of MACHINE 1 at BUS 523942 [MAJSTC-WTG210.6900] to FLT01-3PH, 2026SP

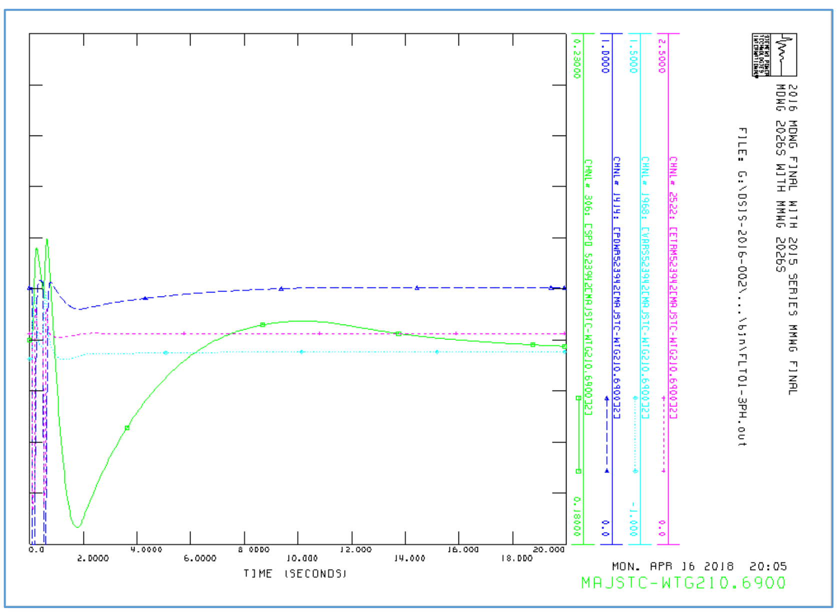


Figure 21 - Response of MACHINE 2 at BUS 523942 [MAJSTC-WTG210.6900] to FLT01-3PH, 2026SP

3.2.6 Impact of switching reactor banks on the 345kV system with proximity to the Woodward EHV station off-line

Initial transient stability simulations, prior to switching off-line the reactor banks on the 345 kV system near Woodward EHV station, indicated nearly sustained oscillation, low frequency oscillation for FLT13-3P and FLT18-3PH in the 2017WP case. FLT13-3PH involves a three-phase fault on the Finney-Holcomb 345 kV line. FLT18-3PH involves a fault on the Potter County 345/230/13.2 kV transformer. Although the oscillation was observed throughout Oklahoma, the angular responses of the Moreland and Anadarko machines for FLT13-3PH and FLFT18-3PH were representative and are shown in Figure 22 and 23, respectively:

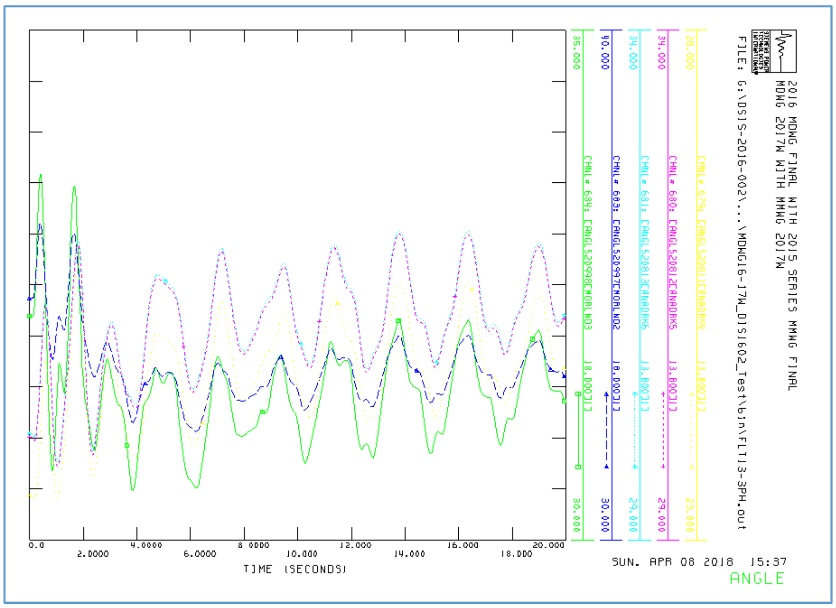


Figure 22 - Angle response of the Moreland and Anadarko machines for FLT13-3PH, 2017WP

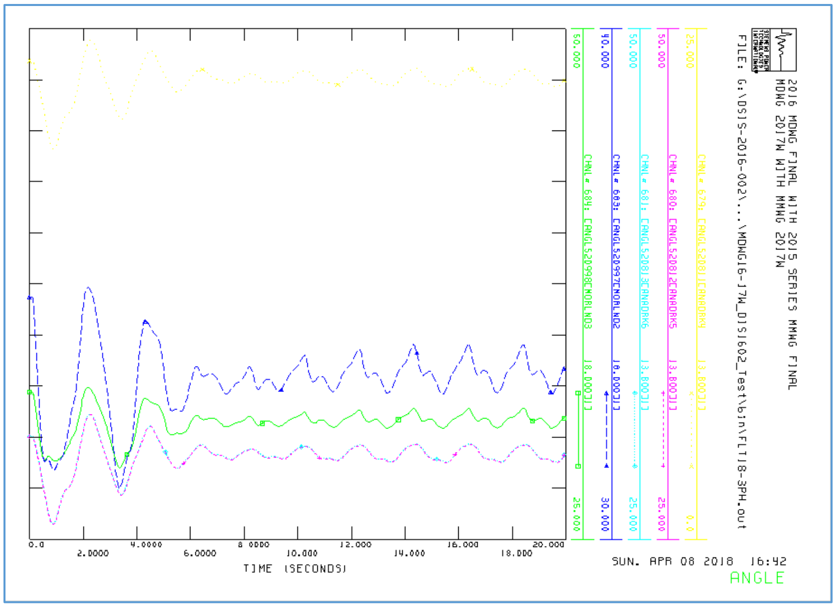


Figure 23 - Angle response of the Moreland and Anadarko machines for FLT18-3PH, 2017WP

Figures 24 and 25 show the angle response (stable) for the Moreland and Anadarko machines for the faults FLT13-3PH and FLT18-3PH for the 2017WP case, respectively, following switching off-line the reactor banks on the 345 kV system near Woodward EHV station.

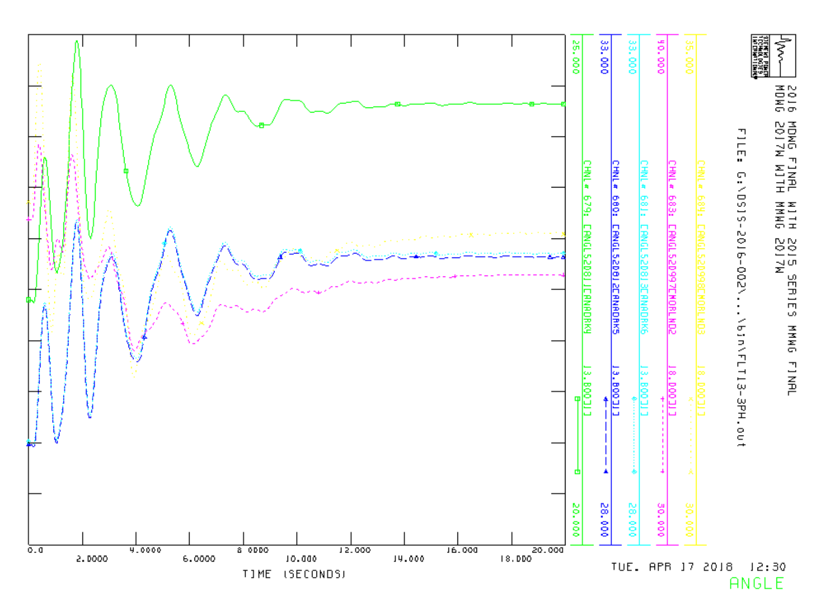


Figure 24 - Angle response of the Moreland and Anadarko machines for FLT13-3PH, 2017WP, following switching reactor banks off-line near Woodward EHV station

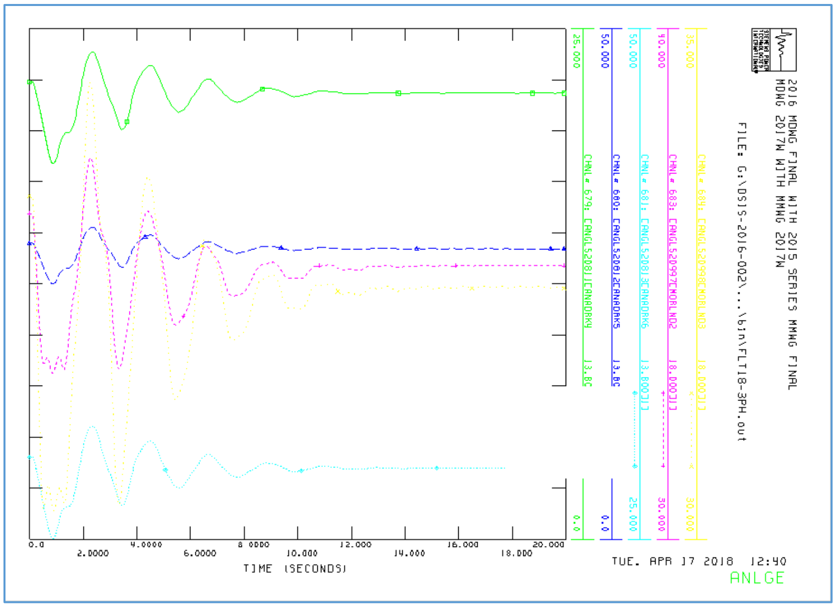


Figure 25 - Angle response of the Moreland and Anadarko machines for FLT18-3PH, 2017WP, following switching reactor banks off-line near Woodward EHV station

As can be seen in Figures 24 and 25, the impact of switching off-line the reactor banks on the 345 kV system near Woodward EHV station has significantly improved system damping eliminating the low frequency oscillations previously found for FLT13-3PH and FLT18-3PH in the 2017WP case.

4 CONCLUSIONS

4.1 Short-Circuit

The greatest increase is at Western Tie 115/ 69/13.2 kV transformer tertiary (20.2%) for both the 2018SP and 2026S cases.

The percent increase in the fault currents at the ASGI-2016-010 POI (Bus 522950) are 19.2% and 19.3%, respectively, for the 2018SP and 2026SSP cases. The percent increase in the fault currents at the GEN-2016-161 POI (Bus 523928) as a contribution of the existing wind project are 13.5% and 13.4%, respectively, for the 2018SP and 2026SSP cases.

Average percent increase in faults currents within 5 levels from each POI is 2.3% and 2.2% in the 2018SP and 2026SP cases, respectively.

4.2 Stability

All units monitored had acceptable response, neither pulling out, tripping, nor exhibiting undamped variations for all contingencies simulated, with the exception of the following:

- Contingency FLT07-3PH: 3 phase fault on the Hitchland-Hansford 115 kV line
- Contingency FLT10-3PH: 3 phase fault on the Hitchland-Potter County 345 kV line
- Contingency FLT13-3PH: 3 phase fault on the Finney-Holcomb 345 kV line
- Contingency FLT18-3PH: 3 phase fault on the Potter County 345/230/13.2 kV transformer

The above faults were simulated with the DISIS-2016-002 Group 2 requests removed from the model and the results compared. This comparison determined the observed issues to be pre-existing and not intensified by the study requests.

Contingency FLT07-3PH trips machine 1 at the bus 523201, EXCELN4-WTG1 on under-voltage for the 2018SP and 2026SP cases.

Contingency FL10-3PH, trips DeWind wind turbines G06-044GEN1A for the 2017WP case, the NOVUS_WND for the 2018SP case, and trips the G06_044GEN2A for the 2026SP case by the RELUNS under-speed relay. This contingency also trips wind turbines NOVUS_WND and G06_44GEN2B for the 2026SP case by the G59REL over-frequency relay. These are previously known issues.

FLT13-3PH and FLT18-3PH for the 2017WP case initially caused a sustained, widespread, low frequency oscillation observed in Oklahoma, but the switching off-line the reactor banks on the 345 kV system near Woodward EHV station has significantly improved system damping mitigating the low frequency oscillations previously found for FLT13-3PH and FLT18-3PH in the 2017WP case.

APPENDIX A: CLUSTER GROUP 2 MACHINE PARAMETERS

A.1 Machine parameters for generation request ASGI-2016-010 (Bus 588482 id 1)

```
 ** GEWTG0501 **  BUS X-- NAME --X   BASEKV  MC      CONS     STATES        VAR       ICON
            588482 A16-010_GEN1   0.6900  1     ***-699    ***-284    ***-177    ***-202

       T1        T2        K1       GE4        Tq        Tp      Emin
   1.0000    1.0000   15.0000    0.0500    0.0000    0.0000   -1.5000

     Emax       GE9      GE10      GE11      GE12      GE13      GE14
   1.5000   20.0000    3.0000    0.9000    1.1000    0.7000    1.5000

     GE15      GE16
   5.0000    0.0200

     GE17      GE18      GE19      GE20
   0.0000    0.5000    0.9000    1.0000

     GE21      GE22      GE23      GE24
   0.0000    0.0000    1.2300    1.2300

     GE25      GE26      GE27      GE28      GE29      GE30      GE31
                     100.0000    0.1000    0.0500    0.1000    3.5000    0.0500    1.0000


     Vlo1      Vup1       TP1      Vlo2      Vup2       TP2      Vlo3      Vup3       TP3
  -1.0000    5.0000   9999.0   -1.0000    5.0000   9999.0    -1.0000    5.0000   9999.0

     Vlo4      Vup4       TP4      Vlo5      Vup5       TP5      Vlo6      Vup6         TP6
  -1.0000    5.0000   9999.0   -1.0000    5.0000   9999.0   -1.0000    5.0000   9999.0

     Vlo7      Vup7       TP7
  -1.0000    5.0000   9999.0

     Flo1      Fup1       TF1      Flo2      Fup2       TF2        TB
  50.0000   70.0000   9999.0   50.0000   70.0000   9999.0  9999.0

 Selected ICONs:
 Monitored bus for protection relays = 588482
 Relay Type =   1


 ** GEWTE0501 **  BUS X-- NAME --X   BASEKV  MC     C O N S     S T A T E S       VAR         ICON
           588482    A16-010_GEN1 0.6900  1  175788-175855  68530-68544   31821-32112   12678-12686

     GE50      GE51      GE52      GE55      GE57
   0.0100    1.1000    0.9000    1.1100    1.7000

     GE58      GE59      GE60      GE61      GE62      GE63
  10.0000    0.2000   66.0000    1.2000    0.4500    0.0330

     GE64      GE65      GE66      GE67      GE68      GE76
   1.0000    0.1000    0.0150    0.0500    0.0150    0.0500

     GE77      GE75      GE69      GE70      GE71
   0.2000    0.0200    0.0150    0.1500    5.0000

       TR        TC       TLD       TLG        FN      DBLL      TPWR
   0.0200    0.4000    0.2200    0.2200    1.0000    0.0070    0.0500

       RC        XC      KQDF     TLPQD       XQD     VERMN     VERMX      VFRZ
   0.0000    0.0000    0.0800    0.1200    0.0000   -0.1000    0.1000   -1.0000

      KIV       KVP        TV      KVP2       TV2
   1.0000    0.1000    0.1500    0.0000    0.1500

     QMX1      QMN1      QMX2      QMN2      QMX3      QMN3
   0.0020   -0.0020    0.4840   -0.4840    0.4840   -0.4840

      PG1       PG2      IQH1      IQH2      IQH3      IQH4
   0.0100    0.4500    1.1000    1.1000    0.6000    0.6000
```

```
    IQH5      IQH6      IQL1      IQL2      IQL3      IQL4
 -1.0000   -1.0000   -0.6000   -0.6000   -0.6000   -0.6000

    IQL5      IQL6      VIQ1      VIQ2      VIQ3      VIQ4
 -1.3000   -1.3000    0.0000    0.8000    0.9000    1.1000

    VIQ5      VIQ6
  1.2000    1.3000  /


Selected ICONs:
VARFLG =   1
PFAFLG =   0
PQFLAG =   1


** GEWTA0501 **  BUS X-- NAME --X   BASEKV MC    C O N S       S T A T E S      VAR         ICON
           588482    A16-010_G  0.6900 1  232638-232680  87654- 87668  48993- 49155  14086- 14089

 USIZE  SPDWI   TP     TPC  KPP     KIP   KPTRQ   KITRQ     KPC     KIC
  2.50  14.0   0.30   0.05 150.0   25.0    3.0     0.60     3.00  30.00

PIMAX  PIMIN PIRAT  PWMAX   PWMIN   PWRAT     H     HG    KTG    DTG
 27.0   0.0  10.0   1.12    0.00    0.45    2.96   0.62   1.1   1.50

 WBASE     TW    TPAV    PA    PBC    PD       FA     FB      FC     FD
 144.0    1.00   0.15   1.00   0.95   0.40    0.96   0.996   1.004   1.04

 PMAX   PMIN  KWI     DBWI    TLPWI   TWOWI  URLWI   DRLWI   PMXWI
 1.0    0.20  0.0   0.0025    1.00    5.50    0.10  -1.00    0.10

                    PMNWI  TDI    TPSET  MWCAP
                     0.0   0.15   5.00   90.00

APCFLG =  0
MASFLG =  1
WFFLG = 0
```

A.2 Machine parameters for generation request GEN-2016-161 (Bus 523941 id 1, Bus 523942 id 1&2523)

```
1    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     SAT, MAR 31 2018  15:10
 2016 MDWG FINAL WITH 2015 SERIES MMWG FINAL
 MDWG 2017W WITH MMWG 2017W

 PLANT MODELS

 REPORT FOR ALL MODELS                    BUS 523941 [MAJSTC-WTG110.6900] MODELS


 ** GEWTG2 **  BUS X-- NAME --X   BASEKV MC  C O N S     S T A T E S        VAR         ICON
           523941    MAJSTC-WT 0.6900 1   55098-55115   23135-23137    3451-3455      516-519

   PRATE        XEQ    VLVPL1    VLVPL2    GLVPL2   VHVRCR2
   1.6000       0.8    0.5000    0.9000    1.2200    1.2000

   CURHVRCR2 VLVACR1   VLVACR2   RIp_LVPL   T_LVPL     LVPL1V
   2.0000    0.4000    0.8000   10.0000    0.0200    0.0000


   LVPL1P   LVPL2V    LVPL2P    LVPL3V     LVPL3P     XLVPL
   0.0000    0.5000    0.1670    0.9000    0.9250    0.0000


 NUMBER OF AGGREGATED ORIGINAL WT UNITS:   53
 WT UNITS USE DFIGs


 ** GEWTE2 OF GEWTG **  BUS X-- NAME --X BASEKV MC       C O N S      S T A T E S     VAR          ICON
                       523941 MAJSTC-WTG11 0.6900 1  157151-157217  63517-63534   26028-26036   10063-10074

   TFV      KPV        KIV       RC        XC        TFP       KPP
   0.1500   18.0000    5.0000    0.0000    0.0000    0.0500    3.0000

   KIP       PMX       PMN       QMX      QMN        IPMAX     TRV
   0.6000    1.1200    0.0400    0.4360   -0.4360    1.1200    0.0200

   RPMX      RPMN      T_POWER   KQi      VMINCL     VMAXCL    KVi
   0.4500   -0.4500   60.0000    0.1000    0.9000    1.1000   40.0000

   XIQmin    XIQmax    Tv        Tp       Fn         TPav
   0.5000    1.4500    0.0500    0.0500    1.0000    0.1500

   FRa       FRb       FRc       FRd
   0.9600    0.9960    1.0040    1.0400

   PFRa      PFRb      PFRc      PFRd
   1.0000    0.9500    0.9500    0.4000

   PFRmax    PFRmin    TW        T_LVPL   V_LVPL
   1.0000    0.2000    1.0000    0.2500   -1.0000

   SPDW1     SPDWMX    SPDWMN    SPD_LOW  WTTHRES
  14.0000   25.0000    3.0000   -0.9000    8.0000

   EBST      KDBR      Pdbr_MAX
   0.2000   10.0000    1.0000

   ImaxTD    Iphl      Iqhl      TIpqd      Kqd      Xqd      Kwi
   1.7000    1.1200    1.2500    5.0000    0.0000    0.0000    0.0000

   dbwi      Tipwi     Twowi     urIwi     drIwi    Pmxwi      Pmnwi
   0.0025    1.0000    5.5000    0.1000   -1.0000    0.1000    0.0000

   Vermx     Vermn     Vfrz      QmxZP    QmnZP
   0.1000   -0.1000    0.7000    0.1200   -0.1200


 Remote controlled Bus #    523941
               VARFLG =  1 PFAFLG =  0
               APCFLG =  0 FRFLG =  0
               PQFLAG =  0 WindFREE Enabling Bit = 1
 Q Droop Branch FROM Bus=       0  TO Bus =       0  ID =  1


 **  GEWTT1 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      ICON
           523941    MAJSTC-WT 0.6900 1  227040-227044  85337-85340   45189-45191   13760

    H           DAMP          Htfrac       Freq1       DSHAFT
```

```
   4.6300       0.0000       0.0000       1.8800       2.3000


--------------------------------------------------------------------------------

1    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     SAT, MAR 31 2018  15:10
 2016 MDWG FINAL WITH 2015 SERIES MMWG FINAL
 MDWG 2017W WITH MMWG 2017W

 PLANT MODELS

 REPORT FOR ALL MODELS                    BUS 523942 [MAJSTC-WTG210.6900] MODELS


 ** GEWTG2 **  BUS X-- NAME --X   BASEKV MC  C O N S     S T A T E S        VAR         ICON
           523942    MAJSTC-WT 0.6900 1   55116-55133  23138-23140    3456-3460      520-523

   PRATE        XEQ    VLVPL1    VLVPL2    GLVPL2   VHVRCR2
   1.6200       0.8    0.5000    0.9000    1.2200    1.2000

   CURHVRCR2 VLVACR1   VLVACR2   RIp_LVPL   T_LVPL     LVPL1V
   2.0000    0.4000    0.8000   10.0000    0.0200    0.0000


   LVPL1P   LVPL2V    LVPL2P    LVPL3V     LVPL3P     XLVPL
   0.0000    0.5000    0.1670    0.9000    0.9250    0.0000


 NUMBER OF AGGREGATED ORIGINAL WT UNITS:   20
 WT UNITS USE DFIGs


 ** GEWTE2 OF GEWTG **  BUS X-- NAME --X BASEKV MC       C O N S       S T A T E S     VAR          ICON
                      523942 MAJSTC-WTG21 0.6900 1  157218-157284  63535-63552   26037-26045   10075-10086

   TFV      KPV        KIV       RC        XC        TFP       KPP
   0.1500   18.0000    5.0000    0.0000    0.0000    0.0500    3.0000

   KIP       PMX       PMN       QMX       QMN       IPMAX     TRV
   0.6000    1.1200    0.0400    0.4360   -0.4360    1.1200    0.0200

   RPMX      RPMN      T_POWER   KQi      VMINCL     VMAXCL    KVi
   0.4500   -0.4500   60.0000    0.1000    0.9000    1.1000   40.0000

   XIQmin    XIQmax    Tv        Tp       Fn         TPav
   0.5000    1.4500    0.0500    0.0500    1.0000    0.1500

   FRa       FRb       FRc       FRd
   0.9600    0.9960    1.0040    1.0400

   PFRa      PFRb      PFRc      PFRd
   1.0000    0.9500    0.9500    0.4000

   PFRmax    PFRmin    TW        T_LVPL   V_LVPL
   1.0000    0.2000    1.0000    0.2500   -1.0000

   SPDW1     SPDWMX    SPDWMN    SPD_LOW  WTTHRES
  14.0000   25.0000    3.0000   -0.9000    8.0000

   EBST      KDBR      Pdbr_MAX
   0.2000   10.0000    1.0000

   ImaxTD    Iphl      Iqhl      TIpqd      Kqd       Xqd       Kwi
   1.7000    1.1200    1.2500    5.0000    0.0000    0.0000    0.0000

   dbwi      Tipwi     Twowi     urIwi    drIwi    Pmxwi      Pmnwi
   0.0025    1.0000    5.5000    0.1000   -1.0000    0.1000    0.0000

   Vermx     Vermn     Vfrz      QmxZP    QmnZP
   0.1000   -0.1000    0.7000    0.1200   -0.1200


 Remote controlled Bus #    523942
               VARFLG =  1 PFAFLG =  0
               APCFLG =  0 FRFLG =  0
               PQFLAG =  0 WindFREE Enabling Bit = 1
 Q Droop Branch FROM Bus=       0  TO Bus =       0  ID =  1
```

```
**  GEWTT1 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      ICON
           523942    MAJSTC-WT 0.6900 1  227045-227049  85341-85344   45192-45194   13761

    H           DAMP          Htfrac        Freq1       DSHAFT
   4.6300       0.0000       0.0000       1.8800       2.3000


** GEWTG2 **  BUS X-- NAME --X   BASEKV MC  C O N S     S T A T E S        VAR        ICON
           523942    MAJSTC-WT 0.6900 2   55134-55151   23141-23143    3461-3465      524-527

  PRATE        XEQ    VLVPL1    VLVPL2    GLVPL2   VHVRCR2
  1.6200       0.8    0.5000    0.9000    1.2200    1.2000

  CURHVRCR2 VLVACR1   VLVACR2   RIp_LVPL   T_LVPL     LVPL1V
  2.0000    0.4000    0.8000   10.0000    0.0200    0.0000


  LVPL1P   LVPL2V    LVPL2P    LVPL3V     LVPL3P     XLVPL
  0.0000    0.5000    0.1670    0.9000    0.9250    0.0000

NUMBER OF AGGREGATED ORIGINAL WT UNITS:   31
WT UNITS USE DFIGs

** GEWTE2 OF GEWTG **  BUS X-- NAME --X BASEKV MC       C O N S       S T A T E S     VAR         ICON
                      523942 MAJSTC-WTG21 0.6900 2  157285-157351  63553-63570   26046-26054   10087-10098

  TFV      KPV        KIV       RC        XC        TFP       KPP
  0.1500   18.0000    5.0000    0.0000    0.0000    0.0500    3.0000

  KIP       PMX       PMN       QMX      QMN        IPMAX     TRV
  0.6000    1.1200    0.0400    0.4360   -0.4360    1.1200    0.0200

  RPMX      RPMN      T_POWER   KQi      VMINCL     VMAXCL    KVi
  0.4500   -0.4500   60.0000    0.1000    0.9000    1.1000   40.0000

  XIQmin    XIQmax    Tv        Tp       Fn         TPav
  0.5000    1.4500    0.0500    0.0500    1.0000    0.1500

  FRa       FRb       FRc       FRd
  0.9600    0.9960    1.0040    1.0400

  PFRa      PFRb      PFRc      PFRd
  1.0000    0.9500    0.9500    0.4000

  PFRmax    PFRmin    TW        T_LVPL   V_LVPL
  1.0000    0.2000    1.0000    0.2500   -1.0000

  SPDW1     SPDWMX    SPDWMN    SPD_LOW  WTTHRES
 14.0000   25.0000    3.0000   -0.9000    8.0000

  EBST      KDBR      Pdbr_MAX
  0.2000   10.0000    1.0000

  ImaxTD    Iphl      Iqhl      TIpqd      Kqd       Xqd      Kwi
  1.7000    1.1200    1.2500    5.0000    0.0000    0.0000    0.0000

  dbwi      Tipwi     Twowi     urIwi    drIwi    Pmxwi      Pmnwi
  0.0025    1.0000    5.5000    0.1000   -1.0000    0.1000    0.0000

  Vermx     Vermn     Vfrz      QmxZP    QmnZP
  0.1000   -0.1000    0.7000    0.1200   -0.1200


Remote controlled Bus #    523942
               VARFLG =  1 PFAFLG =  0
               APCFLG =  0 FRFLG =  0
               PQFLAG =  0 WindFREE Enabling Bit = 1
Q Droop Branch FROM Bus=       0  TO Bus =       0  ID =  1


**  GEWTT1 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S      ICON
           523942    MAJSTC-WT 0.6900 2  227050-227054  85345-85348   45195-45197   13762
```

```
    H          DAMP         Htfrac       Freq1       DSHAFT
   4.6300      0.0000       0.0000       1.8800       2.3000


--------------------------------------------------------------------------------

1    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     SAT, MAR 31 2018  15:10
 2016 MDWG FINAL WITH 2015 SERIES MMWG FINAL
 MDWG 2017W WITH MMWG 2017W

 MAC. OTHER MODELS

 REPORT FOR ALL MODELS                    BUS 523941 [MAJSTC-WTG110.6900] MODELS


 ** GEWGD1**  BUS X-- NAME --X BASEKV MC    C O N S     V A R S        ICON
           523941 MAJSTC-WTG11 0.6900 1  277852-277857  76090-76093   32553

  T1G         TG      MAXG       T1R      T2R       MAXR
  9999.000     5.000    30.000  9999.000  9999.000    30.000


 ** GEWTA2 **  BUS X-- NAME --X BASEKV MC    C O N S     STATE    V A R S
           523941 MAJSTC-WTG11 0.6900 1  277858-277866  96979  76094-76097

     Lambda_Max      Lambda_Min   PITCH_MAX    PITCH_MIN      Ta         RHO
      20.0000       0.0000      27.0000      -4.0000       0.0000       1.2250

       Radius      GB_RATIO        SYNCHR
      35.2500      72.0000       1200.0000



 ** GEWTP2 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S    V A R S       ICON
           523941 MAJSTC-WTG11 0.6900 1  277867-277876  96980-96982   76098-76100   32554

        Tp            Kpp        Kip           Kpc           Kic
       0.3000     150.0000      25.0000       3.0000      30.0000
         TetaMin   TetaMax   RTetaMin   RTetaMax    PMX
         -4.0000   27.0000  -10.0000   10.0000    1.0000



--------------------------------------------------------------------------------

1    PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS(R)E     SAT, MAR 31 2018  15:10
 2016 MDWG FINAL WITH 2015 SERIES MMWG FINAL
 MDWG 2017W WITH MMWG 2017W

 MAC. OTHER MODELS

 REPORT FOR ALL MODELS                    BUS 523942 [MAJSTC-WTG210.6900] MODELS


 ** GEWGD1**  BUS X-- NAME --X BASEKV MC    C O N S     V A R S        ICON
           523942 MAJSTC-WTG21 0.6900 1  277877-277882  76101-76104   32555

  T1G         TG      MAXG       T1R      T2R       MAXR
  9999.000     5.000    30.000  9999.000  9999.000    30.000


 ** GEWTA2 **  BUS X-- NAME --X BASEKV MC    C O N S     STATE    V A R S
           523942 MAJSTC-WTG21 0.6900 1  277883-277891  96983  76105-76108

     Lambda_Max      Lambda_Min   PITCH_MAX    PITCH_MIN      Ta         RHO
      20.0000       0.0000      27.0000      -4.0000       0.0000       1.2250

       Radius      GB_RATIO        SYNCHR
      35.2500      72.0000       1200.0000



 ** GEWTP2 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S    V A R S       ICON
           523942 MAJSTC-WTG21 0.6900 1  277892-277901  96984-96986   76109-76111   32556
```

```
       Tp            Kpp        Kip           Kpc          Kic
     0.3000     150.0000      25.0000       3.0000      30.0000
       TetaMin   TetaMax   RTetaMin   RTetaMax    PMX
       -4.0000   27.0000  -10.0000   10.0000    1.0000
```

```
** GEWGD1**  BUS X-- NAME --X BASEKV MC    C O N S     V A R S        ICON
          523942 MAJSTC-WTG21 0.6900 2  277902-277907  76112-76115   32557

 T1G         TG       MAXG       T1R      T2R       MAXR
 9999.000     5.000    30.000  9999.000  9999.000    30.000
```

```
** GEWTA2 **  BUS X-- NAME --X BASEKV MC    C O N S     STATE    V A R S
          523942 MAJSTC-WTG21 0.6900 2  277908-277916  96987  76116-76119

    Lambda_Max      Lambda_Min   PITCH_MAX    PITCH_MIN      Ta         RHO
     20.0000       0.0000      27.0000      -4.0000       0.0000       1.2250

      Radius      GB_RATIO        SYNCHR
     35.2500      72.0000        1200.0000
```

```
** GEWTP2 **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S    V A R S       ICON
          523942 MAJSTC-WTG21 0.6900 2  277917-277926  96988-96990   76120-76122   32558

       Tp            Kpp        Kip           Kpc          Kic
     0.3000     150.0000      25.0000       3.0000      30.0000
       TetaMin   TetaMax   RTetaMin   RTetaMax    PMX
       -4.0000   27.0000  -10.0000   10.0000    1.0000
```

APPENDIX B: PLOTS OF SPEED, ANGLE, PELEC, QELEC, AND ETERM FOR ALL MONITORED UNITS INCLUDING POI BUS VOLTAGES FOR STUDY AND PRIOR PROJECT QUEUES

- Plots for the 2017WP case included in file Plots_2017WP.pdf, file size: 183,914 kB, included separately due to large file size.
- Plots for the 2018SP case included in file Plots_2018SP.pdf, file size: 203,823 kB, included separately due to large file size.
- Plots for the 2026SP case included in file Plots_2026SP.pdf, file size: 214,484 kB, included separately due to large file size.
- Plots are available upon request to SPP

J4: GROUP 4 DYNAMIC STABILITY ANALYSIS REPORT

Southwest Power Pool Inc. (SPP)

Definitive Impact Study

DISIS-2016-002 (Group 4)

Report Submitted to
Southwest Power Pool Inc.
April 2018

POWER-tek Global Inc.
Mississauga, Ontario, L4Z 1H8 Canada
647 300 3160
info@powertek-usa.com, www.powertek-usa.com

TABLE OF CONTENTS

1. Executive Summary

The DISIS-2016-002 (Group 4) Impact Study is a generation interconnection study performed by POWER-tek Global Inc. for Southwest Power Pool (SPP). This report presents the results of impact study comprising of short circuit and stability analyses for the proposed interconnection projects under DISIS-2016-002 (Group 4) (“The Projects”) as described in Table 1.1 below:

Table 1.1: Interconnection Request

Request	Size (MW)	Generator Model	Point of Interconnection (POI)
GEN-2016-111	302	Wind (587883)	Tap Summit – Reno 345kV Line (587884)
GEN-2016-112	220	Wind (587893)	Tap Reno-Summit 345kV (587894)
GEN-2016-113	155	Wind (587903)	Tap Reno-Summit 345kV (587894)
GEN-2016-114	310	Wind (587913)	Tap Reno-Summit 345kV (587884)
GEN-2016-122	225	Wind (587983)	Tap Reno-Summit 345kV (587894)
GEN-2016-160	20	Battery (588451)	Post Rock 230kV Substation (530584)

Short circuit analysis up to 5 Buses away from each point of interconnection (POI) and transient stability simulations were performed for the Projects in service at its full output. SPP provided three base cases for Winter-2017, Summer-2018, and Summer-2026, each comprising of a power flow, sequence data and corresponding dynamics database. The previous queued request projects were already modeled in the base cases.

There are no impacts on the stability performance of the SPP system during cluster scenarios for the contingencies tested on the provided base cases. The study machines stayed on-line and stable for all simulated faults. The project stability simulations with twenty six (26) specified test disturbances did not show instability problems in the SPP system. Any oscillations were damped out in accordance with the SPP Disturbance Performance Requirements.

2. Introduction

2.1. Project Overview and Assumptions

The DISIS-2016-002 (Group 4) Impact Study is a generation interconnection study performed by POWER-tek Global Inc. for SPP. This report presents the results of impact study comprising of short circuit analysis and stability analyses for the proposed interconnection projects under DISIS-2016-002 (Group 4) ("The Projects") as described in Table 2.1.1 below:

Table 2.1.1: Interconnection requests

Request	Size (MW)	Generator Model	Point of Interconnection (POI)
GEN-2016-111	302	Wind (587883)	Tap Summit – Reno 345kV Line (587884)
GEN-2016-112	220	Wind (587893)	Tap Reno-Summit 345kV (587894)
GEN-2016-113	155	Wind (587903)	Tap Reno-Summit 345kV (587894)
GEN-2016-114	310	Wind (587913)	Tap Reno-Summit 345kV (587884)
GEN-2016-122	225	Wind (587983)	Tap Reno-Summit 345kV (587894)
GEN-2016-160	20	Battery (588451)	Post Rock 230kV Substation (530584)

Figure 2.1.1, 2.1.2, and 2.1.3 shows the single line diagram for the interconnection of the Projects to present and planned system of SPP. This arrangement was modeled and studied in power flow cases for these projects.

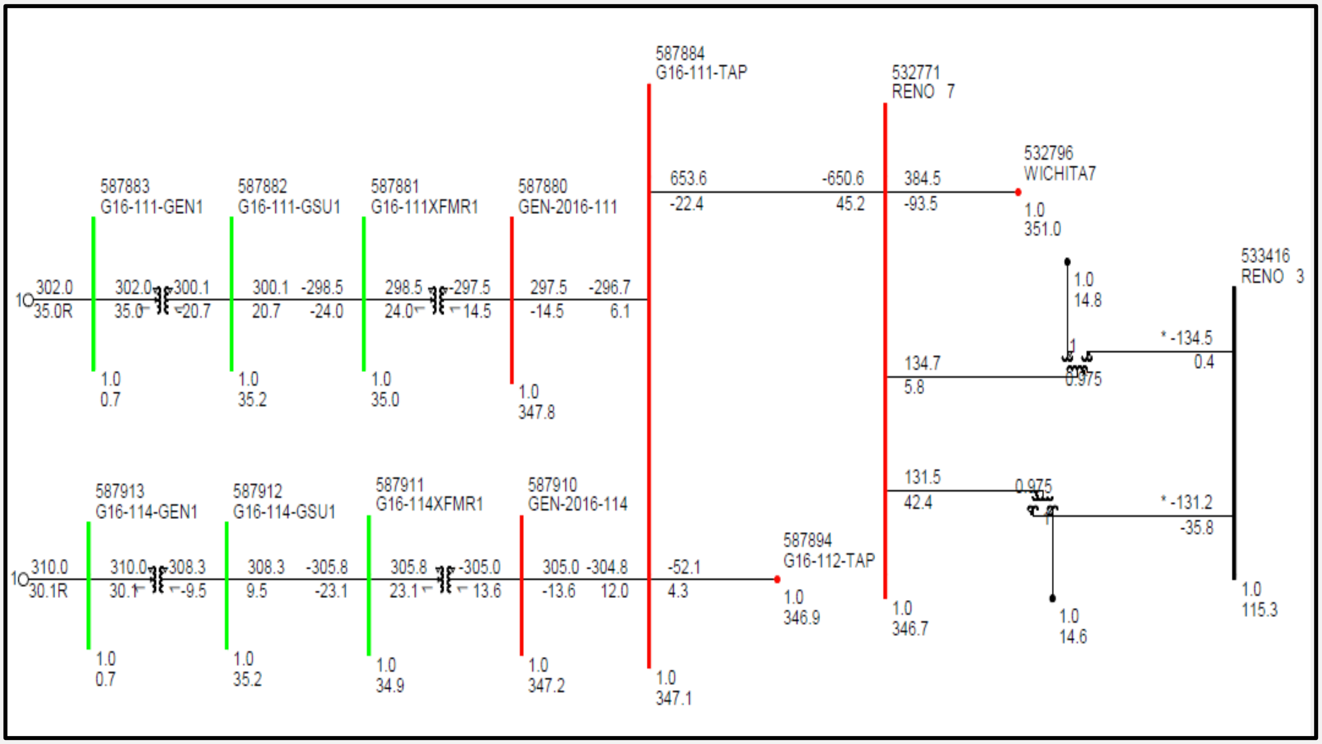


Figure 2.1.1: Power flow single line diagram for GEN-2016-111, GEN-2016-114 and surrounding system components

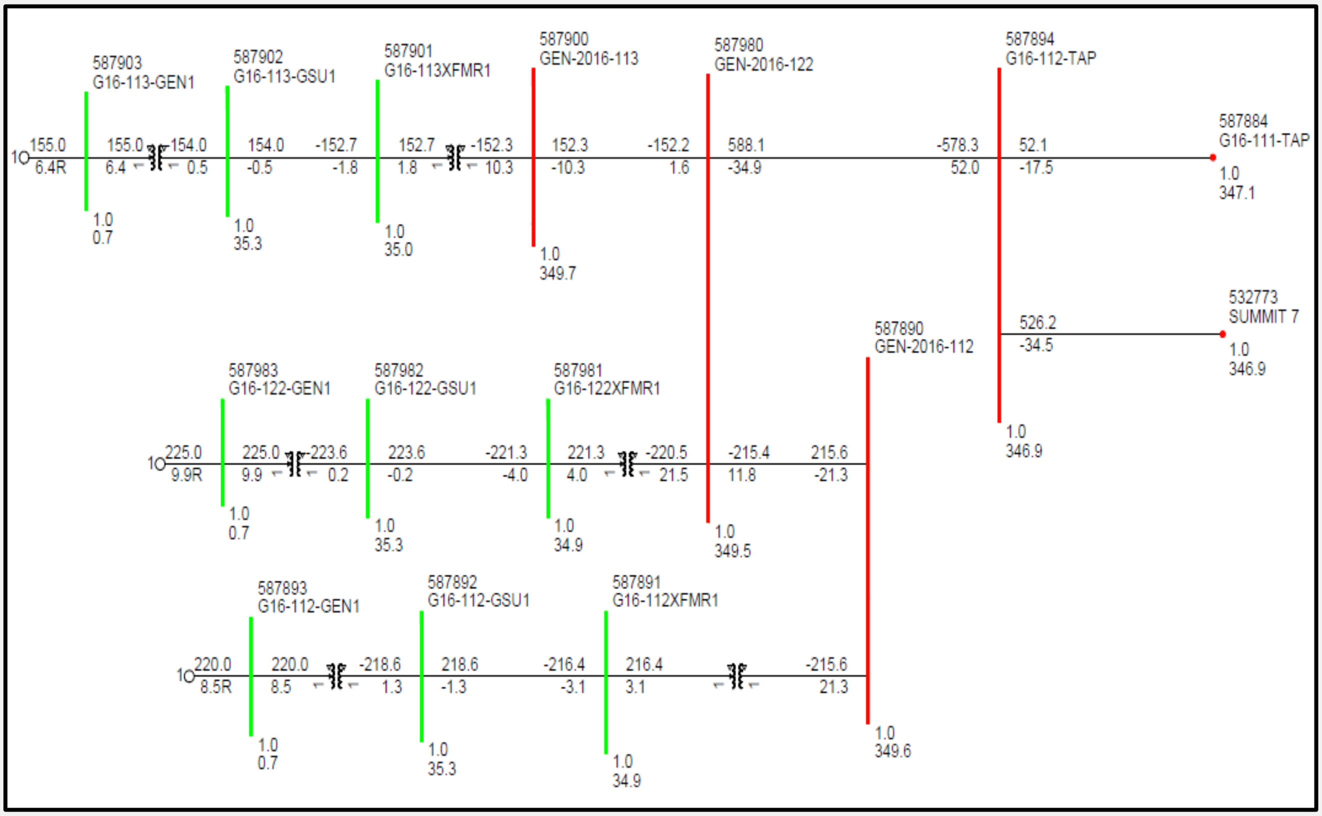


Figure 2.1.2: Power flow single line diagram for GEN-2016-112, GEN-2016-113, GEN-2016-122 and surrounding system components

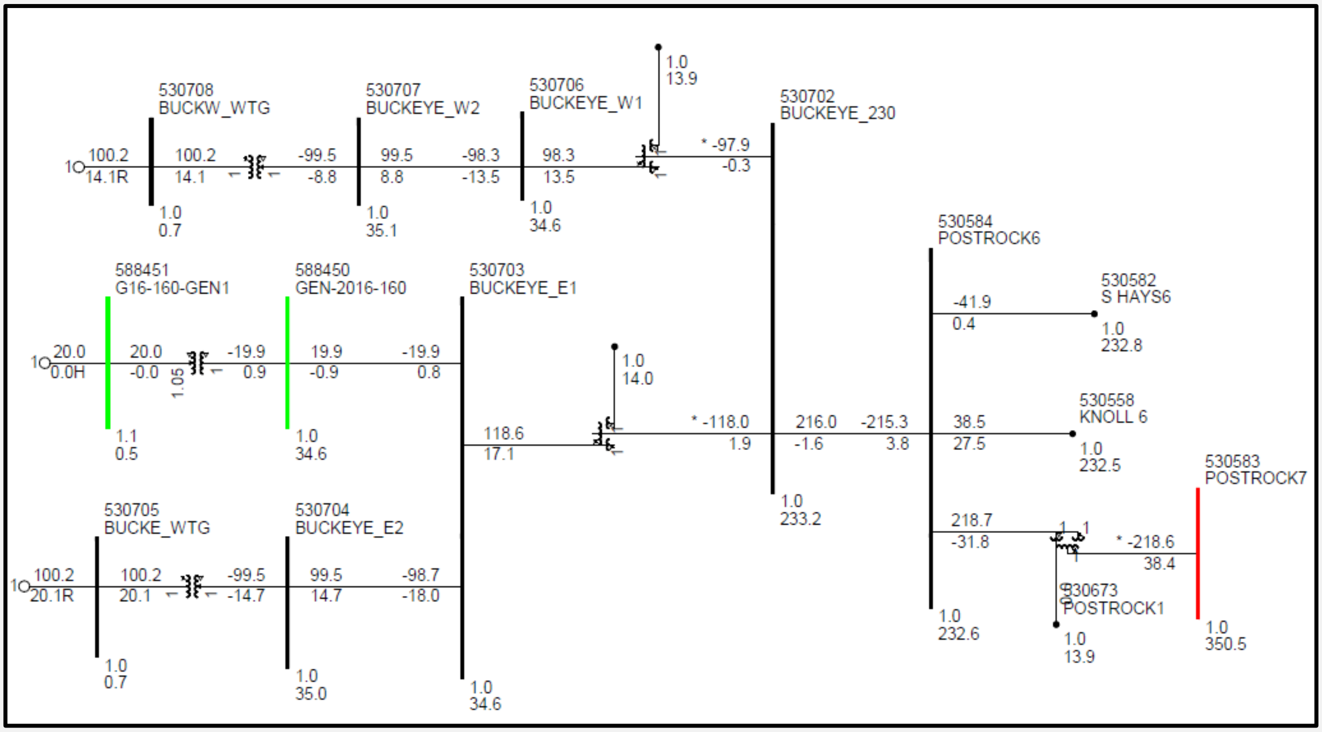


Figure 2.1.3: Power flow single line diagram for GEN-2016-160 and surrounding system components

Appendix-D contains the machines, interconnection, and machines user model parameters.

Table 2.1.2 below shows the list of prior queued projects modeled in the base case.

Table 2.1.2: List of previous queued request projects

Request	Size (MW)	Wind Turbine Model	Point of Interconnection
GEN-2001-039M	99	Vestas V90 VCRS 3.0MW	Central Plains 115kV (531485)
GEN-2003-006A	201	Vestes V90 VCRS 3.0MW	Elm Creek 230kV (539639)
GEN-2003-019	249.3	GE 1.5MW, Vestas V80 1.8MW	Smoky Hills Tap 230kV (530592)
GEN-2006-031/GEN-2013-033	104	Wartsila 20V34SG 8.439MW, Wartsila 20V34SG 9.341MW	Knoll 115kV (530561)
GEN-2008-092	200.48	GE 1.79MW	Post Rock 230kV (530584)
GEN-2009-008	198.69	GE 1.79MW	South Hays 230kV (530582)
GEN-2009-020/GEN-2014-025	50.715	Siemens 108m 2.415MW	Walnut Creek 69kV (530700)
GEN-2010-057	201	GE 1.5MW	Rice County 230kV (530686)
ASGI-2013-004	27.6 Summer 36.6 Winter	CT 12.2MW	Morris 115kV (531430)
GEN-2015-064	197.8	Siemens VS 2.3MW	Mingo 115kV (531429)
GEN-2015-065	202.4	Siemens VS 2.3MW	Mingo 345kV (531451)
GEN-2016-067	73.6	Siemens VS 2.3MW	Mingo 345kV (531451)

ATC (Available Transfer Capability) studies were not performed as part of this study. These studies will be required at the time transmission service is actually requested. Additional transmission upgrades may be required based on that analysis.

Study assumptions in general have been based on the specific information and data provided by SPP. The accuracy of the conclusions contained within this study is dependent on the assumptions made with respect to other generation additions and transmission improvements planned by other entities. Changes in the assumptions of the timing of other generation additions or transmission improvements may affect this study's conclusions.

2.2. Objectives

The objectives of the study are to determine the impact on system stability of interconnecting the proposed power plants to SPP's transmission system.

2.3. Models and Simulations Tools Used

Version 33.7 of the Siemens, PSS/E^{TM} power system simulation program was used in this study.

SPP provided its latest stability database cases for Winter-2017, Summer-2018, and Summer-2026 peak seasons. The Project's PSS/E model had been developed prior to this study and was included in the power flow case and the dynamics database. Machines, interconnection and dynamic model data for the Project plants is provided in Appendix D.

Power flow single line diagram of the projects in summer 2018 peak condition is shown in Figure 2.1.1, 2.1.2, and 2.1.3 respectively. These figures shows that wind farms model includes representation of the radial transmission line, the substation transformer from transmission voltage (230kV and 345kV) to 34.5V. The remainder of each wind farm is represented by lumped equivalents including a generator, a step-up transformer, and collector system impedance.

No special modeling is required of line relays in these cases, except for the special modeling related to the wind-turbine tripping.

All generators in Areas 520, 524, 525, 526, 531, 534, 536, and 640 were monitored.

3. Short Circuit Analysis

The short circuit analysis out five buses away was performed for 2018, and 2026 summer peak case for each interconnection request under project cluster scenario of DISIS-2016-002 (Group 4). No outage was assumed in the system model.

3.1. Short Circuit Result for 2018 Summer Peak Case

The short circuit results for summer-2018 scenario (assumed not outage) at the POI are tabulated below.

3.1.1. Short Circuit Result for Tap Summit – Reno 345kV Line (587884)

The results of the short circuit analysis for POI i.e., Tap Summit – Reno 345kV Line (587884) and five bus levels away are tabulated below in Table 4.1.1.

Table 4.1.1: Short circuit results for Tap Summit – Reno 345kV Line (587884)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
587884	G16-111-TAP 345.0	0 LEVELS AWAY	10998.6
532771	RENO 7 345.0	1 LEVELS AWAY	12041.2
587880	GEN-2016-111345.0	1 LEVELS AWAY	6983.4
587894	G16-112-TAP 345.0	1 LEVELS AWAY	10839.6
587910	GEN-2016-114345.0	1 LEVELS AWAY	9848.7
532773	SUMMIT 7 345.0	2 LEVELS AWAY	11426.7
532796	WICHITA7 345.0	2 LEVELS AWAY	25874
532807	RENO 1X1 14.40	2 LEVELS AWAY	41192.4
532810	RENO 2X1 14.40	2 LEVELS AWAY	42265.7
533416	RENO 3 115.0	2 LEVELS AWAY	23097
587881	G16-111XFMR134.50	2 LEVELS AWAY	30329.8
587911	G16-114XFMR134.50	2 LEVELS AWAY	35566.4
587980	GEN-2016-122345.0	2 LEVELS AWAY	5390.1
532767	GEARY 7 345.0	3 LEVELS AWAY	9934.4
532782	BUFFALO7 345.0	3 LEVELS AWAY	21510.4
532791	BENTON 7 345.0	3 LEVELS AWAY	20462.9
532798	VIOLA 7 345.0	3 LEVELS AWAY	14039.6
532813	SUMMIT 1 14.40	3 LEVELS AWAY	30657.3

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532829	WICH11 1 13.80	3 LEVELS AWAY	50198.3
532830	WICH12 1 13.80	3 LEVELS AWAY	50395.1
532873	SUMMIT 6 230.0	3 LEVELS AWAY	13744.5
533040	EVANS N4 138.0	3 LEVELS AWAY	40855.2
533413	CIRCLE 3 115.0	3 LEVELS AWAY	19117.1
533415	DAVIS 3 115.0	3 LEVELS AWAY	8311.3
533429	MOUNDRG3 115.0	3 LEVELS AWAY	7106.2
533438	WMCPHER3 115.0	3 LEVELS AWAY	12236.3
539805	ELMCREEK7 345.0	3 LEVELS AWAY	5207.8
562476	G14-001-TAP 345.0	3 LEVELS AWAY	11136.7
587882	G16-111-GSU134.50	3 LEVELS AWAY	29772.5
587890	GEN-2016-112345.0	3 LEVELS AWAY	4810.7
587900	GEN-2016-113345.0	3 LEVELS AWAY	4870.3
587912	G16-114-GSU134.50	3 LEVELS AWAY	33497.6
587981	G16-122XFMR134.50	3 LEVELS AWAY	23856.2
515543	RENFROW7 345.0	4 LEVELS AWAY	12967.6
530592	SMOKYHL6 230.0	4 LEVELS AWAY	6959.5
532721	EEC U1 16.00	4 LEVELS AWAY	77897.5
532722	EEC U2 24.00	4 LEVELS AWAY	99007.1
532729	EVAN SVC 8.000	4 LEVELS AWAY	139942.1
532766	JEC N 7 345.0	4 LEVELS AWAY	23526.6
532768	EMPEC 7 345.0	4 LEVELS AWAY	17315.2
532783	KINGMAN7 345.0	4 LEVELS AWAY	6856.2
532794	ROSEHIL7 345.0	4 LEVELS AWAY	19526.5
532797	WOLFCRK7 345.0	4 LEVELS AWAY	15927.5
532821	BENTN1 1 13.80	4 LEVELS AWAY	23750.9
532822	BENTN2 1 13.80	4 LEVELS AWAY	45316.1
532832	VIOLA1X1 13.80	4 LEVELS AWAY	35127.1
532834	GEARY1X1 13.80	4 LEVELS AWAY	67925.7

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532871	CIRCLE 6 230.0	4 LEVELS AWAY	8994.1
532872	EMCPHER6 230.0	4 LEVELS AWAY	8364
532874	UNIONRG6 230.0	4 LEVELS AWAY	8896.3
532892	CIRCLE 1 13.80	4 LEVELS AWAY	49379.4
532896	SUMIT2 1 13.80	4 LEVELS AWAY	47639.6
532897	SUMIT3 1 13.80	4 LEVELS AWAY	48715.2
532986	BENTON 4 138.0	4 LEVELS AWAY	29051
533013	MOUND 4 138.0	4 LEVELS AWAY	4848.8
533041	EVANS S4 138.0	4 LEVELS AWAY	40855.2
533065	SG12COL4 138.0	4 LEVELS AWAY	21200.4
533075	VIOLA 4 138.0	4 LEVELS AWAY	18659.9
533097	MOUN 2X1 7.200	4 LEVELS AWAY	5752
533336	GEARY 3 115.0	4 LEVELS AWAY	17149.7
533380	SPRGCRK3 115.0	4 LEVELS AWAY	3607
533381	SUMMIT 3 115.0	4 LEVELS AWAY	17545.4
533390	MAIZEW 4 138.0	4 LEVELS AWAY	27595
533394	CORONAD3 115.0	4 LEVELS AWAY	7184.8
533412	ARKVALJ3 115.0	4 LEVELS AWAY	9874.1
533414	CITIES 3 115.0	4 LEVELS AWAY	8310.8
533419	HEC 3 115.0	4 LEVELS AWAY	17831.6
533421	HEC GT 3 115.0	4 LEVELS AWAY	18565.1
533426	MANVILE3 115.0	4 LEVELS AWAY	10101.5
533428	MCPHER 3 115.0	4 LEVELS AWAY	11773.4
533439	WHEATLD3 115.0	4 LEVELS AWAY	7106.7
533444	DAVIS 1 34.50	4 LEVELS AWAY	3264.9
533506	DAVIS 2 69.00	4 LEVELS AWAY	7331.8
539639	ELMCREK6 230.0	4 LEVELS AWAY	7251.1
539801	THISTLE7 345.0	4 LEVELS AWAY	16177.2
539806	ELMCREEK1 13.80	4 LEVELS AWAY	65135.9

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
583850	GEN-2014-001345.0	4 LEVELS AWAY	7586.3
587500	GEN-2016-073345.0	4 LEVELS AWAY	15618.5
587883	G16-111-GEN10.690	4 LEVELS AWAY	1292873
587891	G16-112XFMR134.50	4 LEVELS AWAY	22844.8
587901	G16-113XFMR134.50	4 LEVELS AWAY	21801.1
587913	G16-114-GEN10.690	4 LEVELS AWAY	1353246.4
587982	G16-122-GSU134.50	4 LEVELS AWAY	22564.2
588320	GEN-2016-162345.0	4 LEVELS AWAY	9931.4
588364	G16-153-TAP 345.0	4 LEVELS AWAY	7772.3
515375	WWRDEHV7 345.0	5 LEVELS AWAY	18882.8
515544	RENFROW4 138.0	5 LEVELS AWAY	14109.8
515545	RENFRO11 13.80	5 LEVELS AWAY	24368.9
515646	GRNTWD 7 345.0	5 LEVELS AWAY	11325.6
530558	KNOLL 6 230.0	5 LEVELS AWAY	10725.1
530593	SMKYP1 6 230.0	5 LEVELS AWAY	6043.8
530599	SMKYP2 6 230.0	5 LEVELS AWAY	6457.2
530618	HUNTSVL3 115.0	5 LEVELS AWAY	4011.2
530620	LYONS 3 115.0	5 LEVELS AWAY	5377.4
530686	RICE 6 230.0	5 LEVELS AWAY	4713.8
532652	JEC U2 26.00	5 LEVELS AWAY	189200.3
532653	JEC U3 26.00	5 LEVELS AWAY	188498.1
532696	HEC GT2 13.80	5 LEVELS AWAY	28013
532697	HEC GT3 13.80	5 LEVELS AWAY	18263.5
532698	HEC GT4 13.80	5 LEVELS AWAY	24900
532702	MCPHGT1 13.80	5 LEVELS AWAY	16897.5
532703	MCPHGT2 13.80	5 LEVELS AWAY	16897.5
532704	MCPHGT3 13.80	5 LEVELS AWAY	16897.5
532705	MCPHGT4 13.80	5 LEVELS AWAY	49294.1
532723	EEC GT1 13.80	5 LEVELS AWAY	50249.8

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532724	EEC GT2 13.80	5 LEVELS AWAY	50286
532725	EEC GT3 18.00	5 LEVELS AWAY	67616.1
532740	EMPEC121 13.80	5 LEVELS AWAY	60920.7
532741	EMPEC341 13.80	5 LEVELS AWAY	60920.7
532742	EMPEC5 1 18.00	5 LEVELS AWAY	85436.5
532743	EMPEC6 1 18.00	5 LEVELS AWAY	85436.5
532744	EMPEC7 1 18.00	5 LEVELS AWAY	85436.5
532751	WCGS U1 25.00	5 LEVELS AWAY	207423.4
532765	HOYT 7 345.0	5 LEVELS AWAY	15513.8
532769	LANG 7 345.0	5 LEVELS AWAY	17103.6
532770	MORRIS 7 345.0	5 LEVELS AWAY	12780.3
532774	SWISVAL7 345.0	5 LEVELS AWAY	16359.9
532784	NINN1WF7 345.0	5 LEVELS AWAY	5686.1
532792	FR2EAST7 345.0	5 LEVELS AWAY	7070.4
532799	WAVERLY7 345.0	5 LEVELS AWAY	14608.6
532800	LATHAMS7 345.0	5 LEVELS AWAY	10570.6
532805	JEC 13 1 14.40	5 LEVELS AWAY	33398
532806	JEC 26 1 14.40	5 LEVELS AWAY	33608.7
532817	UNIONRG1 13.20	5 LEVELS AWAY	18698.9
532826	ROSEH1 1 13.80	5 LEVELS AWAY	39337.7
532827	ROSEH5 1 13.80	5 LEVELS AWAY	39097.8
532831	ROSEH3 1 13.80	5 LEVELS AWAY	39273.7
532852	JEC 6 230.0	5 LEVELS AWAY	24614.7
532863	MORRIS 6 230.0	5 LEVELS AWAY	13851
532865	NMANHT6 230.0	5 LEVELS AWAY	8792.4
532894	EMCPHER1 13.80	5 LEVELS AWAY	52449.5
532962	WOLFCRK1 17.00	5 LEVELS AWAY	8826.9
532988	BELAIRE4 138.0	5 LEVELS AWAY	19155.1
532990	MIDIAN 4 138.0	5 LEVELS AWAY	10166.7

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
533011	HALSTD 4 138.0	5 LEVELS AWAY	4249.3
533015	BENTLEY4 138.0	5 LEVELS AWAY	10060.8
533024	29TH 4 138.0	5 LEVELS AWAY	19960
533035	CHISHLM4 138.0	5 LEVELS AWAY	22665.5
533036	CLEARWT4 138.0	5 LEVELS AWAY	14449.8
533047	GILL 4 138.0	5 LEVELS AWAY	26010.7
533053	LAKERDG4 138.0	5 LEVELS AWAY	18982.4
533054	MAIZE 4 138.0	5 LEVELS AWAY	23322.9
533062	ROSEHIL4 138.0	5 LEVELS AWAY	32122
533074	45TH ST4 138.0	5 LEVELS AWAY	27781.7
533095	MOUND1X1 13.20	5 LEVELS AWAY	8412.4
533328	FT JCT 3 115.0	5 LEVELS AWAY	14543.4
533335	MCDOWEL3 115.0	5 LEVELS AWAY	17721.7
533359	UNIONRG3 115.0	5 LEVELS AWAY	3796.4
533362	CHAPMAN3 115.0	5 LEVELS AWAY	10394.8
533366	FLORENC3 115.0	5 LEVELS AWAY	3224
533368	EXIDE J3 115.0	5 LEVELS AWAY	12403.2
533369	HILSBOR3 115.0	5 LEVELS AWAY	2454.1
533371	NORTHVW3 115.0	5 LEVELS AWAY	11644.4
533372	PHILIPS3 115.0	5 LEVELS AWAY	12442.1
533379	SO GATE3 115.0	5 LEVELS AWAY	10682.6
533411	ARKVAL 3 115.0	5 LEVELS AWAY	9682.8
533417	EMCPHER3 115.0	5 LEVELS AWAY	12664.3
533427	REFINRY3 115.0	5 LEVELS AWAY	11566.4
533434	SALTCRK3 115.0	5 LEVELS AWAY	8775.7
533440	43LORAN 115.0	5 LEVELS AWAY	12660.3
533445	HEC 1 34.50	5 LEVELS AWAY	2352.7
533453	CITIES 1 3.906	5 LEVELS AWAY	22398.9
533505	NCTYSVC2 69.00	5 LEVELS AWAY	3942.9

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533513	HEC 2 69.00	5 LEVELS AWAY	7941
533516	MAPLE J2 69.00	5 LEVELS AWAY	7057.7
533529	MWIRNJ22 69.00	5 LEVELS AWAY	6423.2
533653	WOLFCRK2 69.00	5 LEVELS AWAY	5808.1
533742	MOUND 2 69.00	5 LEVELS AWAY	5886.6
534001	K1 LV 1 34.50	5 LEVELS AWAY	14429
534002	K2 LV 1 34.50	5 LEVELS AWAY	14309.3
534031	K1 WFTX1 13.80	5 LEVELS AWAY	25514.8
534032	K2 WFTX1 13.80	5 LEVELS AWAY	25431.9
539008	MILAN_GOAB 138.0	5 LEVELS AWAY	10410.8
539009	CONWAY 138.0	5 LEVELS AWAY	11186.9
539637	MRWYP16 230.0	5 LEVELS AWAY	6619.6
539658	CONCRD6 230.0	5 LEVELS AWAY	5364.1
539679	GRTBEND6 230.0	5 LEVELS AWAY	8194.9
539802	THISTLE T1 13.80	5 LEVELS AWAY	7817.8
539804	THISTLE4 138.0	5 LEVELS AWAY	17356.6
560053	G15-052T 345.0	5 LEVELS AWAY	13076.3
560072	G16-005-TAP 345.0	5 LEVELS AWAY	12803.8
560086	G16-072-TAP 345.0	5 LEVELS AWAY	13083.4
583851	G14-001XFMR134.50	5 LEVELS AWAY	17327.2
583854	G14-001XFMR234.50	5 LEVELS AWAY	16925.9
585070	GEN-2015-069230.0	5 LEVELS AWAY	6628.1
585100	GEN-2015-073345.0	5 LEVELS AWAY	14180.4
587501	G16-073XFMR134.50	5 LEVELS AWAY	29062.3
587892	G16-112-GSU134.50	5 LEVELS AWAY	21734.2
587902	G16-113-GSU134.50	5 LEVELS AWAY	20319.6
587983	G16-122-GEN10.690	5 LEVELS AWAY	976295.9
588321	G16-162XFMR134.50	5 LEVELS AWAY	29514
588330	GEN-2016-163345.0	5 LEVELS AWAY	8757.3

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
588360	GEN-2016-153345.0	5 LEVELS AWAY	7425.8

3.1.2. Short Circuit Result for Tap Reno-Summit 345kV (587894)

The results of the short circuit analysis for POI i.e., Tap Reno-Summit 345kV (587894) and five bus levels away are tabulated below in Table 4.1.2.

Table 4.1.2: Short circuit results for Tap Reno-Summit 345kV (587894)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
587894	G16-112-TAP 345.0	0 LEVELS AWAY	10839.6
532773	SUMMIT 7 345.0	1 LEVELS AWAY	11426.7
587884	G16-111-TAP 345.0	1 LEVELS AWAY	10998.6
587980	GEN-2016-122345.0	1 LEVELS AWAY	5390.1
532767	GEARY 7 345.0	2 LEVELS AWAY	9934.4
532771	RENO 7 345.0	2 LEVELS AWAY	12041.2
532813	SUMMIT 1 14.40	2 LEVELS AWAY	30657.3
532873	SUMMIT 6 230.0	2 LEVELS AWAY	13744.5
539805	ELMCREEK7 345.0	2 LEVELS AWAY	5207.8
587880	GEN-2016-111345.0	2 LEVELS AWAY	6983.4
587890	GEN-2016-112345.0	2 LEVELS AWAY	4810.7
587900	GEN-2016-113345.0	2 LEVELS AWAY	4870.3
587910	GEN-2016-114345.0	2 LEVELS AWAY	9848.7
587981	G16-122XFMR134.50	2 LEVELS AWAY	23856.2
530592	SMOKYHL6 230.0	3 LEVELS AWAY	6959.5
532766	JEC N 7 345.0	3 LEVELS AWAY	23526.6
532796	WICHITA7 345.0	3 LEVELS AWAY	25874
532807	RENO 1X1 14.40	3 LEVELS AWAY	41192.4
532810	RENO 2X1 14.40	3 LEVELS AWAY	42265.7

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532834	GEARY1X1 13.80	3 LEVELS AWAY	67925.7
532872	EMCPHER6 230.0	3 LEVELS AWAY	8364
532874	UNIONRG6 230.0	3 LEVELS AWAY	8896.3
532896	SUMIT2 1 13.80	3 LEVELS AWAY	47639.6
532897	SUMIT3 1 13.80	3 LEVELS AWAY	48715.2
533336	GEARY 3 115.0	3 LEVELS AWAY	17149.7
533381	SUMMIT 3 115.0	3 LEVELS AWAY	17545.4
533416	RENO 3 115.0	3 LEVELS AWAY	23097
539639	ELMCREK6 230.0	3 LEVELS AWAY	7251.1
539806	ELMCREEK1 13.80	3 LEVELS AWAY	65135.9
587881	G16-111XFMR134.50	3 LEVELS AWAY	30329.8
587891	G16-112XFMR134.50	3 LEVELS AWAY	22844.8
587901	G16-113XFMR134.50	3 LEVELS AWAY	21801.1
587911	G16-114XFMR134.50	3 LEVELS AWAY	35566.4
587982	G16-122-GSU134.50	3 LEVELS AWAY	22564.2
530558	KNOLL 6 230.0	4 LEVELS AWAY	10725.1
530593	SMKYP1 6 230.0	4 LEVELS AWAY	6043.8
530599	SMKYP2 6 230.0	4 LEVELS AWAY	6457.2
532652	JEC U2 26.00	4 LEVELS AWAY	189200.3
532653	JEC U3 26.00	4 LEVELS AWAY	188498.1
532765	HOYT 7 345.0	4 LEVELS AWAY	15513.8
532770	MORRIS 7 345.0	4 LEVELS AWAY	12780.3
532782	BUFFALO7 345.0	4 LEVELS AWAY	21510.4
532791	BENTON 7 345.0	4 LEVELS AWAY	20462.9
532798	VIOLA 7 345.0	4 LEVELS AWAY	14039.6
532805	JEC 13 1 14.40	4 LEVELS AWAY	33398
532806	JEC 26 1 14.40	4 LEVELS AWAY	33608.7
532817	UNIONRG1 13.20	4 LEVELS AWAY	18698.9
532829	WICH11 1 13.80	4 LEVELS AWAY	50198.3

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
532830	WICH12 1 13.80	4 LEVELS AWAY	50395.1
532852	JEC 6 230.0	4 LEVELS AWAY	24614.7
532863	MORRIS 6 230.0	4 LEVELS AWAY	13851
532865	NMANHT6 230.0	4 LEVELS AWAY	8792.4
532871	CIRCLE 6 230.0	4 LEVELS AWAY	8994.1
532894	EMCPHER1 13.80	4 LEVELS AWAY	52449.5
533040	EVANS N4 138.0	4 LEVELS AWAY	40855.2
533328	FT JCT 3 115.0	4 LEVELS AWAY	14543.4
533335	MCDOWEL3 115.0	4 LEVELS AWAY	17721.7
533359	UNIONRG3 115.0	4 LEVELS AWAY	3796.4
533362	CHAPMAN3 115.0	4 LEVELS AWAY	10394.8
533368	EXIDE J3 115.0	4 LEVELS AWAY	12403.2
533371	NORTHVW3 115.0	4 LEVELS AWAY	11644.4
533379	SO GATE3 115.0	4 LEVELS AWAY	10682.6
533413	CIRCLE 3 115.0	4 LEVELS AWAY	19117.1
533415	DAVIS 3 115.0	4 LEVELS AWAY	8311.3
533417	EMCPHER3 115.0	4 LEVELS AWAY	12664.3
533429	MOUNDRG3 115.0	4 LEVELS AWAY	7106.2
533438	WMCPHER3 115.0	4 LEVELS AWAY	12236.3
539637	MRWYP16 230.0	4 LEVELS AWAY	6619.6
539658	CONCRD6 230.0	4 LEVELS AWAY	5364.1
562476	G14-001-TAP 345.0	4 LEVELS AWAY	11136.7
585070	GEN-2015-069230.0	4 LEVELS AWAY	6628.1
587882	G16-111-GSU134.50	4 LEVELS AWAY	29772.5
587892	G16-112-GSU134.50	4 LEVELS AWAY	21734.2
587902	G16-113-GSU134.50	4 LEVELS AWAY	20319.6
587912	G16-114-GSU134.50	4 LEVELS AWAY	33497.6
587983	G16-122-GEN10.690	4 LEVELS AWAY	976295.9
515543	RENFROW7 345.0	5 LEVELS AWAY	12967.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
530561	KNOLL 3 115.0	5 LEVELS AWAY	11562.6
530584	POSTROCK6 230.0	5 LEVELS AWAY	10897.6
530595	SHP134 1 34.50	5 LEVELS AWAY	17944.2
530604	SHP234 1 34.50	5 LEVELS AWAY	23604.4
530629	KNLL1 1 11.49	5 LEVELS AWAY	36034.4
530633	SMKYT1 1 13.20	5 LEVELS AWAY	39051.8
530634	SMKYT2 1 13.86	5 LEVELS AWAY	48184.6
530686	RICE 6 230.0	5 LEVELS AWAY	4713.8
532651	JEC U1 26.00	5 LEVELS AWAY	180186.4
532721	EEC U1 16.00	5 LEVELS AWAY	77897.5
532722	EEC U2 24.00	5 LEVELS AWAY	99007.1
532729	EVAN SVC 8.000	5 LEVELS AWAY	139942.1
532768	EMPEC 7 345.0	5 LEVELS AWAY	17315.2
532772	STRANGR7 345.0	5 LEVELS AWAY	23843.1
532783	KINGMAN7 345.0	5 LEVELS AWAY	6856.2
532794	ROSEHIL7 345.0	5 LEVELS AWAY	19526.5
532797	WOLFCRK7 345.0	5 LEVELS AWAY	15927.5
532804	HOYT 1 14.40	5 LEVELS AWAY	31456.4
532809	MORRIS1X1 14.40	5 LEVELS AWAY	31461
532821	BENTN1 1 13.80	5 LEVELS AWAY	23750.9
532822	BENTN2 1 13.80	5 LEVELS AWAY	45316.1
532832	VIOLA1X1 13.80	5 LEVELS AWAY	35127.1
532851	AUBURN 6 230.0	5 LEVELS AWAY	13288.2
532856	SWISVAL6 230.0	5 LEVELS AWAY	21326.1
532861	EMANHAT6 230.0	5 LEVELS AWAY	9592
532862	MCDOWEL6 230.0	5 LEVELS AWAY	6909.9
532890	MORRIS2X1 13.80	5 LEVELS AWAY	39038.4
532892	CIRCLE 1 13.80	5 LEVELS AWAY	49379.4
532898	MCDOWL 1 13.80	5 LEVELS AWAY	30122.1

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532901	NMANHX1 14.40	5 LEVELS AWAY	44985.1
532986	BENTON 4 138.0	5 LEVELS AWAY	29051
533013	MOUND 4 138.0	5 LEVELS AWAY	4848.8
533041	EVANS S4 138.0	5 LEVELS AWAY	40855.2
533065	SG12COL4 138.0	5 LEVELS AWAY	21200.4
533075	VIOLA 4 138.0	5 LEVELS AWAY	18659.9
533097	MOUN 2X1 7.200	5 LEVELS AWAY	5752
533163	HOYT 3 115.0	5 LEVELS AWAY	22718.3
533305	MORRIS 3 115.0	5 LEVELS AWAY	12433.2
533323	CLAYCTR3 115.0	5 LEVELS AWAY	2894
533326	EMANHAT3 115.0	5 LEVELS AWAY	13114.3
533330	JCTCTY 3 115.0	5 LEVELS AWAY	12421.9
533341	STAGGHL3 115.0	5 LEVELS AWAY	9354
533342	WJCCTY 3 115.0	5 LEVELS AWAY	13065.4
533344	WJCCTYW3 115.0	5 LEVELS AWAY	12976.4
533347	NMANHT3 115.0	5 LEVELS AWAY	12401.2
533350	SMAN_W_3 115.0	5 LEVELS AWAY	12470.5
533360	TCHOPE 3 115.0	5 LEVELS AWAY	3374
533361	AEC 3 115.0	5 LEVELS AWAY	7432.9
533365	EABILEN3 115.0	5 LEVELS AWAY	7610.2
533367	EXIDE 3 115.0	5 LEVELS AWAY	10544.6
533370	NORTHST3 115.0	5 LEVELS AWAY	10435.8
533372	PHILIPS3 115.0	5 LEVELS AWAY	12442.1
533378	SMOKYHLLS3 115.0	5 LEVELS AWAY	11112.5
533380	SPRGCRK3 115.0	5 LEVELS AWAY	3607
533390	MAIZEW 4 138.0	5 LEVELS AWAY	27595
533394	CORONAD3 115.0	5 LEVELS AWAY	7184.8
533412	ARKVALJ3 115.0	5 LEVELS AWAY	9874.1
533414	CITIES 3 115.0	5 LEVELS AWAY	8310.8

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533419	HEC 3 115.0	5 LEVELS AWAY	17831.6
533421	HEC GT 3 115.0	5 LEVELS AWAY	18565.1
533426	MANVILE3 115.0	5 LEVELS AWAY	10101.5
533427	REFINRY3 115.0	5 LEVELS AWAY	11566.4
533428	MCPHER 3 115.0	5 LEVELS AWAY	11773.4
533439	WHEATLD3 115.0	5 LEVELS AWAY	7106.7
533444	DAVIS 1 34.50	5 LEVELS AWAY	3264.9
533506	DAVIS 2 69.00	5 LEVELS AWAY	7331.8
539634	MRWYP26 230.0	5 LEVELS AWAY	5591.6
539635	MRWYP1T1 13.80	5 LEVELS AWAY	27640.2
539636	MRWYG11 34.50	5 LEVELS AWAY	11551.3
539657	CONCORD3 115.0	5 LEVELS AWAY	7257.3
539679	GRTBEND6 230.0	5 LEVELS AWAY	8194.9
539801	THISTLE7 345.0	5 LEVELS AWAY	16177.2
539904	CONCOD-T 13.80	5 LEVELS AWAY	27527.1
583850	GEN-2014-001345.0	5 LEVELS AWAY	7586.3
585071	G15-069-XF-134.50	5 LEVELS AWAY	35733.9
587500	GEN-2016-073345.0	5 LEVELS AWAY	15618.5
587883	G16-111-GEN10.690	5 LEVELS AWAY	1292873
587893	G16-112-GEN10.690	5 LEVELS AWAY	943641.6
587903	G16-113-GEN10.690	5 LEVELS AWAY	820207.5
587913	G16-114-GEN10.690	5 LEVELS AWAY	1353246.4
588320	GEN-2016-162345.0	5 LEVELS AWAY	9931.4
588364	G16-153-TAP 345.0	5 LEVELS AWAY	7772.3

3.1.3. Short Circuit Result for Post Rock 230kV Substation (530584)

The results of the short circuit analysis for POI i.e., Post Rock 230kV Substation (530584) and five bus levels away are tabulated below in Table 4.1.3.

Table 4.1.3: Short circuit results for Post Rock 230kV Substation (530584)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
530584	POSTROCK6 230.0	0 LEVELS AWAY	10897.6
530558	KNOLL 6 230.0	1 LEVELS AWAY	10725.1
530582	S HAYS6 230.0	1 LEVELS AWAY	8573.4
530583	POSTROCK7 345.0	1 LEVELS AWAY	7929.9
530673	POSTROCK1 13.80	1 LEVELS AWAY	25495.9
530702	BUCKEYE_230 230.0	1 LEVELS AWAY	7862.4
530553	S HAYS 3 115.0	2 LEVELS AWAY	8761.9
530561	KNOLL 3 115.0	2 LEVELS AWAY	11562.6
530592	SMOKYHL6 230.0	2 LEVELS AWAY	6959.5
530610	SHAYS_230 230.0	2 LEVELS AWAY	3385
530629	KNLL1 1 11.49	2 LEVELS AWAY	36034.4
530632	SHYS1 1 12.47	2 LEVELS AWAY	17047.8
530703	BUCKEYE_E1 34.50	2 LEVELS AWAY	11704.1
530706	BUCKEYE_W1 34.50	2 LEVELS AWAY	11645.9
530709	BUCKE_TERT 13.80	2 LEVELS AWAY	20117.3
530710	BUCKW_TERT 13.80	2 LEVELS AWAY	20112.2
539679	GRTBEND6 230.0	2 LEVELS AWAY	8194.9
560082	G16-050-TAP 345.0	2 LEVELS AWAY	6963.9
562334	G13-010-TAP 345.0	2 LEVEL AWAY	7624.8
530551	SALINE 3 115.0	3 LEVELS AWAY	4987.7
530552	GORHAM 3 115.0	3 LEVELS AWAY	3125.6
530581	N HAYS3 115.0	3 LEVELS AWAY	10090.9
530593	SMKYP1 6 230.0	3 LEVELS AWAY	6043.8
530599	SMKYP2 6 230.0	3 LEVEL AWAY	6457.2
530605	REDLIN 3 115.0	3 LEVELS AWAY	3778.8

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
530611	SHAYS_13.8 13.80	3 LEVELS AWAY	29360.3
530612	SHAYS_COLLR234.50	3 LEVELS AWAY	15179.8
530676	GMEC 3 115.0	3 LEVELS AWAY	11031.5
530677	OGALATP3 115.0	3 LEVELS AWAY	2607.3
530680	HEIZER 6 230.0	3 LEVELS AWAY	8148.4
530695	CHETOLAH3 115.0	3 LEVELS AWAY	8845.4
530704	BUCKEYE_E2 34.50	3 LEVELS AWAY	11203.4
530707	BUCKEYE_W2 34.50	3 LEVELS AWAY	10767.9
531469	SPERVIL7 345.0	3 LEVELS AWAY	13904.8
532871	CIRCLE 6 230.0	3 LEVELS AWAY	8994.1
532873	SUMMIT 6 230.0	3 LEVELS AWAY	13744.5
539678	GRTBEND3 115.0	3 LEVELS AWAY	12656.4
539695	SPEARVL6 230.0	3 LEVELS AWAY	12658.1
539920	GRTBNDTT 13.80	3 LEVELS AWAY	33256.3
583600	GEN-2013-010345.0	3 LEVELS AWAY	7624.8
587350	GEN-2016-050345.0	3 LEVELS AWAY	6260.8
588450	GEN-2016-16034.50	3 LEVELS AWAY	11570
640065	AXTELL 3 345.0	3 LEVELS AWAY	9347.5
530557	BEACH 3 115.0	4 LEVELS AWAY	3648.7
530560	WKNNY 3 115.0	4 LEVELS AWAY	2191.4
530590	BEMIS 3 115.0	4 LEVELS AWAY	3967.8
530595	SHP134 1 34.50	4 LEVELS AWAY	17944.2
530601	HEIZER 3 115.0	4 LEVELS AWAY	12483.5
530604	SHP234 1 34.50	4 LEVELS AWAY	23604.4
530613	SHAYS_COLLR134.50	4 LEVELS AWAY	14750
530626	HZRT1 1 12.50	4 LEVELS AWAY	17118.8
530633	SMKYT1 1 13.20	4 LEVELS AWAY	39051.8
530634	SMKYT2 1 13.86	4 LEVELS AWAY	48184.6
530674	GMECG1 1 13.80	4 LEVELS AWAY	28190.4

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
530675	GMECG2 1 13.80	4 LEVELS AWAY	32586.9
530684	RUSLPMP3 115.0	4 LEVELS AWAY	2031.3
530686	RICE 6 230.0	4 LEVELS AWAY	4713.8
530693	VINETAP3 115.0	4 LEVELS AWAY	8899.9
530694	VINE2 3 115.0	4 LEVELS AWAY	8379.6
530705	BUCKE_WTG 0.690	4 LEVELS AWAY	450324.8
530708	BUCKW_WTG 0.690	4 LEVELS AWAY	437531.6
531468	SPERTER1 13.80	4 LEVELS AWAY	12829.5
531492	OG ONEOK 115.0	4 LEVELS AWAY	2112.5
531501	BUCKNER7 345.0	4 LEVELS AWAY	9806
532773	SUMMIT 7 345.0	4 LEVELS AWAY	11426.7
532813	SUMMIT 1 14.40	4 LEVELS AWAY	30657.3
532872	EMCPHER6 230.0	4 LEVELS AWAY	8364
532874	UNIONRG6 230.0	4 LEVELS AWAY	8896.3
532892	CIRCLE 1 13.80	4 LEVELS AWAY	49379.4
532896	SUMIT2 1 13.80	4 LEVELS AWAY	47639.6
532897	SUMIT3 1 13.80	4 LEVELS AWAY	48715.2
533381	SUMMIT 3 115.0	4 LEVELS AWAY	17545.4
533413	CIRCLE 3 115.0	4 LEVELS AWAY	19117.1
539642	ELLSWTP3 115.0	4 LEVELS AWAY	3949.8
539666	GBENDTP3 115.0	4 LEVELS AWAY	7598.5
539677	GRTBEND1 13.80	4 LEVELS AWAY	57303.3
539681	N-GBEND3 115.0	4 LEVELS AWAY	8234.9
539684	OTISSUB3 115.0	4 LEVELS AWAY	2943.7
539686	PLAINVL3 115.0	4 LEVELS AWAY	3689.1
539694	SPEARVL3 115.0	4 LEVELS AWAY	10440.5
539719	GRTBEND1 34.50	4 LEVELS AWAY	4005.7
539743	SPWIND-T1 13.80	4 LEVELS AWAY	35836.2
539744	SPWIND-T2 13.80	4 LEVELS AWAY	30692.2

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
539752	GPEWIND1 34.50	4 LEVELS AWAY	23307.9
539759	SPRVL 3 115.0	4 LEVELS AWAY	11622.3
539803	IRONWOOD7 345.0	4 LEVELS AWAY	13296.4
539921	GRTBENDT 7.200	4 LEVELS AWAY	8601.5
539935	SPERVLTT 13.80	4 LEVELS AWAY	31514.3
539960	SPRVL-T 13.80	4 LEVELS AWAY	27357.8
560002	IRONWOOD2 7345.0	4 LEVELS AWAY	13461.9
583601	G13-010XFMR134.50	4 LEVELS AWAY	13212.4
587351	G16-050XFMR134.50	4 LEVELS AWAY	24138.2
588451	G16-160-GEN10.480	4 LEVELS AWAY	313325.3
599161	SPRVILL-EHVB230.0	4 LEVELS AWAY	12307.9
640066	AXTELL 7 115.0	4 LEVELS AWAY	14055.7
640067	AXTELL 9 13.80	4 LEVELS AWAY	22822
640312	PAULINE3 345.0	4 LEVELS AWAY	7998.1
640374	SWEET W3 345.0	4 LEVELS AWAY	10733.2
530556	HOXIE 3 115.0	5 LEVELS AWAY	3511.7
530563	HEIZER 2 69.00	5 LEVELS AWAY	8784
530591	VINE 3 115.0	5 LEVELS AWAY	8797.8
530594	SMKYP1G1 0.690	5 LEVELS AWAY	957898.1
530600	SMKYP2G1 0.690	5 LEVELS AWAY	1198809.4
530602	LAXTAP 3 115.0	5 LEVELS AWAY	4067.2
530609	HZRNGPL3 115.0	5 LEVELS AWAY	7901.1
530614	SHAYS_GEN 0.690	5 LEVELS AWAY	674499.2
530623	RICE 3 115.0	5 LEVELS AWAY	6837.3
530627	HZRT2 1 12.50	5 LEVELS AWAY	11961.2
530628	HZRT3 1 12.50	5 LEVELS AWAY	9549.7
530687	RICET1 12.47	5 LEVELS AWAY	16800.2
530688	BUFLOCRK6 230.0	5 LEVELS AWAY	3574.1
531386	GRHMSUB3 115.0	5 LEVELS AWAY	3382.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
531387	HILLCTY3 34.50	5 LEVELS AWAY	4170.2
531449	HOLCOMB7 345.0	5 LEVELS AWAY	10470.7
531502	CIMRRN 7 345.0	5 LEVELS AWAY	7647.6
531504	CIMWD2 7 345.5	5 LEVELS AWAY	7766.6
532767	GEARY 7 345.0	5 LEVELS AWAY	9934.4
532817	UNIONRG1 13.20	5 LEVELS AWAY	18698.9
532863	MORRIS 6 230.0	5 LEVELS AWAY	13851
532894	EMCPHER1 13.80	5 LEVELS AWAY	52449.5
533359	UNIONRG3 115.0	5 LEVELS AWAY	3796.4
533368	EXIDE J3 115.0	5 LEVELS AWAY	12403.2
533371	NORTHVW3 115.0	5 LEVELS AWAY	11644.4
533379	SO GATE3 115.0	5 LEVELS AWAY	10682.6
533412	ARKVALJ3 115.0	5 LEVELS AWAY	9874.1
533416	RENO 3 115.0	5 LEVELS AWAY	23097
533417	EMCPHER3 115.0	5 LEVELS AWAY	12664.3
533419	HEC 3 115.0	5 LEVELS AWAY	17831.6
533421	HEC GT 3 115.0	5 LEVELS AWAY	18565.1
539643	ROLLHLS3 115.0	5 LEVELS AWAY	3620.4
539661	24-FREY3 115.0	5 LEVELS AWAY	5569.5
539685	PHLBURG3 115.0	5 LEVELS AWAY	3441.7
539692	SEWARD 3 115.0	5 LEVELS AWAY	5580.5
539701	RUSSELL3 115.0	5 LEVELS AWAY	3454.5
539721	N-GBEND1 34.50	5 LEVELS AWAY	3039.8
539723	OTISSUB1 34.50	5 LEVELS AWAY	1624.3
539725	PLAINVL1 34.50	5 LEVELS AWAY	4201.8
539732	SPEARVL1 34.50	5 LEVELS AWAY	4151.9
539771	NFTDODG3 115.0	5 LEVELS AWAY	12477.9
539800	CLARKCOUNTY7345.0	5 LEVELS AWAY	13570.7
539805	ELMCREEK7 345.0	5 LEVELS AWAY	5207.8

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
539807	IRONWOOD 1 34.50	5 LEVELS AWAY	24572.6
539808	IRONWOOD T1 13.80	5 LEVELS AWAY	46280.7
539923	NGBEND-T 13.80	5 LEVELS AWAY	4671.2
539925	OTIS1-T 2.400	5 LEVELS AWAY	33422.9
539926	OTIS2-T 2.400	5 LEVELS AWAY	12550.4
539928	PLAINV-T 13.80	5 LEVELS AWAY	10504.6
539936	SPERVLDT 13.80	5 LEVELS AWAY	1774.2
560080	G16-046-TAP 345.0	5 LEVELS AWAY	11610
579480	GEN-2008-124345.0	5 LEVELS AWAY	12834.5
580049	GEN-2010-045345.0	5 LEVELS AWAY	6929.7
582016	GEN-2011-016345.0	5 LEVELS AWAY	7457.7
583602	G13-010-GSU134.50	5 LEVELS AWAY	12643.7
585070	GEN-2015-069230.0	5 LEVELS AWAY	6628.1
587352	G16-050-GSU134.50	5 LEVELS AWAY	22875.9
587680	GEN-2016-074345.0	5 LEVELS AWAY	6395.2
587784	G16-096-TAP 345.0	5 LEVELS AWAY	9186.4
587894	G16-112-TAP 345.0	5 LEVELS AWAY	10839.6
599019	GPW-CB2 34.50	5 LEVELS AWAY	20271
599162	SPRVILLXFMR134.50	5 LEVELS AWAY	24365.6
640183	GENTLMN3 345.0	5 LEVELS AWAY	15975.3
640224	HOLDREG7 115.0	5 LEVELS AWAY	6010.5
640250	KEARNEY7 115.0	5 LEVELS AWAY	11533.8
640275	MINDEN 7 115.0	5 LEVELS AWAY	7069.9
640313	PAULINE7 115.0	5 LEVELS AWAY	16092.8
640315	PAULINE9 13.80	5 LEVELS AWAY	15825.6
653571	GR ISLD3 345.0	5 LEVELS AWAY	11869.7

3.2. Short Circuit Result for 2026 Summer Peak Case

The short circuit results for summer-2026 scenario (assumed not outage) at the POI are tabulated below.

3.2.1. Short Circuit Result for Tap Summit – Reno 345kV Line (587884)

The results of the short circuit analysis for POI i.e., Tap Summit – Reno 345kV Line (587884) and five bus levels away are tabulated below in Table 4.2.1.

Table 4.2.1: Short circuit results for Tap Summit – Reno 345kV Line (587884)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
587884	G16-111-TAP 345.0	0 LEVELS AWAY	11296.8
532771	RENO 7 345.0	1 LEVELS AWAY	12540.1
587880	GEN-2016-111345.0	1 LEVELS AWAY	7095
587894	G16-112-TAP 345.0	1 LEVELS AWAY	11085.3
587910	GEN-2016-114345.0	1 LEVELS AWAY	10083.9
532773	SUMMIT 7 345.0	2 LEVELS AWAY	11675.6
532796	WICHITA7 345.0	2 LEVELS AWAY	26122.3
532807	RENO 1X1 14.40	2 LEVELS AWAY	42116.3
532810	RENO 2X1 14.40	2 LEVELS AWAY	43260.2
533416	RENO 3 115.0	2 LEVELS AWAY	25418.5
587881	G16-111XFMR134.50	2 LEVELS AWAY	30481.3
587911	G16-114XFMR134.50	2 LEVELS AWAY	35790.6
587980	GEN-2016-122345.0	2 LEVELS AWAY	5436.4
532767	GEARY 7 345.0	3 LEVELS AWAY	10013.3
532782	BUFFALO7 345.0	3 LEVELS AWAY	21662.7
532791	BENTON 7 345.0	3 LEVELS AWAY	20517.4
532798	VIOLA 7 345.0	3 LEVELS AWAY	14283.2
532813	SUMMIT 1 14.40	3 LEVELS AWAY	30805.4
532829	WICH11 1 13.80	3 LEVELS AWAY	50216.5
532830	WICH12 1 13.80	3 LEVELS AWAY	50414
532873	SUMMIT 6 230.0	3 LEVELS AWAY	14195.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533040	EVANS N4 138.0	3 LEVELS AWAY	40993.4
533413	CIRCLE 3 115.0	3 LEVELS AWAY	21989.8
533415	DAVIS 3 115.0	3 LEVELS AWAY	8693.6
533429	MOUNDRG3 115.0	3 LEVELS AWAY	7205.7
533438	WMCPHER3 115.0	3 LEVELS AWAY	14687.4
539805	ELMCREEK7 345.0	3 LEVELS AWAY	5240.5
562476	G14-001-TAP 345.0	3 LEVELS AWAY	11164.2
587882	G16-111-GSU134.50	3 LEVELS AWAY	29917
587890	GEN-2016-112345.0	3 LEVELS AWAY	4846.8
587900	GEN-2016-113345.0	3 LEVELS AWAY	4907.5
587912	G16-114-GSU134.50	3 LEVELS AWAY	33690
587981	G16-122XFMR134.50	3 LEVELS AWAY	23924.7
515543	RENFROW7 345.0	4 LEVELS AWAY	13025.7
530592	SMOKYHL6 230.0	4 LEVELS AWAY	6999.4
532721	EEC U1 16.00	4 LEVELS AWAY	77925.6
532722	EEC U2 24.00	4 LEVELS AWAY	99064.1
532729	EVAN SVC 8.000	4 LEVELS AWAY	140035.8
532766	JEC N 7 345.0	4 LEVELS AWAY	23688.7
532768	EMPEC 7 345.0	4 LEVELS AWAY	17361.3
532783	KINGMAN7 345.0	4 LEVELS AWAY	6868.1
532794	ROSEHIL7 345.0	4 LEVELS AWAY	19563.5
532797	WOLFCRK7 345.0	4 LEVELS AWAY	15931.2
532821	BENTN1 1 13.80	4 LEVELS AWAY	23754.5
532822	BENTN2 1 13.80	4 LEVELS AWAY	45329.8
532832	VIOLA1X1 13.80	4 LEVELS AWAY	35897
532834	GEARY1X1 13.80	4 LEVELS AWAY	68050.3
532871	CIRCLE 6 230.0	4 LEVELS AWAY	9702.4
532872	EMCPHER6 230.0	4 LEVELS AWAY	9065
532874	UNIONRG6 230.0	4 LEVELS AWAY	8961.7

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532892	CIRCLE 1 13.80	4 LEVELS AWAY	51798
532896	SUMIT2 1 13.80	4 LEVELS AWAY	48059.4
532897	SUMIT3 1 13.80	4 LEVELS AWAY	49138.2
532986	BENTON 4 138.0	4 LEVELS AWAY	29104.5
533013	MOUND 4 138.0	4 LEVELS AWAY	4889.3
533041	EVANS S4 138.0	4 LEVELS AWAY	40993.4
533065	SG12COL4 138.0	4 LEVELS AWAY	21244.7
533075	VIOLA 4 138.0	4 LEVELS AWAY	20540.2
533097	MOUN 2X1 7.200	4 LEVELS AWAY	5756.1
533336	GEARY 3 115.0	4 LEVELS AWAY	17217.2
533380	SPRGCRK3 115.0	4 LEVELS AWAY	3623.2
533381	SUMMIT 3 115.0	4 LEVELS AWAY	18001.4
533390	MAIZEW 4 138.0	4 LEVELS AWAY	27650.3
533394	CORONAD3 115.0	4 LEVELS AWAY	7527.3
533412	ARKVALJ3 115.0	4 LEVELS AWAY	10515.7
533414	CITIES 3 115.0	4 LEVELS AWAY	8752.9
533419	HEC 3 115.0	4 LEVELS AWAY	20501.1
533421	HEC GT 3 115.0	4 LEVELS AWAY	21333.9
533426	MANVILE3 115.0	4 LEVELS AWAY	11247.2
533428	MCPHER 3 115.0	4 LEVELS AWAY	14502.6
533439	WHEATLD3 115.0	4 LEVELS AWAY	7711.9
533444	DAVIS 1 34.50	4 LEVELS AWAY	3283.4
533506	DAVIS 2 69.00	4 LEVELS AWAY	7519
539639	ELMCREK6 230.0	4 LEVELS AWAY	7285.1
539801	THISTLE7 345.0	4 LEVELS AWAY	16234.8
539806	ELMCREEK1 13.80	4 LEVELS AWAY	65294.7
583850	GEN-2014-001345.0	4 LEVELS AWAY	7598
587500	GEN-2016-073345.0	4 LEVELS AWAY	15697.5
587883	G16-111-GEN10.690	4 LEVELS AWAY	1297649.5

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
587891	G16-112XFMR134.50	4 LEVELS AWAY	22906.6
587901	G16-113XFMR134.50	4 LEVELS AWAY	21862.3
587913	G16-114-GEN10.690	4 LEVELS AWAY	1358426.1
587982	G16-122-GSU134.50	4 LEVELS AWAY	22623.5
588320	GEN-2016-162345.0	4 LEVELS AWAY	9943
588364	G16-153-TAP 345.0	4 LEVELS AWAY	7828
515375	WWRDEHV7 345.0	5 LEVELS AWAY	18931.2
515544	RENFROW4 138.0	5 LEVELS AWAY	14142.4
515545	RENFRO11 13.80	5 LEVELS AWAY	24379.8
515646	GRNTWD 7 345.0	5 LEVELS AWAY	11369.3
530558	KNOLL 6 230.0	5 LEVELS AWAY	10761
530593	SMKYP1 6 230.0	5 LEVELS AWAY	6072.6
530599	SMKYP2 6 230.0	5 LEVELS AWAY	6490.5
530618	HUNTSVL3 115.0	5 LEVELS AWAY	4061.8
530620	LYONS 3 115.0	5 LEVELS AWAY	5560
530686	RICE 6 230.0	5 LEVELS AWAY	4855.7
532652	JEC U2 26.00	5 LEVELS AWAY	189504.2
532653	JEC U3 26.00	5 LEVELS AWAY	188796.8
532696	HEC GT2 13.80	5 LEVELS AWAY	52432.2
532697	HEC GT3 13.80	5 LEVELS AWAY	18546.9
532698	HEC GT4 13.80	5 LEVELS AWAY	25429.2
532702	MCPHGT1 13.80	5 LEVELS AWAY	39614.6
532703	MCPHGT2 13.80	5 LEVELS AWAY	17458.7
532704	MCPHGT3 13.80	5 LEVELS AWAY	39614.6
532705	MCPHGT4 13.80	5 LEVELS AWAY	50067.4
532723	EEC GT1 13.80	5 LEVELS AWAY	50257.2
532724	EEC GT2 13.80	5 LEVELS AWAY	50293.4
532725	EEC GT3 18.00	5 LEVELS AWAY	67630.7
532740	EMPEC121 13.80	5 LEVELS AWAY	60925.9

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532741	EMPEC341 13.80	5 LEVELS AWAY	60925.9
532742	EMPEC5 1 18.00	5 LEVELS AWAY	85456.9
532743	EMPEC6 1 18.00	5 LEVELS AWAY	85456.9
532744	EMPEC7 1 18.00	5 LEVELS AWAY	85456.9
532751	WCGS U1 25.00	5 LEVELS AWAY	207446.6
532765	HOYT 7 345.0	5 LEVELS AWAY	15758.3
532769	LANG 7 345.0	5 LEVELS AWAY	17148.7
532770	MORRIS 7 345.0	5 LEVELS AWAY	12819.7
532774	SWISVAL7 345.0	5 LEVELS AWAY	16414.5
532784	NINN1WF7 345.0	5 LEVELS AWAY	5693.8
532792	FR2EAST7 345.0	5 LEVELS AWAY	7114.1
532799	WAVERLY7 345.0	5 LEVELS AWAY	14611.1
532800	LATHAMS7 345.0	5 LEVELS AWAY	10567.9
532805	JEC 13 1 14.40	5 LEVELS AWAY	33406.3
532806	JEC 26 1 14.40	5 LEVELS AWAY	33617.2
532817	UNIONRG1 13.20	5 LEVELS AWAY	18715.4
532826	ROSEH1 1 13.80	5 LEVELS AWAY	39360.6
532827	ROSEH5 1 13.80	5 LEVELS AWAY	39120.4
532831	ROSEH3 1 13.80	5 LEVELS AWAY	39296.5
532852	JEC 6 230.0	5 LEVELS AWAY	24693.2
532863	MORRIS 6 230.0	5 LEVELS AWAY	13900.7
532865	NMANHT6 230.0	5 LEVELS AWAY	8810.2
532894	EMCPHER1 13.80	5 LEVELS AWAY	53856.9
532962	WOLFCRK1 17.00	5 LEVELS AWAY	8826.9
532984	SUMNER 4 138.0	5 LEVELS AWAY	10650.6
532988	BELAIRE4 138.0	5 LEVELS AWAY	19182
532990	MIDIAN 4 138.0	5 LEVELS AWAY	10178.1
533011	HALSTD 4 138.0	5 LEVELS AWAY	4272.5
533015	BENTLEY4 138.0	5 LEVELS AWAY	10075.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533024	29TH 4 138.0	5 LEVELS AWAY	19988.9
533035	CHISHLM4 138.0	5 LEVELS AWAY	22696.6
533036	CLEARWT4 138.0	5 LEVELS AWAY	14679.1
533047	GILL 4 138.0	5 LEVELS AWAY	26181.4
533053	LAKERDG4 138.0	5 LEVELS AWAY	19016
533054	MAIZE 4 138.0	5 LEVELS AWAY	23359
533062	ROSEHIL4 138.0	5 LEVELS AWAY	32253.3
533074	45TH ST4 138.0	5 LEVELS AWAY	27849.3
533095	MOUND1X1 13.20	5 LEVELS AWAY	8421.9
533328	FT JCT 3 115.0	5 LEVELS AWAY	14589.9
533335	MCDOWEL3 115.0	5 LEVELS AWAY	17741.4
533359	UNIONRG3 115.0	5 LEVELS AWAY	3802.3
533362	CHAPMAN3 115.0	5 LEVELS AWAY	10432.2
533366	FLORENC3 115.0	5 LEVELS AWAY	3233.6
533368	EXIDE J3 115.0	5 LEVELS AWAY	12707.6
533369	HILSBOR3 115.0	5 LEVELS AWAY	2461.5
533371	NORTHVW3 115.0	5 LEVELS AWAY	11837.5
533372	PHILIPS3 115.0	5 LEVELS AWAY	12754.2
533379	SO GATE3 115.0	5 LEVELS AWAY	10894.1
533411	ARKVAL 3 115.0	5 LEVELS AWAY	10298.9
533417	EMCPHER3 115.0	5 LEVELS AWAY	14463.5
533427	REFINRY3 115.0	5 LEVELS AWAY	13724.6
533434	SALTCRK3 115.0	5 LEVELS AWAY	9284.2
533440	43LORAN 115.0	5 LEVELS AWAY	13882.2
533445	HEC 1 34.50	5 LEVELS AWAY	2487.9
533453	CITIES 1 3.906	5 LEVELS AWAY	22502.1
533505	NCTYSVC2 69.00	5 LEVELS AWAY	4000.3
533513	HEC 2 69.00	5 LEVELS AWAY	11054.6
533516	MAPLE J2 69.00	5 LEVELS AWAY	7236.5

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533529	MWIRNJ22 69.00	5 LEVELS AWAY	6566.2
533653	WOLFCRK2 69.00	5 LEVELS AWAY	5808
533742	MOUND 2 69.00	5 LEVELS AWAY	5911.6
534001	K1 LV 1 34.50	5 LEVELS AWAY	14433
534002	K2 LV 1 34.50	5 LEVELS AWAY	14313.3
534031	K1 WFTX1 13.80	5 LEVELS AWAY	25519.7
534032	K2 WFTX1 13.80	5 LEVELS AWAY	25436.8
539008	MILAN_GOAB 138.0	5 LEVELS AWAY	10928
539009	CONWAY 138.0	5 LEVELS AWAY	11745
539637	MRWYP16 230.0	5 LEVELS AWAY	6647.5
539658	CONCRD6 230.0	5 LEVELS AWAY	5381.7
539679	GRTBEND6 230.0	5 LEVELS AWAY	8275.3
539802	THISTLE T1 13.80	5 LEVELS AWAY	7819
539804	THISTLE4 138.0	5 LEVELS AWAY	17408.7
560053	G15-052T 345.0	5 LEVELS AWAY	13083.6
560072	G16-005-TAP 345.0	5 LEVELS AWAY	12831.9
560086	G16-072-TAP 345.0	5 LEVELS AWAY	13129.3
583851	G14-001XFMR134.50	5 LEVELS AWAY	17330.1
583854	G14-001XFMR234.50	5 LEVELS AWAY	16928.8
585070	GEN-2015-069230.0	5 LEVELS AWAY	6656.2
585100	GEN-2015-073345.0	5 LEVELS AWAY	14211
587501	G16-073XFMR134.50	5 LEVELS AWAY	29082.3
587892	G16-112-GSU134.50	5 LEVELS AWAY	21788.5
587902	G16-113-GSU134.50	5 LEVELS AWAY	20371.3
587983	G16-122-GEN10.690	5 LEVELS AWAY	978260.6
588321	G16-162XFMR134.50	5 LEVELS AWAY	29521.5
588330	GEN-2016-163345.0	5 LEVELS AWAY	8766.1
588360	GEN-2016-153345.0	5 LEVELS AWAY	7476.3

3.2.2. Short Circuit Result for Tap Reno-Summit 345kV (587894)

The results of the short circuit analysis for POI i.e., Tap Reno-Summit 345kV (587894) and five bus levels away are tabulated below in Table 4.2.2.

Table 4.2.2: Short circuit results for Tap Reno-Summit 345kV (587894)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
587894	G16-112-TAP 345.0	0 LEVELS AWAY	11085.3
532773	SUMMIT 7 345.0	1 LEVELS AWAY	11675.6
587884	G16-111-TAP 345.0	1 LEVELS AWAY	11296.8
587980	GEN-2016-122345.0	1 LEVELS AWAY	5436.4
532767	GEARY 7 345.0	2 LEVELS AWAY	10013.3
532771	RENO 7 345.0	2 LEVELS AWAY	12540.1
532813	SUMMIT 1 14.40	2 LEVELS AWAY	30805.4
532873	SUMMIT 6 230.0	2 LEVELS AWAY	14195.4
539805	ELMCREEK7 345.0	2 LEVELS AWAY	5240.5
587880	GEN-2016-111345.0	2 LEVELS AWAY	7095
587890	GEN-2016-112345.0	2 LEVELS AWAY	4846.8
587900	GEN-2016-113345.0	2 LEVELS AWAY	4907.5
587910	GEN-2016-114345.0	2 LEVELS AWAY	10083.9
587981	G16-122XFMR134.50	2 LEVELS AWAY	23924.7
530592	SMOKYHL6 230.0	3 LEVELS AWAY	6999.4
532766	JEC N 7 345.0	3 LEVELS AWAY	23688.7
532796	WICHITA7 345.0	3 LEVELS AWAY	26122.3
532807	RENO 1X1 14.40	3 LEVELS AWAY	42116.3
532810	RENO 2X1 14.40	3 LEVELS AWAY	43260.2
532834	GEARY1X1 13.80	3 LEVELS AWAY	68050.3
532872	EMCPHER6 230.0	3 LEVELS AWAY	9065
532874	UNIONRG6 230.0	3 LEVELS AWAY	8961.7
532896	SUMIT2 1 13.80	3 LEVELS AWAY	48059.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532897	SUMIT3 1 13.80	3 LEVELS AWAY	49138.2
533336	GEARY 3 115.0	3 LEVELS AWAY	17217.2
533381	SUMMIT 3 115.0	3 LEVELS AWAY	18001.4
533416	RENO 3 115.0	3 LEVELS AWAY	25418.5
539639	ELMCREK6 230.0	3 LEVELS AWAY	7285.1
539806	ELMCREEK1 13.80	3 LEVELS AWAY	65294.7
587881	G16-111XFMR134.50	3 LEVELS AWAY	30481.3
587891	G16-112XFMR134.50	3 LEVELS AWAY	22906.6
587901	G16-113XFMR134.50	3 LEVELS AWAY	21862.3
587911	G16-114XFMR134.50	3 LEVELS AWAY	35790.6
587982	G16-122-GSU134.50	3 LEVELS AWAY	22623.5
530558	KNOLL 6 230.0	4 LEVELS AWAY	10761
530593	SMKYP1 6 230.0	4 LEVELS AWAY	6072.6
530599	SMKYP2 6 230.0	4 LEVELS AWAY	6490.5
532652	JEC U2 26.00	4 LEVELS AWAY	189504.2
532653	JEC U3 26.00	4 LEVELS AWAY	188796.8
532765	HOYT 7 345.0	4 LEVELS AWAY	15758.3
532770	MORRIS 7 345.0	4 LEVELS AWAY	12819.7
532782	BUFFALO7 345.0	4 LEVELS AWAY	21662.7
532791	BENTON 7 345.0	4 LEVELS AWAY	20517.4
532798	VIOLA 7 345.0	4 LEVELS AWAY	14283.2
532805	JEC 13 1 14.40	4 LEVELS AWAY	33406.3
532806	JEC 26 1 14.40	4 LEVELS AWAY	33617.2
532817	UNIONRG1 13.20	4 LEVELS AWAY	18715.4
532829	WICH11 1 13.80	4 LEVELS AWAY	50216.5
532830	WICH12 1 13.80	4 LEVELS AWAY	50414
532852	JEC 6 230.0	4 LEVELS AWAY	24693.2
532863	MORRIS 6 230.0	4 LEVELS AWAY	13900.7
532865	NMANHT6 230.0	4 LEVELS AWAY	8810.2

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532871	CIRCLE 6 230.0	4 LEVELS AWAY	9702.4
532894	EMCPHER1 13.80	4 LEVELS AWAY	53856.9
533040	EVANS N4 138.0	4 LEVELS AWAY	40993.4
533328	FT JCT 3 115.0	4 LEVELS AWAY	14589.9
533335	MCDOWEL3 115.0	4 LEVELS AWAY	17741.4
533359	UNIONRG3 115.0	4 LEVELS AWAY	3802.3
533362	CHAPMAN3 115.0	4 LEVELS AWAY	10432.2
533368	EXIDE J3 115.0	4 LEVELS AWAY	12707.6
533371	NORTHVW3 115.0	4 LEVELS AWAY	11837.5
533379	SO GATE3 115.0	4 LEVELS AWAY	10894.1
533413	CIRCLE 3 115.0	4 LEVELS AWAY	21989.8
533415	DAVIS 3 115.0	4 LEVELS AWAY	8693.6
533417	EMCPHER3 115.0	4 LEVELS AWAY	14463.5
533429	MOUNDRG3 115.0	4 LEVELS AWAY	7205.7
533438	WMCPHER3 115.0	4 LEVELS AWAY	14687.4
539637	MRWYP16 230.0	4 LEVELS AWAY	6647.5
539658	CONCRD6 230.0	4 LEVELS AWAY	5381.7
562476	G14-001-TAP 345.0	4 LEVELS AWAY	11164.2
585070	GEN-2015-069230.0	4 LEVELS AWAY	6656.2
587882	G16-111-GSU134.50	4 LEVELS AWAY	29917
587892	G16-112-GSU134.50	4 LEVELS AWAY	21788.5
587902	G16-113-GSU134.50	4 LEVELS AWAY	20371.3
587912	G16-114-GSU134.50	4 LEVELS AWAY	33690
587983	G16-122-GEN10.690	4 LEVELS AWAY	978260.6
515543	RENFROW7 345.0	5 LEVELS AWAY	13025.7
530561	KNOLL 3 115.0	5 LEVELS AWAY	11581
530584	POSTROCK6 230.0	5 LEVELS AWAY	10934.3
530595	SHP134 1 34.50	5 LEVELS AWAY	17958.6
530604	SHP234 1 34.50	5 LEVELS AWAY	23632.1

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
530629	KNLL1 1 11.49	5 LEVELS AWAY	36052.8
530633	SMKYT1 1 13.20	5 LEVELS AWAY	39081.4
530634	SMKYT2 1 13.86	5 LEVELS AWAY	48236.4
530686	RICE 6 230.0	5 LEVELS AWAY	4855.7
532651	JEC U1 26.00	5 LEVELS AWAY	180405.3
532721	EEC U1 16.00	5 LEVELS AWAY	77925.6
532722	EEC U2 24.00	5 LEVELS AWAY	99064.1
532729	EVAN SVC 8.000	5 LEVELS AWAY	140035.8
532768	EMPEC 7 345.0	5 LEVELS AWAY	17361.3
532772	STRANGR7 345.0	5 LEVELS AWAY	26119.6
532783	KINGMAN7 345.0	5 LEVELS AWAY	6868.1
532794	ROSEHIL7 345.0	5 LEVELS AWAY	19563.5
532797	WOLFCRK7 345.0	5 LEVELS AWAY	15931.2
532804	HOYT 1 14.40	5 LEVELS AWAY	31484.9
532809	MORRIS1X1 14.40	5 LEVELS AWAY	31477.9
532821	BENTN1 1 13.80	5 LEVELS AWAY	23754.5
532822	BENTN2 1 13.80	5 LEVELS AWAY	45329.8
532832	VIOLA1X1 13.80	5 LEVELS AWAY	35897
532851	AUBURN 6 230.0	5 LEVELS AWAY	13280.2
532856	SWISVAL6 230.0	5 LEVELS AWAY	21398.3
532861	EMANHAT6 230.0	5 LEVELS AWAY	9611.5
532862	MCDOWEL6 230.0	5 LEVELS AWAY	6920.3
532890	MORRIS2X1 13.80	5 LEVELS AWAY	39061.5
532892	CIRCLE 1 13.80	5 LEVELS AWAY	51798
532898	MCDOWL 1 13.80	5 LEVELS AWAY	30126.4
532901	NMANHX1 14.40	5 LEVELS AWAY	45013.3
532986	BENTON 4 138.0	5 LEVELS AWAY	29104.5
533013	MOUND 4 138.0	5 LEVELS AWAY	4889.3
533041	EVANS S4 138.0	5 LEVELS AWAY	40993.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533065	SG12COL4 138.0	5 LEVELS AWAY	21244.7
533075	VIOLA 4 138.0	5 LEVELS AWAY	20540.2
533097	MOUN 2X1 7.200	5 LEVELS AWAY	5756.1
533163	HOYT 3 115.0	5 LEVELS AWAY	22836.8
533305	MORRIS 3 115.0	5 LEVELS AWAY	12452.9
533323	CLAYCTR3 115.0	5 LEVELS AWAY	2897
533326	EMANHAT3 115.0	5 LEVELS AWAY	13133.2
533330	JCTCTY 3 115.0	5 LEVELS AWAY	12456.2
533340	SMANHAT3 115.0	5 LEVELS AWAY	11933.8
533341	STAGGHL3 115.0	5 LEVELS AWAY	9363
533342	WJCCTY 3 115.0	5 LEVELS AWAY	13106
533344	WJCCTYW3 115.0	5 LEVELS AWAY	13016.7
533347	NMANHT3 115.0	5 LEVELS AWAY	12418.6
533360	TCHOPE 3 115.0	5 LEVELS AWAY	3378.6
533361	AEC 3 115.0	5 LEVELS AWAY	7471.7
533365	EABILEN3 115.0	5 LEVELS AWAY	7646
533367	EXIDE 3 115.0	5 LEVELS AWAY	10764
533370	NORTHST3 115.0	5 LEVELS AWAY	10600.8
533372	PHILIPS3 115.0	5 LEVELS AWAY	12754.2
533378	SMOKYHLLS3 115.0	5 LEVELS AWAY	11349.1
533380	SPRGCRK3 115.0	5 LEVELS AWAY	3623.2
533390	MAIZEW 4 138.0	5 LEVELS AWAY	27650.3
533394	CORONAD3 115.0	5 LEVELS AWAY	7527.3
533412	ARKVALJ3 115.0	5 LEVELS AWAY	10515.7
533414	CITIES 3 115.0	5 LEVELS AWAY	8752.9
533419	HEC 3 115.0	5 LEVELS AWAY	20501.1
533421	HEC GT 3 115.0	5 LEVELS AWAY	21333.9
533426	MANVILE3 115.0	5 LEVELS AWAY	11247.2
533427	REFINRY3 115.0	5 LEVELS AWAY	13724.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533428	MCPHER 3 115.0	5 LEVELS AWAY	14502.6
533439	WHEATLD3 115.0	5 LEVELS AWAY	7711.9
533444	DAVIS 1 34.50	5 LEVELS AWAY	3283.4
533506	DAVIS 2 69.00	5 LEVELS AWAY	7519
539634	MRWYP26 230.0	5 LEVELS AWAY	5611.3
539635	MRWYP1T1 13.80	5 LEVELS AWAY	27669.5
539636	MRWYG11 34.50	5 LEVELS AWAY	11560.8
539657	CONCORD3 115.0	5 LEVELS AWAY	7271.6
539679	GRTBEND6 230.0	5 LEVELS AWAY	8275.3
539801	THISTLE7 345.0	5 LEVELS AWAY	16234.8
539904	CONCOD-T 13.80	5 LEVELS AWAY	27551.7
583850	GEN-2014-001345.0	5 LEVELS AWAY	7598
585071	G15-069-XF-134.50	5 LEVELS AWAY	35797.8
587500	GEN-2016-073345.0	5 LEVELS AWAY	15697.5
587883	G16-111-GEN10.690	5 LEVELS AWAY	1297649.5
587893	G16-112-GEN10.690	5 LEVELS AWAY	945454.5
587903	G16-113-GEN10.690	5 LEVELS AWAY	821699.6
587913	G16-114-GEN10.690	5 LEVELS AWAY	1358426.1
588320	GEN-2016-162345.0	5 LEVELS AWAY	9943
588364	G16-153-TAP 345.0	5 LEVELS AWAY	7828

3.2.3. Short Circuit Result for Post Rock 230kV Substation (530584)

The results of the short circuit analysis for POI i.e., Post Rock 230kV Substation (530584) and five bus levels away are tabulated below in Table 4.2.3.

Table 4.2.3: Short circuit results for Post Rock 230kV Substation (530584)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
530584	POSTROCK6 230.0	0 LEVELS AWAY	10934.3
530558	KNOLL 6 230.0	1 LEVELS AWAY	10761
530582	S HAYS6 230.0	1 LEVELS AWAY	8603.4
530583	POSTROCK7 345.0	1 LEVELS AWAY	7951.6
530673	POSTROCK1 13.80	1 LEVELS AWAY	25508.7
530702	BUCKEYE_230 230.0	1 LEVELS AWAY	7880.9
530553	S HAYS 3 115.0	2 LEVELS AWAY	8774.7
530561	KNOLL 3 115.0	2 LEVELS AWAY	11581
530592	SMOKYHL6 230.0	2 LEVELS AWAY	6999.4
530610	SHAYS_230 230.0	2 LEVELS AWAY	3388.7
530629	KNLL1 1 11.49	2 LEVELS AWAY	36052.8
530632	SHYS1 1 12.47	2 LEVELS AWAY	17052.8
530703	BUCKEYE_E1 34.50	2 LEVELS AWAY	11708.9
530706	BUCKEYE_W1 34.50	2 LEVELS AWAY	11650.6
530709	BUCKE_TERT 13.80	2 LEVELS AWAY	20122.9
530710	BUCKW_TERT 13.80	2 LEVELS AWAY	20117.8
539679	GRTBEND6 230.0	2 LEVELS AWAY	8275.3
560082	G16-050-TAP 345.0	2 LEVELS AWAY	6984.6
562334	G13-010-TAP 345.0	2 LEVELS AWAY	7642.4
530551	SALINE 3 115.0	3 LEVELS AWAY	4991.5
530552	GORHAM 3 115.0	3 LEVELS AWAY	3127.2
530581	N HAYS3 115.0	3 LEVELS AWAY	10105.6
530593	SMKYP1 6 230.0	3 LEVELS AWAY	6072.6
530599	SMKYP2 6 230.0	3 LEVELS AWAY	6490.5
530605	REDLIN 3 115.0	3 LEVELS AWAY	3781.1
530611	SHAYS_13.8 13.80	3 LEVELS AWAY	29372.8
530612	SHAYS_COLLR234.50	3 LEVELS AWAY	15188.1
530676	GMEC 3 115.0	3 LEVELS AWAY	11047.8
530677	OGALATP3 115.0	3 LEVELS AWAY	2608.3

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
530680	HEIZER 6 230.0	3 LEVELS AWAY	8227.9
530695	CHETOLAH3 115.0	3 LEVELS AWAY	8857.6
530704	BUCKEYE_E2 34.50	3 LEVELS AWAY	11207.8
530707	BUCKEYE_W2 34.50	3 LEVELS AWAY	10771.8
531469	SPERVIL7 345.0	3 LEVELS AWAY	13953.7
532871	CIRCLE 6 230.0	3 LEVELS AWAY	9702.4
532873	SUMMIT 6 230.0	3 LEVELS AWAY	14195.4
539678	GRTBEND3 115.0	3 LEVELS AWAY	12742.5
539695	SPEARVL6 230.0	3 LEVELS AWAY	12689.5
539920	GRTBNDTT 13.80	3 LEVELS AWAY	33328.2
583600	GEN-2013-010345.0	3 LEVELS AWAY	7642.4
587350	GEN-2016-050345.0	3 LEVELS AWAY	6277.3
588450	GEN-2016-16034.50	3 LEVELS AWAY	11574.7
640065	AXTELL 3 345.0	3 LEVELS AWAY	9397.8
530557	BEACH 3 115.0	4 LEVELS AWAY	3651.5
530560	WKNNY 3 115.0	4 LEVELS AWAY	2192
530590	BEMIS 3 115.0	4 LEVELS AWAY	3970.1
530595	SHP134 1 34.50	4 LEVELS AWAY	17958.6
530601	HEIZER 3 115.0	4 LEVELS AWAY	12567.2
530604	SHP234 1 34.50	4 LEVELS AWAY	23632.1
530613	SHAYS_COLLR134.50	4 LEVELS AWAY	14757.5
530626	HZRT1 1 12.50	4 LEVELS AWAY	17140.1
530633	SMKYT1 1 13.20	4 LEVELS AWAY	39081.4
530634	SMKYT2 1 13.86	4 LEVELS AWAY	48236.4
530674	GMECG1 1 13.80	4 LEVELS AWAY	28194.4
530675	GMECG2 1 13.80	4 LEVELS AWAY	32591.5
530684	RUSLPMP3 115.0	4 LEVELS AWAY	2032
530686	RICE 6 230.0	4 LEVELS AWAY	4855.7
530693	VINETAP3 115.0	4 LEVELS AWAY	8912.2

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
530694	VINE2 3 115.0	4 LEVELS AWAY	8390.6
530705	BUCKE_WTG 0.690	4 LEVELS AWAY	450448.8
530708	BUCKW_WTG 0.690	4 LEVELS AWAY	437646.7
531468	SPERTER1 13.80	4 LEVELS AWAY	12831
531492	OG ONEOK 115.0	4 LEVELS AWAY	2113.1
531501	BUCKNER7 345.0	4 LEVELS AWAY	9859.3
532773	SUMMIT 7 345.0	4 LEVELS AWAY	11675.6
532813	SUMMIT 1 14.40	4 LEVELS AWAY	30805.4
532872	EMCPHER6 230.0	4 LEVELS AWAY	9065
532874	UNIONRG6 230.0	4 LEVELS AWAY	8961.7
532892	CIRCLE 1 13.80	4 LEVELS AWAY	51798
532896	SUMIT2 1 13.80	4 LEVELS AWAY	48059.4
532897	SUMIT3 1 13.80	4 LEVELS AWAY	49138.2
533381	SUMMIT 3 115.0	4 LEVELS AWAY	18001.4
533413	CIRCLE 3 115.0	4 LEVELS AWAY	21989.8
539642	ELLSWTP3 115.0	4 LEVELS AWAY	3966.7
539666	GBENDTP3 115.0	4 LEVELS AWAY	7631.7
539677	GRTBEND1 13.80	4 LEVELS AWAY	57367.1
539681	N-GBEND3 115.0	4 LEVELS AWAY	8271
539684	OTISSUB3 115.0	4 LEVELS AWAY	2948.2
539686	PLAINVL3 115.0	4 LEVELS AWAY	3691.4
539694	SPEARVL3 115.0	4 LEVELS AWAY	10449.4
539719	GRTBEND1 34.50	4 LEVELS AWAY	4008.3
539743	SPWIND-T1 13.80	4 LEVELS AWAY	35849.8
539744	SPWIND-T2 13.80	4 LEVELS AWAY	30702.2
539752	GPEWIND1 34.50	4 LEVELS AWAY	23320.7
539759	SPRVL 3 115.0	4 LEVELS AWAY	11632.3
539803	IRONWOOD7 345.0	4 LEVELS AWAY	13339.9
539921	GRTBENDT 7.200	4 LEVELS AWAY	8604

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
539935	SPERVLTT 13.80	4 LEVELS AWAY	31524.1
539960	SPRVL-T 13.80	4 LEVELS AWAY	27364.4
560002	IRONWOOD2 7345.0	4 LEVELS AWAY	13506.9
583601	G13-010XFMR134.50	4 LEVELS AWAY	13215.8
587351	G16-050XFMR134.50	4 LEVELS AWAY	24155.9
588451	G16-160-GEN10.480	4 LEVELS AWAY	313372.9
599161	SPRVILL-EHVB230.0	4 LEVELS AWAY	12337.6
640066	AXTELL 7 115.0	4 LEVELS AWAY	14110.1
640067	AXTELL 9 13.80	4 LEVELS AWAY	22839.9
640312	PAULINE3 345.0	4 LEVELS AWAY	8041.4
640374	SWEET W3 345.0	4 LEVELS AWAY	10825.2
530556	HOXIE 3 115.0	5 LEVELS AWAY	3515.8
530563	HEIZER 2 69.00	5 LEVELS AWAY	8808.6
530591	VINE 3 115.0	5 LEVELS AWAY	8809.8
530594	SMKYP1G1 0.690	5 LEVELS AWAY	958284.4
530600	SMKYP2G1 0.690	5 LEVELS AWAY	1199689
530602	LAXTAP 3 115.0	5 LEVELS AWAY	4073.8
530609	HZRNGPL3 115.0	5 LEVELS AWAY	7934.6
530614	SHAYS_GEN 0.690	5 LEVELS AWAY	674769.6
530623	RICE 3 115.0	5 LEVELS AWAY	7022.7
530627	HZRT2 1 12.50	5 LEVELS AWAY	11969.5
530628	HZRT3 1 12.50	5 LEVELS AWAY	9555
530687	RICET1 12.47	5 LEVELS AWAY	16920.9
530688	BUFLOCRK6 230.0	5 LEVELS AWAY	3626
531386	GRHMSUB3 115.0	5 LEVELS AWAY	3385
531387	HILLCTY3 34.50	5 LEVELS AWAY	4171.3
531449	HOLCOMB7 345.0	5 LEVELS AWAY	10604.9
531502	CIMRRN 7 345.0	5 LEVELS AWAY	7680
531504	CIMWD2 7 345.5	5 LEVELS AWAY	7799.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532767	GEARY 7 345.0	5 LEVELS AWAY	10013.3
532817	UNIONRG1 13.20	5 LEVELS AWAY	18715.4
532863	MORRIS 6 230.0	5 LEVELS AWAY	13900.7
532894	EMCPHER1 13.80	5 LEVELS AWAY	53856.9
533359	UNIONRG3 115.0	5 LEVELS AWAY	3802.3
533368	EXIDE J3 115.0	5 LEVELS AWAY	12707.6
533371	NORTHVW3 115.0	5 LEVELS AWAY	11837.5
533379	SO GATE3 115.0	5 LEVELS AWAY	10894.1
533412	ARKVALJ3 115.0	5 LEVELS AWAY	10515.7
533416	RENO 3 115.0	5 LEVELS AWAY	25418.5
533417	EMCPHER3 115.0	5 LEVELS AWAY	14463.5
533419	HEC 3 115.0	5 LEVELS AWAY	20501.1
533421	HEC GT 3 115.0	5 LEVELS AWAY	21333.9
539643	ROLLHLS3 115.0	5 LEVELS AWAY	3637
539661	24-FREY3 115.0	5 LEVELS AWAY	5585.9
539685	PHLBURG3 115.0	5 LEVELS AWAY	3444.4
539692	SEWARD 3 115.0	5 LEVELS AWAY	5601.7
539701	RUSSELL3 115.0	5 LEVELS AWAY	3466.5
539721	N-GBEND1 34.50	5 LEVELS AWAY	3041.3
539723	OTISSUB1 34.50	5 LEVELS AWAY	1624.8
539725	PLAINVL1 34.50	5 LEVELS AWAY	4202.7
539732	SPEARVL1 34.50	5 LEVELS AWAY	4152.3
539771	NFTDODG3 115.0	5 LEVELS AWAY	12488.5
539800	CLARKCOUNTY7345.0	5 LEVELS AWAY	13602.4
539805	ELMCREEK7 345.0	5 LEVELS AWAY	5240.5
539807	IRONWOOD 1 34.50	5 LEVELS AWAY	24587.4
539808	IRONWOOD T1 13.80	5 LEVELS AWAY	46301.8
539923	NGBEND-T 13.80	5 LEVELS AWAY	4672.6
539925	OTIS1-T 2.400	5 LEVELS AWAY	33435.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
539926	OTIS2-T 2.400	5 LEVELS AWAY	12552.2
539928	PLAINV-T 13.80	5 LEVELS AWAY	10506.8
539936	SPERVLDT 13.80	5 LEVELS AWAY	1774.2
560080	G16-046-TAP 345.0	5 LEVELS AWAY	11635.6
579480	GEN-2008-124345.0	5 LEVELS AWAY	12875
580049	GEN-2010-045345.0	5 LEVELS AWAY	6955.2
582016	GEN-2011-016345.0	5 LEVELS AWAY	7470.7
583602	G13-010-GSU134.50	5 LEVELS AWAY	12646.7
585070	GEN-2015-069230.0	5 LEVELS AWAY	6656.2
587352	G16-050-GSU134.50	5 LEVELS AWAY	22891.2
587680	GEN-2016-074345.0	5 LEVELS AWAY	6424.1
587784	G16-096-TAP 345.0	5 LEVELS AWAY	9232.4
587894	G16-112-TAP 345.0	5 LEVELS AWAY	11085.3
599019	GPW-CB2 34.50	5 LEVELS AWAY	20280.1
599162	SPRVILLXFMR134.50	5 LEVELS AWAY	24379.8
640183	GENTLMN3 345.0	5 LEVELS AWAY	17198.6
640224	HOLDREG7 115.0	5 LEVELS AWAY	6022.3
640250	KEARNEY7 115.0	5 LEVELS AWAY	11586.9
640275	MINDEN 7 115.0	5 LEVELS AWAY	7086.6
640313	PAULINE7 115.0	5 LEVELS AWAY	16213.9
640315	PAULINE9 13.80	5 LEVELS AWAY	15838
653571	GR ISLD3 345.0	5 LEVELS AWAY	12260.3

4. Stability Analysis for Cluster Scenario

4.1. Faults Simulated

Twenty six (26) faults were considered for the transient stability simulations which included three phase faults, as well as single phase line faults. Single-phase line faults were simulated by applying fault impedance to the positive sequence network at the fault location. As per the SPP current practice to compute the fault levels, the fault impedance was computed to give a positive sequence voltage at the specified fault location of approximately 60% of pre-fault voltage.

Concurrently and previously queued projects as respectively shown in Table-1 and Table-2 of the study request i.e., GEN-2001-039M, GEN-2003-006A, GEN-2003-019, GEN-2006-031/GEN-2013-033, GEN-2008-092, GEN-2009-008, GEN-2009-020/GEN-2014-025, GEN-2010-057, ASGI-2013-004, GEN-2015-064, GEN-2015-065, GEN-2016-067 as well as areas number 520, 524, 525, 526, 531, 534, 536, and 640 were monitored during all the simulations. Table 5.1.1 shows the list of simulated contingencies. This Table also shows the fault clearing time and the time delay before re-closing for all the study contingencies.

Simulations were performed with a 0.1-second steady-state run followed by the appropriate disturbance as described in Table 5.1.1. Simulations were run for minimum 15-second duration to confirm proper machine damping.

Table 5.1.1 summarizes the overall results for all faults simulations of cluster scenario. Complete sets of plots for Winter-2017, Summer-2018, and Summer-2026 peak seasons for each fault are included in Appendices A, B and C respectively.

Since the machines under study are more in numbers, as well as the prior queued projects and requested monitored areas are also include in the plotting. Therefore for each contingency description, four (4) plots sheets are included i.e., Page-1, , Page-2, Page-3 and Page-4 that respectively represents the machines quantities under this project, prior queued machine quantities, and machine and bus voltages for different areas.. Overall for each scenario there are 104 plots sheets for twenty six (26) contingency description.

Table 5.1.1: List of simulated faults for cluster scenario stability analysis

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
1	FLT01-3PH	3 phase fault on the RENO7 (532771) to WICHITA7 (532796) 345kV line circuit 1, near RENO7. a. Apply fault at the RENO7 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
2	FLT02-1PH	Single phase fault on the RENO7 (532771) to WICHITA7 (532796) 345kV line circuit 1, near RENO7. a. Apply fault at the RENO7 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
3	FLT03-3PH	3 phase fault on the RENO7 (532771) to G16-111-TAP (587884) 345kV line circuit 1, near RENO7. a. Apply fault at the RENO7 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
4	FLT04-1PH	Single phase fault on the RENO7 (532771) to G16-111-TAP (587884) 345kV line circuit 1, near RENO7. a. Apply fault at the RENO7 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
5	FLT05-3PH	3 phase fault on the RENO7 (532771) to RENO3 (533416) to RENO 2X1 (532810) 3 Phase Transformer ID-1, near RENO7 a. Apply fault at the RENO7 345kV bus. b. Clear fault after 5 cycles by tripping the faulted Transformer	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
6	FLT06-3PH	3 phase fault on the G16-111-TAP (587884) to G16-112-TAP (587894) 345kV line circuit 1, near G16-111-TAP. a. Apply fault at the G16-111-TAP 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
7	FLT07-1PH	Single phase fault on the G16-111-TAP (587884) to G16-112-TAP (587894) 345kV line circuit 1, near G16-111-TAP. a. Apply fault at the G16-111-TAP 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
8	FLT08-3PH	3 phase fault on the G16-112-TAP (587894) to SUMMIT 7 (532773) 345kV line circuit 1, near G16-112-TAP. a. Apply fault at the G16-112-TAP 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
9	FLT09-1PH	Single phase fault on the G16-112-TAP (587894) to SUMMIT 7 (532773) 345kV line circuit 1, near G16-112-TAP. a. Apply fault at the G16-112-TAP 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
10	FLT10-3PH	3 phase fault on the SUMMIT 7 (532773) to SUMMIT 6 (532873) to SUMMIT 1 (532813) 3 Phase Transformer ID-1, near SUMMIT 7. a. Apply fault at the SUMMIT 7 345kV bus. b. Clear fault after 5 cycles by tripping the faulted Transformer	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
11	FLT11-3PH	3 phase fault on the WICHITA7 (532796) to BENTON 7 (532791) 345kV line circuit 1, near WICHITA7. a. Apply fault at the WICHITA7 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
12	FLT12-1PH	Single phase fault on the WICHITA7 (532796) to BENTON 7 (532791) 345kV line circuit 1, near WICHITA7. a. Apply fault at the WICHITA7 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
13	FLT13-3PH	3 phase fault on the WICHITA7 (532796) to G14-001-TAP (562476) 345kV line circuit 1, near WICHITA7. a. Apply fault at the WICHITA7 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
14	FLT14-3PH	3 phase fault on the WICHITA7 (532796) to BUFFALO7 (532782) 345kV line circuit 1, near WICHITA7. a. Apply fault at the WICHITA7 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
15	FLT15-3PH	3 phase fault on the WICHITA7 (532796) to VIOLA7 (532798) 345kV line circuit 1, near WICHITA7. a. Apply fault at the WICHITA7 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
16	FLT16-3PH	3 phase fault on the WICHITA7 (532796) to EVANS N4 (533040) to WICH11 (532829) 3 Phase Transformer ID-1, near WICHITA7. a. Apply fault at the WICHITA7 345kV bus. b. Clear fault after 5 cycles by tripping the faulted Transformer	Stable	Stable	Stable
17	FLT17-3PH	3 phase fault on the POSTROCK6 (530584) to KNOLL 6 (530558) 230kV line circuit 1, near POSTROCK6. a. Apply fault at the POSTROCK6 230kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
18	FLT18-1PH	Single phase fault on the POSTROCK6 (530584) to KNOLL 6 (530558) 230kV line circuit 1, near POSTROCK6. a. Apply fault at the POSTROCK6 230kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
19	FLT19-3PH	3 phase fault on the POSTROCK6 (530584) to S HAYS6 (530582) 230kV line circuit 1, near POSTROCK6. a. Apply fault at the POSTROCK6 230kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
20	FLT20-1PH	Single phase fault on the POSTROCK6 (530584) to S HAYS6 (530582) 230kV line circuit 1, near POSTROCK6. a. Apply fault at the POSTROCK6 230kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
21	FLT21-3PH	3 phase fault on the POSTROCK6 (530584) to POSTROCK7 (530583) to POSTROCK1 (530673) 3 Phase Transformer ID-1, near POSTROCK6. a. Apply fault at the POSTROCK6 230kV bus. b. Clear fault after 5 cycles by tripping the faulted Transformer	Stable	Stable	Stable
22	FLT22-3PH	3 phase fault on the KNOLL 6 (530558) to SMOKYHL6 (530592) 230kV line circuit 1, near KNOLL 6. a. Apply fault at the KNOLL 6 230kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
23	FLT23-1PH	Single phase fault on the KNOLL 6 (530558) to SMOKYHL6 (530592) 230kV line circuit 1, near KNOLL 6. a. Apply fault at the KNOLL 6 230kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
24	FLT24-3PH	3 phase fault on the S HAYS6 (530582) to GRTBEND6 (539679) 230kV line circuit 1, near S HAYS6. a. Apply fault at the S HAYS6 230kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
25	FLT25-PO	**WICHITA7 to VIOLA7 345kV Prior Outage** a. Prior Outage: Switch out WICHITA7 (532796) to VIOLA7 (532798) 345kV line and solve. b. Apply 3 phase fault on WICHITA7 (532796) to G14-001-TAP (562476) 345kV line, near WICHITA7. a. Clear fault after 5 cycles and trip the faulted line.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
26	FLT26-PO	**POSTROCK6 to KNOLL 6 230kV Prior Outage** c. Prior Outage: Switch out POSTROCK6 (530584) to KNOLL 6 (530558) 230kV line and solve. d. Apply 3 phase fault on POSTROCK6 (530584) to S HAYS6 (530582) 230kV line, near POSTROCK6. a. Clear fault after 5 cycles and trip the faulted line.	Stable	Stable	Stable

4.2. Simulation Results for Cluster Scenario

For cluster scenario, there are no impacts on the stability performance of the SPP system for the contingencies tested on the SPP provided base cases.

5. Conclusions

The findings of the impact study for the proposed interconnection projects under DISIS-2016-002 (Group 4) considered 100% of their proposed installed capacity is as follows:

1. There are no impacts on the stability performance of the SPP system during cluster scenarios for the contingencies tested on the provided base cases. The study machines stayed on-line and stable for all simulated faults. The project stability simulations with twenty six (26) specified test disturbances did not show instability problems in the SPP system. Any oscillations were damped out.

6. **Appendix A: 2017 winter Peak Case Stability Run Plots – Cluster**

7. **Appendix B: 2018 summer Peak Case Stability Run Plots – Cluster**

8. **Appendix C: 2026 Summer Peak Case Stability Run Plots – Cluster**

9. **Appendix D: Project Model Data**

(Appendices available from SPP upon request.)

J6: GROUP 6 DYNAMIC STABILITY ANALYSIS REPORT

MITSUBISHI ELECTRIC POWER PRODUCTS, INC.
POWER SYSTEMS ENGINEERING DIVISION
530 KEYSTONE DRIVE
WARRENDALE, PA 15086, U.S.A.

Phone: (724) 778-5111 Fax: (724) 778-5149
Home Page: www.meppi.com

Southwest Power Pool, Inc. (SPP)

DISIS-2016-002 (Group 06) Definitive Impact Study

Final Report

REP-0301
Revision #01

July 2018

Submitted By:
Mitsubishi Electric Power Products, Inc. (MEPPI)
Power Systems Engineering Division
Warrendale, PA

MITSUBISHI ELECTRIC POWER PRODUCTS, INC.
POWER SYSTEMS ENGINEERING DIVISION
530 KEYSTONE DRIVE
WARRENDALE, PA 15086, U.S.A.

Phone: (724) 778-5111 Fax: (724) 778-5149
Home Page: www.meppi.com

Report Revision Table

Revision	Reason for Revision	Date	Approved
0	Issue Final Report	7/5/2018	NWT
1	Add FLT341, FLT342, FLT343 Add detail for mitigation requirements	7/6/2018	NWT

Title: **DISIS-2016-002 (Group 06) Definitive Impact Study: Final Report REP-0301**
Date: July 2018
Author: Nicholas W. Tenza; Senior Engineer, Power Systems Engineering Division *Nicholas W. Tenza*
Approved: Donald J. Shoup; General Manager, Power Systems Engineering Division *Donald J. Shoup*

EXECUTIVE SUMMARY

SPP requested a Definitive Interconnection System Impact Study (DISIS). The DISIS required a Stability Analysis and a Short Circuit Analysis detailing the impacts of the interconnecting projects as shown in Table ES-1.

Table ES-1
Interconnection Projects Evaluated

Request	Size (MW)	Generator Model	Point of Interconnection
ASGI-2016-009	3	Wind (588472)	Wolfforth Substation 115kV (526481)
GEN-2015-039	50	Solar (584803)	Tap Deaf Smith - Plant X 230kV (560051)
GEN-2015-040	50.1	Solar (584813)	Mustang 230kV substation (527151)
GEN-2015-078	50.1	Solar (585153)	Mustang 115kV substation (527146)
GEN-2015-099	73.26	Solar (587673)	Maddox 115kV (528355)
GEN-2016-039	112	Solar (587253)	Swisher 115kV (525212)
GEN-2016-077	54	Solar (587693)	Dixon 69kV (526711)
GEN-2016-078	108	Solar (587703)	Bailey County 115kV (525028)
GEN-2016-120	400	Wind (587963, 587967)	Tap Crawfish Draw – Border 345kV Line (587964)
GEN-2016-121	110	Solar (587993)	Roadrunner 115kV (528025)
GEN-2016-123	298	Wind (588003, 588006)	Crossroads 345kV (527656)
GEN-2016-124	150	Wind (588013)	Crossroads 345kV (527656)
GEN-2016-125	74	Wind (588023)	Crossroads 345kV (527656)
GEN-2016-169	260	Solar (588433, 588436)	Hobbs Interchange 345kV (527896)
GEN-2016-171	60.8	Solar (588353)	Tap Hobbs –Yoakum 230kV Line (560059)

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2016-172	229.95	Wind (588443, 588446)	Newhart 115kV (525460)
GEN-2016-175	150	Wind (587973)	Tap Crawfish Draw – Border 345kV Line (587964)
GEN-2016-177	17	Gas Turbine (588461)	Tap Ink Basin – Denver City 115kV (588462)

SUMMARY OF STABILITY ANALYSIS

The Stability Analysis determined that there were multiple contingencies across all seasons that resulted in system/voltage instability, generation tripping offline, and poor post-fault voltage recovery when all generation interconnection requests were at 100% output. To mitigate the system/voltage instability, voltage violations, generation tripping offline, and poor post-fault steady-state voltages, the following upgrades were provided by SPP and implemented (upgrades provided here are required for 17W season and thus, implemented in remaining years):

- Crawfish Draw SVC +600 MVAR
  - For this study, the SVC size was determined at the POI. Actual SVC size may differ at the 13.8 kV bus.
- Crawfish Draw 345/230 kV transformer #2
- Crawfish Draw to Crossroads 765 kV circuit #1
- Crawfish Draw to midpoint station to Seminole 765 kV circuit #1 and #2
- Crossroads 765/345 kV transformer #1 and #2
- Crawfish Draw 765/345 kV transformer #1 and #2
- Seminole 765/345 kV transformer #1 and #2
- Hobbs to Yoakum to Tuco 345 kV circuit #1 (advancement in 17W and 18S)
- Yoakum 345/230 kV transformer #1 (advancement in 17W and 18S)
- Tolk 345/230 kV transformer #3

FLT252-PO, a prior outage of Crossroads to Tolk 345 kV line followed by a three-phase fault resulting in the loss of Crossroads to Crawfish Draw 765 kV line (line identified as mitigation), was observed to have system instability after implemented the mitigation identified above. For this prior outage, the following generation curtailment was required:

- 17W: curtail study generation by 950 MW
- 18S: curtail study generation by 750 MW
- 26S: curtail study generation by 550 MW

In all three seasons, under normal system dispatch, system instability exists for three-phase faults at Crawfish Draw (345 kV and 765 kV) following a prior outage of the Crawfish Draw to Crawfish Draw Tap (new bus) 765 kV line. For this reason, it is necessary to curtail generation and limit line flow along the parallel circuit of the Crawfish Draw to Crawfish Draw Tap 765 kV circuits following the outage of one circuit from Crawfish Draw to Crawfish Draw Tap 765 kV. It was necessary to curtail generation and limit the line flow on the parallel circuit to the following:

- 17W: Reduce from 3090 MW to 1950 MW (curtail all study generation)
- 18S: Reduce from 2645 MW to 1730 MW (curtail study generation by 2200 MW)
- 26S: Reduce from 2140 MW to 1720 MW (curtail study generation by 1000 MW)

FLT341-PO, a prior outage of the Crawfish Draw 765/345 kV transformer circuit #1 followed by a three-phase fault resulting in the loss of the second Crawfish Draw 765/345 kV transformer, was observed to have system instability after implemented the mitigation identified in this study and under normal dispatch. For this prior outage, the following generation curtailment was required:

- 17W: curtail study generation by 700 MW
- 18S: curtail study generation by 400 MW
- 26S: No curtailment

In addition to the above generation curtailment for the prior outage of one of the Crawfish Draw 765/345 kV transformers, line reactors on the Crawfish Draw to Crawfish Draw Tap to Seminole 765 kV double circuit were required as a system adjustment to mitigate high overvoltages. The following line reactors were required to be switched in-service for each season for this prior outage:

- Crawfish Draw 765 kV line end
  - 17W: 200 Mvar line reactor
  - 18S: 300 Mvar line reactor (increase of 190 Mvar)
  - 26S: 400 Mvar line reactor (increase of 150 Mvar)
- Seminole 765 kV line end
  - 17W: 150 Mvar line reactor
  - 18S: 200 Mvar line reactor (increase of 90 Mvar)
  - 26S: 350 Mvar line reactor (increase of 100 Mvar)

Note for the following study projects, frequency transient spikes were observed in the simulations following fault clearing:

- GEN-2016-077 (TMEIC solar inverter)
- GEN-2016-078 (TMEIC solar inverter)

The frequency transient spike that was observed is a known artifact of the PSS/E software because the positive-sequence model does not estimate the actual frequency variations during and immediately following the fault fairly and thus cannot be trusted as a good indication of frequency. For these simulations, the instantaneous frequency protection was changed to incur 1 second of time delay for each of projects listed above. In addition, it is recommended the manufacturer investigates the frequency calculation of the TMEIC inverter.

After implementing the above upgrades, the contingency analysis was re-simulated for all contingencies. With the upgrades, the Stability Analysis determined that there was no wind turbine tripping or system instability observed as a result of interconnecting all study projects at 100% output.

SUMMARY OF THE SHORT CIRCUIT ANALYSIS

The short circuit analysis was performed on the 2018 Summer Peak and 2026 Summer Peak power flows for all study projects. Refer to Table ES-2 and Table ES-3 for a list of maximum fault currents observed for each study project for the 18S and 26S cases, respectively.

Table ES-2
2018SP: List of Maximum Fault Currents Observed for Each Study Project

Study Project	Fault Current at POI (kA)	Maximum Fault Current (kA)	Fault Location
ASGI-2016-009	11.38	32.78	Tuco 230 kV
GEN-2015-039	7.52	32.78	Tuco 230 kV
GEN-2015-040	15.79	32.78	Tuco 230 kV
GEN-2015-078	22.41	32.78	Tuco 230 kV
GEN-2015-099	25.30	30.30	Hobbs 115 kV
GEN-2016-039	11.97	32.78	Tuco 230 kV
GEN-2016-077	2.50	20.84	Denver N 115 kV
GEN-2016-078	5.03	32.78	Tuco 230 kV
GEN-2016-120	8.72	33.20	Cimaron 345 kV
GEN-2016-121	8.67	30.30	Hobbs 115 kV
GEN-2016-123	16.70	32.83	Seminole 345 kV
GEN-2016-124	16.70	32.83	Seminole 345 kV
GEN-2016-125	16.70	32.83	Seminole 345 kV
GEN-2016-169	9.81	32.78	Tuco 230 kV
GEN-2016-171	9.21	32.78	Tuco 230 kV
GEN-2016-172	17.09	32.78	Tuco 230 kV
GEN-2016-175	8.72	33.20	Cimaron 345 kV
GEN-2016-177	9.23	30.30	Hobbs 115 kV

Table ES-3
2026SP: List of Maximum Fault Currents Observed for Each Study Project

Study Project	Fault Current at POI (kA)	Maximum Fault Current (kA)	Fault Location
ASGI-2016-009	11.49	32.78	Tuco 230 kV
GEN-2015-039	7.45	32.78	Tuco 230 kV
GEN-2015-040	15.65	32.78	Tuco 230 kV
GEN-2015-078	22.31	32.78	Tuco 230 kV
GEN-2015-099	24.85	29.35	Hobbs 115 kV
GEN-2016-039	11.86	32.78	Tuco 230 kV
GEN-2016-077	2.50	20.74	Denver N 115 kV
GEN-2016-078	6.13	32.78	Tuco 230 kV
GEN-2016-120	8.71	33.12	Cimaron 345 kV
GEN-2016-121	8.60	29.35	Hobbs 115 kV
GEN-2016-123	16.63	32.78	Seminole 345 kV
GEN-2016-124	16.63	32.78	Seminole 345 kV
GEN-2016-125	16.63	32.78	Seminole 345 kV
GEN-2016-169	9.39	32.78	Tuco 230 kV
GEN-2016-171	8.93	32.78	Tuco 230 kV
GEN-2016-172	16.84	32.78	Tuco 230 kV
GEN-2016-175	8.71	33.12	Cimaron 345 kV
GEN-2016-177	9.20	29.35	Hobbs 115 kV

Table of Contents

SECTION 1: OBJECTIVES

The objective of this report is to provide Southwest Power Pool, Inc. (SPP) with the deliverables for the "DISIS-2016-002 (Group 06) Definitive Impact Study." SPP requested an Interconnection System Impact Study for eighteen (18) generation interconnections for 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak, which requires a Stability Analysis, Short Circuit Analysis, and an Impact Study Report.

SECTION 2: BACKGROUND

The Siemens Power Technologies International PSS/E power system simulation program Version 33.10.0 was used for this study. SPP provided the stability database cases for 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak conditions and a list of contingencies to be examined. The model includes the study projects shown in Table 2-1 and the previously queued projects listed in Table 2-2. Refer to Appendix A for the steady-state and dynamic model data for the study projects. A power flow one-line diagram for each generation interconnection project is shown in Figures 2-1 through 2-13. Note that the one-line diagrams represent the 2018 Summer Peak case.

The Stability Analysis determined the impacts of the new interconnecting projects on the stability and voltage recovery of the nearby system and the ability of the interconnecting projects to meet FERC Order 661A. If problems with stability or voltage recovery are identified, the need for reactive compensation or system upgrades were investigated. Three-phase faults and single line-to-ground faults were examined as listed in Table 2-3.

A Short Circuit Analysis was performed on the 2018 Summer Peak and 2026 Summer Peak study years for each study generator. The study was performed five buses out from the study generator's point of interconnection and results were documented.

Table 2-1
Interconnection Projects Evaluated

Request	Size (MW)	Generator Model	Point of Interconnection
ASGI-2016-009	3	Wind (588472)	Wolfforth Substation 115kV (526481)
GEN-2015-039	50	Solar (584803)	Tap Deaf Smith - Plant X 230kV (560051)
GEN-2015-040	50.1	Solar (584813)	Mustang 230kV substation (527151)
GEN-2015-078	50.1	Solar (585153)	Mustang 115kV substation (527146)
GEN-2015-099	73.26	Solar (587673)	Maddox 115kV (528355)
GEN-2016-039	112	Solar (587253)	Swisher 115kV (525212)
GEN-2016-077	54	Solar (587693)	Dixon 69kV (526711)
GEN-2016-078	108	Solar (587703)	Bailey County 115kV (525028)
GEN-2016-120	400	Wind (587963, 587967)	Tap Crawfish Draw-Border 345kV Line (587964)
GEN-2016-121	110	Solar (587993)	Roadrunner 115kV (528025)
GEN-2016-123	298	Wind (588003, 588006)	Crossroads 345kV (527656)
GEN-2016-124	150	Wind (588013)	Crossroads 345kV (527656)
GEN-2016-125	74	Wind (588023)	Crossroads 345kV (527656)
GEN-2016-169	260	Solar (588433, 588436)	Hobbs Interchange 345kV (527896)
GEN-2016-171	60.8	Solar (588353)	Tap Hobbs –Yoakum 230kV Line (560059)
GEN-2016-172	229.95	Wind (588443, 588446)	Newhart 115kV (525460)
GEN-2016-175	150	Wind (587973)	Tap Crawfish Draw-Border 345kV Line (587964)
GEN-2016-177	17	Gas Turbine (588461)	Tap Ink Basin – Denver City 115kV (588462)

Table 2-2
Previously Queued Nearby Interconnection Projects Included

Request	Size (MW)	Generator Model	Point of Interconnection
Hopi	10	Solar 1.0MW	Hopi 115kV (528226)
Jal	10	Solar 1.0MW	S Jal 115kV (528547)
Lea Road	10	Solar 1.0MW	Lea Road 115kV (528505)
Monument	10	Solar 1.0MW	Monument 115kV (528491)
Ocotillo	10	Solar 1.0MW	S_Jal 115kV (528132)
Yuma	0.9	SNL 0.9MW	SP-Yuma 69kV (526469)
Sunray	49.5	GE 1.5MW	Valero 115kV (523277)
GEN-2001-033	180	Mitsubishi MHI 1000A 1.0MW	San Juan Tap 230kV (524885)
GEN-2001-036	80	Mitsubishi MHI 1000A 1.0MW	Norton 115kV (524502)
GEN-2006-018	168.135	Wartsila 9.34MW	Tuco Interchange 230kV (525830)
GEN-2006-026	502	Thermal 144/145/213MW	Hobbs 115kV (527891) Hobbs 230kV (527894)
GEN-2008-022	300	Vestas V100 VCSS 2.0MW	Crossroads 345kV (527656)
GEN-2010-006	205	Thermal 205MW	Jones 230kV(526337)
ASGI-2010-010	42.196	Wartsila 20V34SG 8.4392MW	Lovington 115kV (528334)
ASGI-2010-020	29.9	Nordex N100 2.3MW	Tap LE-Tatum to LE-Crossroads 69kV (560360)
ASGI-2010-021	15	Mitsubishi MPS-1000A 1.0MW	Tap LE-Saundrtp to LE-Anderson 69kV (560364)
GEN-2010-046	56	Wartsila 9.34MW	Tuco Interchange 230kV (525830)
ASGI-2011-001	27.3	Suzlon S97 2.1MW	Lovington 115kV (528334)
ASGI-2011-003	10	Sany 2.0MW	Hendricks 69kV (525943)
ASGI-2011-004	19.8	Sany 93m/100m 1.8MW	Pleasant Hill 69kV (525915)
GEN-2011-025	78.76	GE 100m 1.79MW	Tap Floyd County - Crosby County 115kV (562004)
GEN-2011-045	205	Thermal 205MW	Jones 230kV (526337)
GEN-2011-046	27	Thermal 27MW	Lopez 115kV (524472)
GEN-2011-048/ GEN-2012-036	182	Thermal 182MW	Mustang 230kV (527151)

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2012-001	61.2	CCWE 3.6MW	Cirrus Tap 230kV (526679)
ASGI-2012-002/ASGI-2013-005	19.8	Vestas V82 1.65MW	FE-Clovis Interchange 115kV (524808)
GEN-2012-020	477.12	GE 1.68MW	Tuco 230kV (525830)
GEN-2012-034	7 MW increase (Pgen=157MW)	Thermal 157MW	Mustang 230kV (527151)
GEN-2012-035	7 MW increase (Pgen=157MW)	Thermal 157MW	Mustang 230kV (527151)
GEN-2012-037	203	GE 7FA Gas CT 203MW	Tuco 345kV (525832)
GEN-2013-016/GEN-2015-041	208	GE 7FA Gas CT 208MW	Tuco 345kV (525832)
ASGI-2013-002	18.4	Siemens VS 2.3MW	FE Tucumcari 115kV (524509)
ASGI-2013-003	18.4	Siemens VS 2.3MW	FE Clovis 115kV (524808)
GEN-2013-022	24.2	SMA SC-2200-US 2.2MW	Norton 115kV (524486)
GEN-2013-027	148.35	Vestas V126 GS 3.45MW	Tap Tolk - Yoakum 230kV (562480)
GEN-2014-012	225	Siemens CT 225MW	Tap Hobbs 527896to Andrews (528604) 345kV (528611)
GEN-2014-033	70	GE LV5 0.95MW, Schneider XC 680 0.64MW	Chaves County 115kV (527482)
GEN-2014-034	70	GE LV5 3.89MW	Chaves County 115kV (527482)
GEN-2014-035	30	GE LV5 3.75MW	Chaves County 115kV (527482)
GEN-2014-040	319.7	GE 2.3MW	Castro 115kV (524746)
ASGI-2015-002/ASGI-2016-002	2.65	GE 2.65MW	SP-Yuma 69kV (526469)
GEN-2015-014	150	Vestas V110 VCSS 2.0MW	Tap Cochran - Lehman 115kV (560030)
GEN-2015-020	99.96	Eaton Power Xpert Solar 1.67MW	Oasis 115kV (524874)
GEN-2015-022	112	GE LV5 4.0MW	Swisher 115kV (525212)
GEN-2015-031	150.53	GE 1.79/2.3MW	Swisher (525213) to Amarillo South (524415) 230 kV (560050)

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2015-056	101.2	GE 2.3MW	Crossroads 345kV (527656) (Tap Eddy (527802) to Tolk(525549)
GEN-2015-058	50.01	TMEIC Solarware Samurai1.667 MW inverter (solar)	Atoka 115kV (527786)
GEN-2015-068	300	GE 2.0 MW	Tuco Interchange 345kV (525832)
GEN-2015-075	51.48	GE LV5 1500V 3.96 MW (solar)	Carlisle 69kV (526159)
GEN-2015-079	129.2	GE LV5 1500V 3.8MW (solar)	Tap Yoakum (526935) to Hobbs (527894) 230 kV (560059)
GEN-2015-080	129.2	GE LV5 1500V 3.8MW (solar)	Tap Yoakum (526935) to Hobbs (527894) 230 kV (560059)
ASGI-2016-004	10	3 x Alstom 3.2MW/4 x Renewtech 100kW	Palo Duro 115kV (524530)
GEN-2016-015	100	TMEIC Solarware Samurai 1833GRQ 1.67MW	Andrews 345kV (528604)
GEN-2016-056	200	GE 2.0MW (wind)	Carlisle 230 kV (526161)
GEN-2016-062	250.7	GE 2.3MW (wind)	Andrews 345kV (528604)
GEN-2016-069	31.35	GE LV5 0.95MW	Chaves County 115kV (527482)

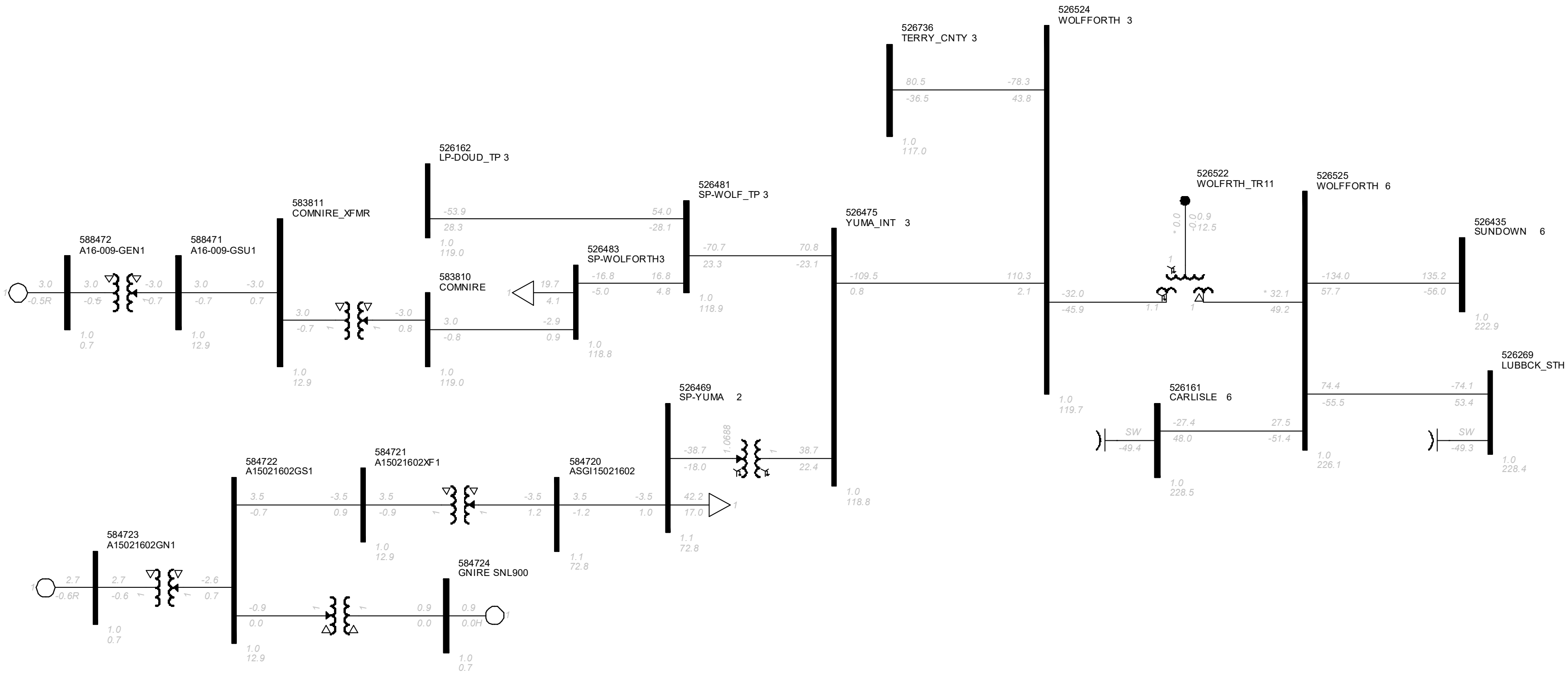


Figure 2-1. Power flow one-line diagram for interconnection project at the Wolfforth Substation 115 kV (ASGI-2016-009).

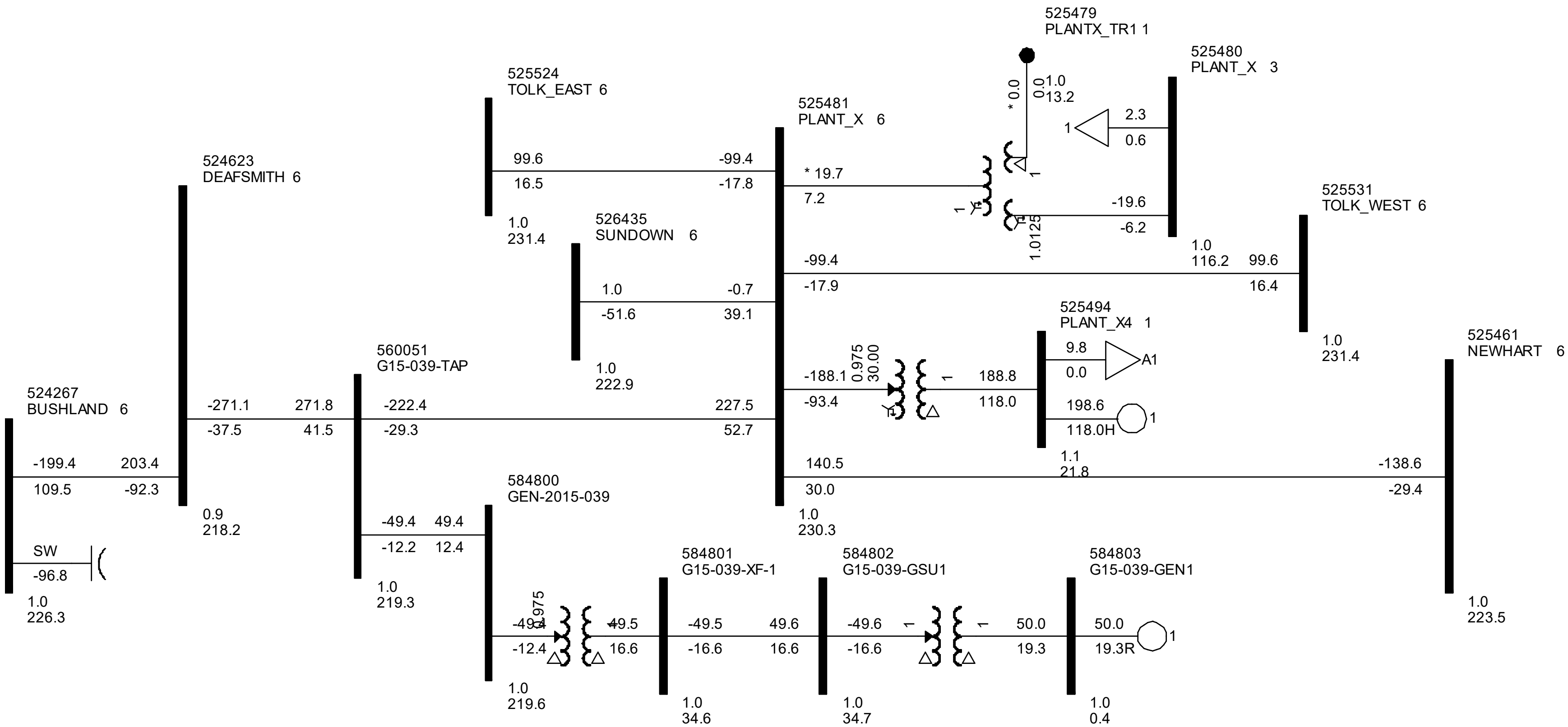


Figure 2-2. Power flow one-line diagram for interconnection project at the Deaf Smith to Plant X Tap 230 kV POI (GEN-2015-039).

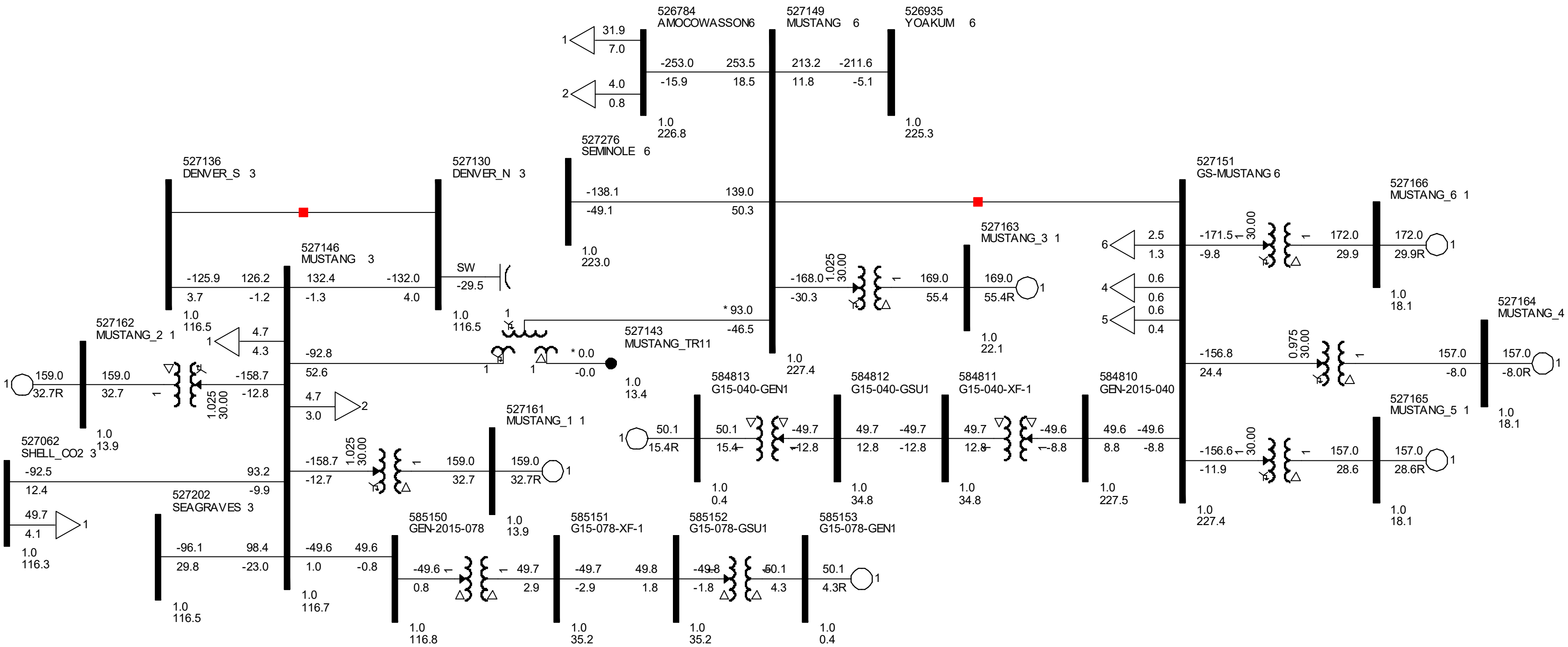


Figure 2-3. Power flow one-line diagram for interconnection project at Mustang 115 kV and 230 kV (GEN-2015-040 and -078).

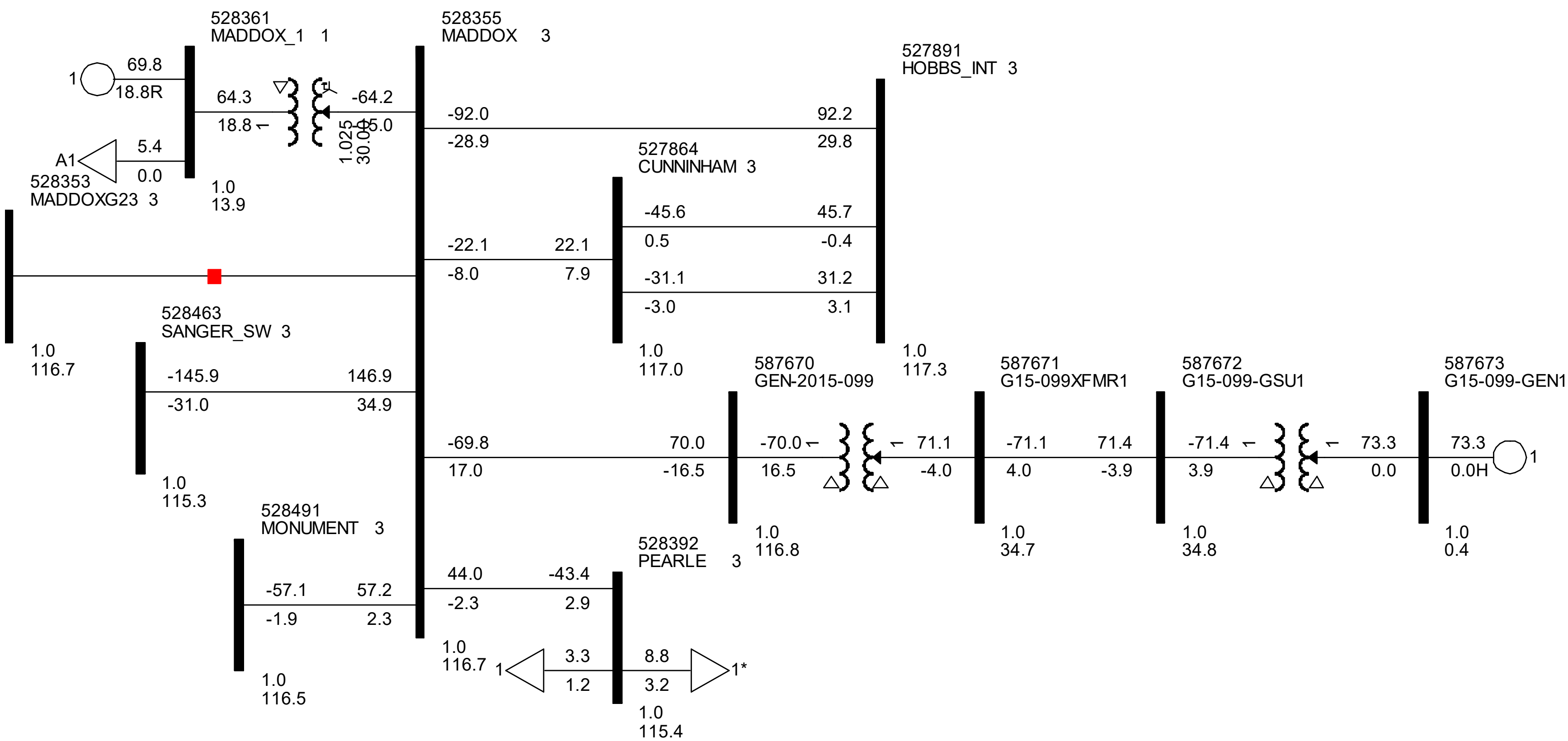


Figure 2-4. Power flow one-line diagram for interconnection project at Maddox 115 kV (GEN-2015-099).

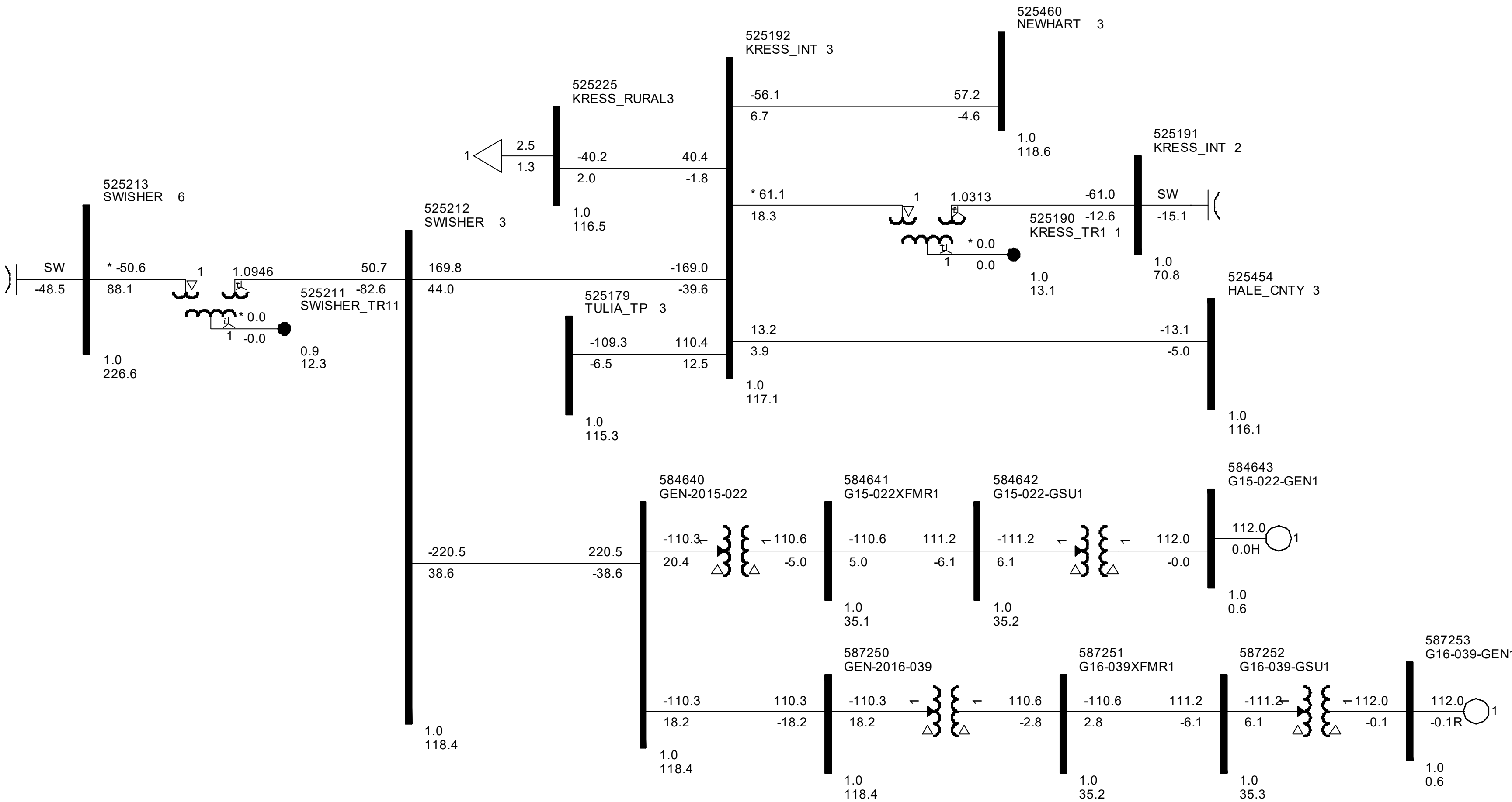


Figure 2-5. Power flow one-line diagram for interconnection project at Swisher 115 kV (GEN-2016-039).

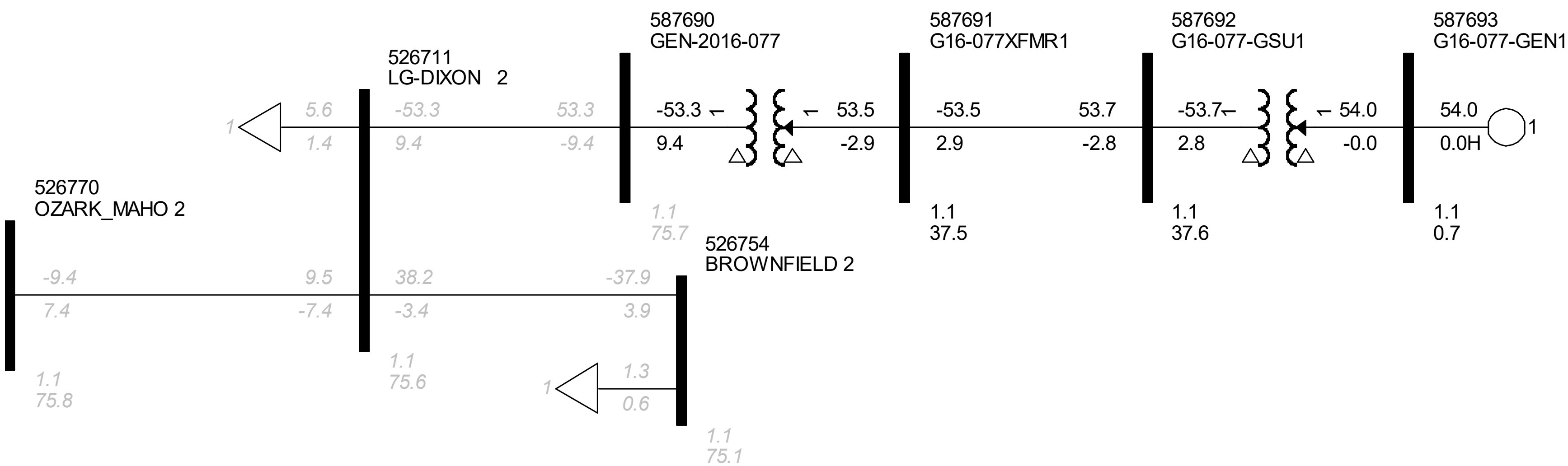


Figure 2-6. Power flow one-line diagram for interconnection project at Dixon 69 kV (GEN-2016-077).

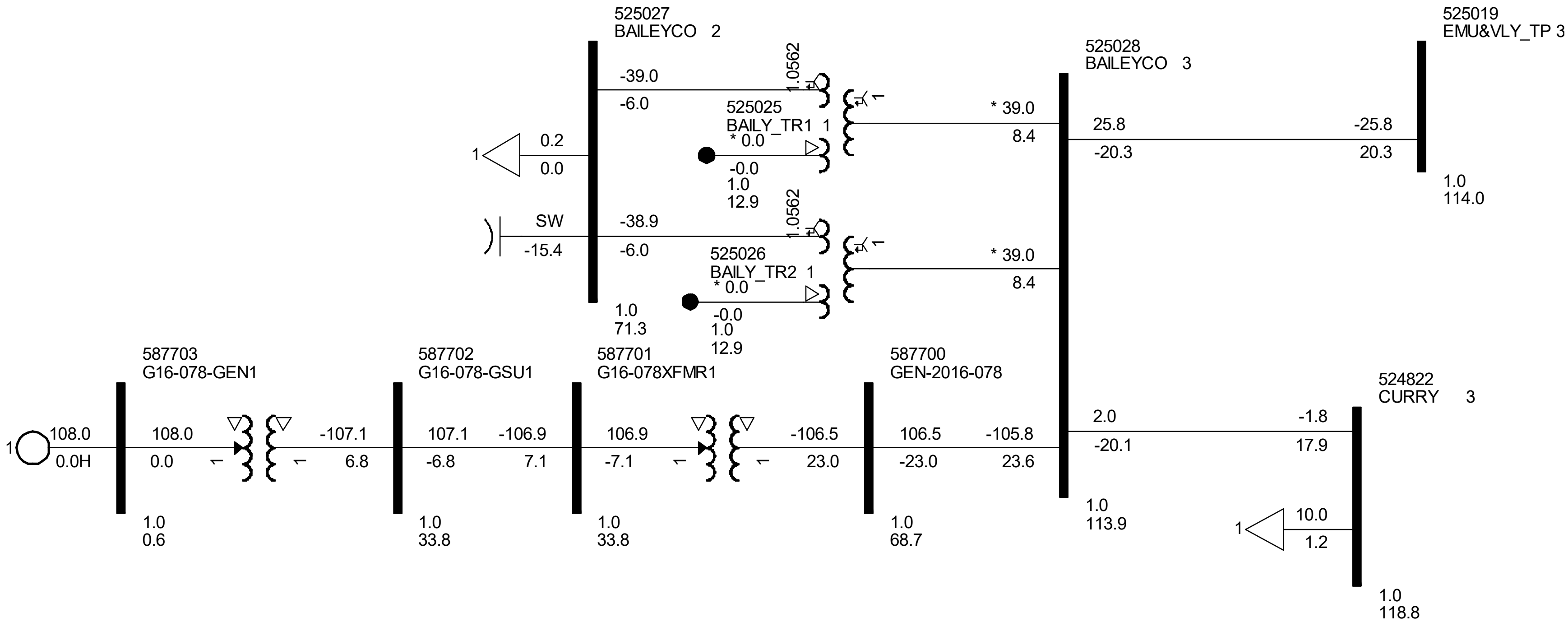


Figure 2-7. Power flow one-line diagram for interconnection project at Bailey County 115 kV (GEN-2016-078).

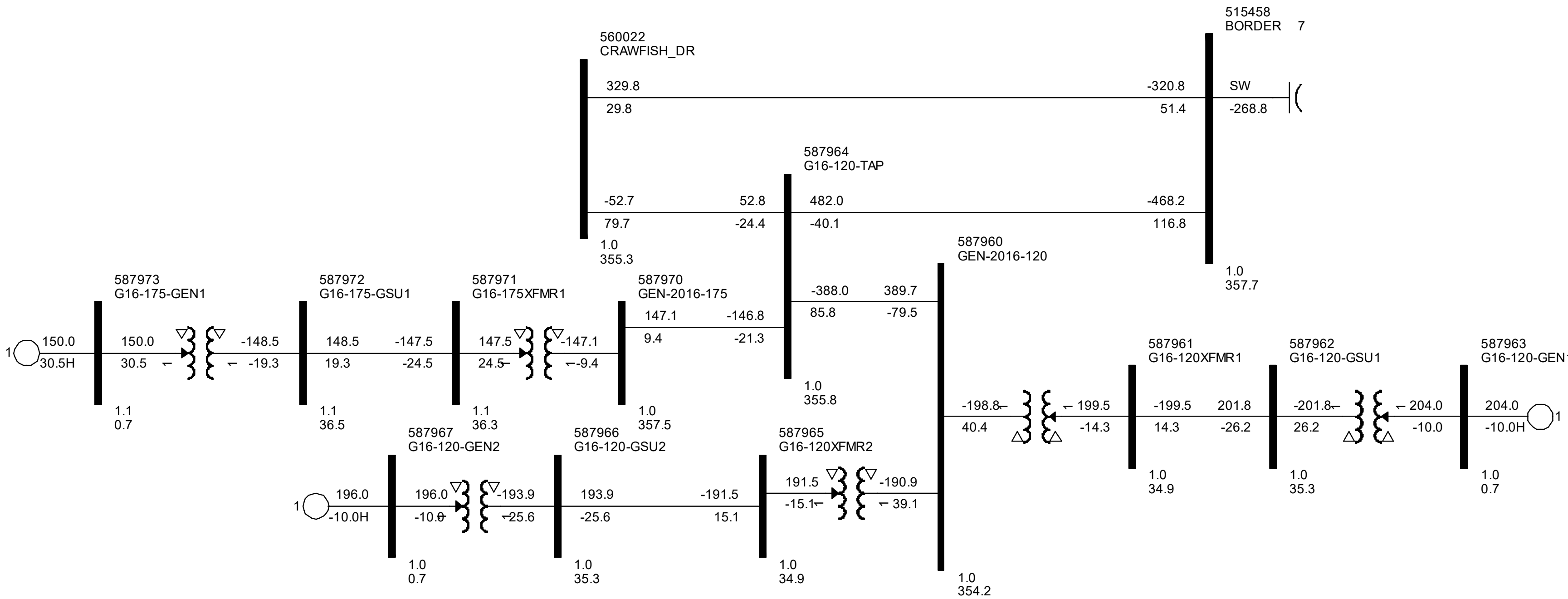


Figure 2-8. Power flow one-line diagram for interconnection project at Crawfish Draw to Border 345 kV Tap POI (GEN-2016-120 and -175).

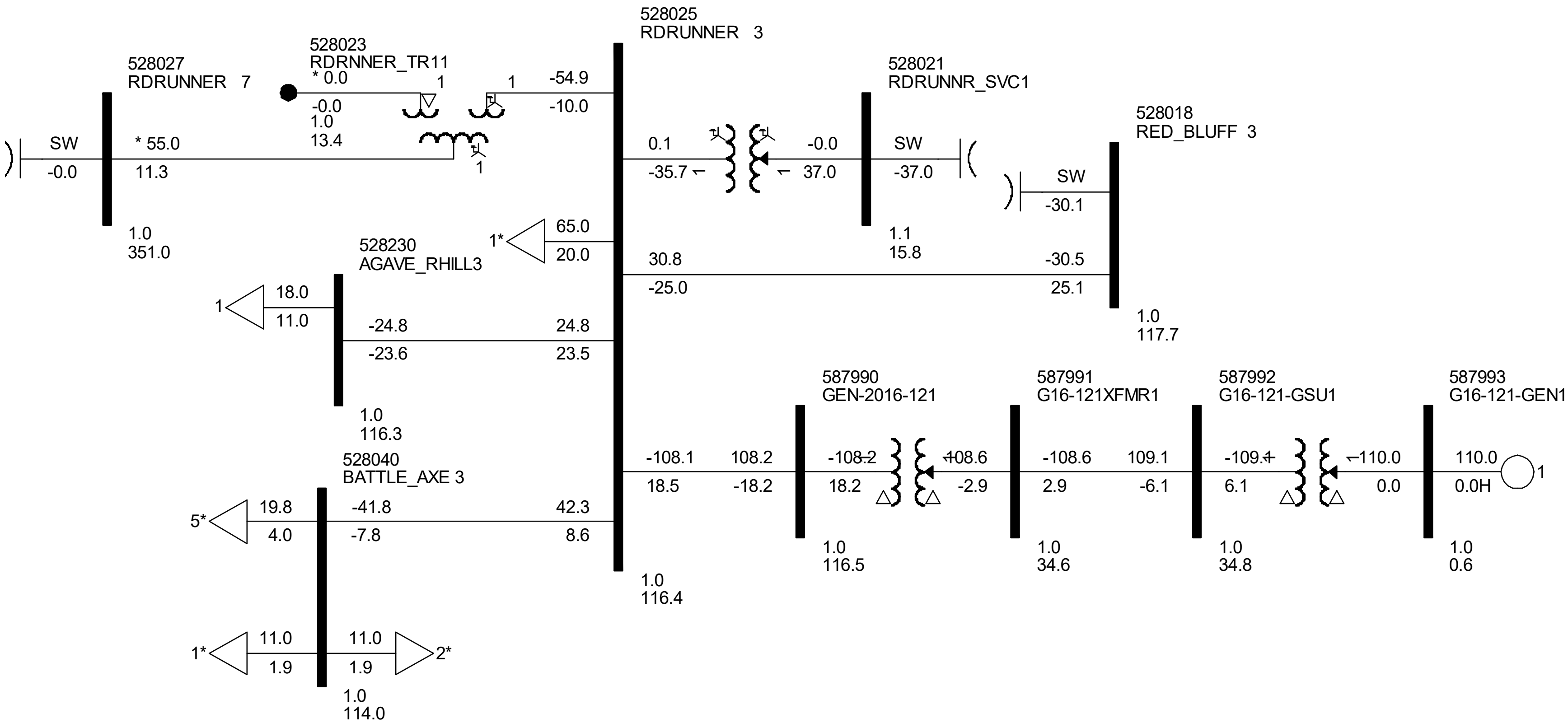


Figure 2-9. Power flow one-line diagram for interconnection project at Roadrunner 115 kV (GEN-2016-121).

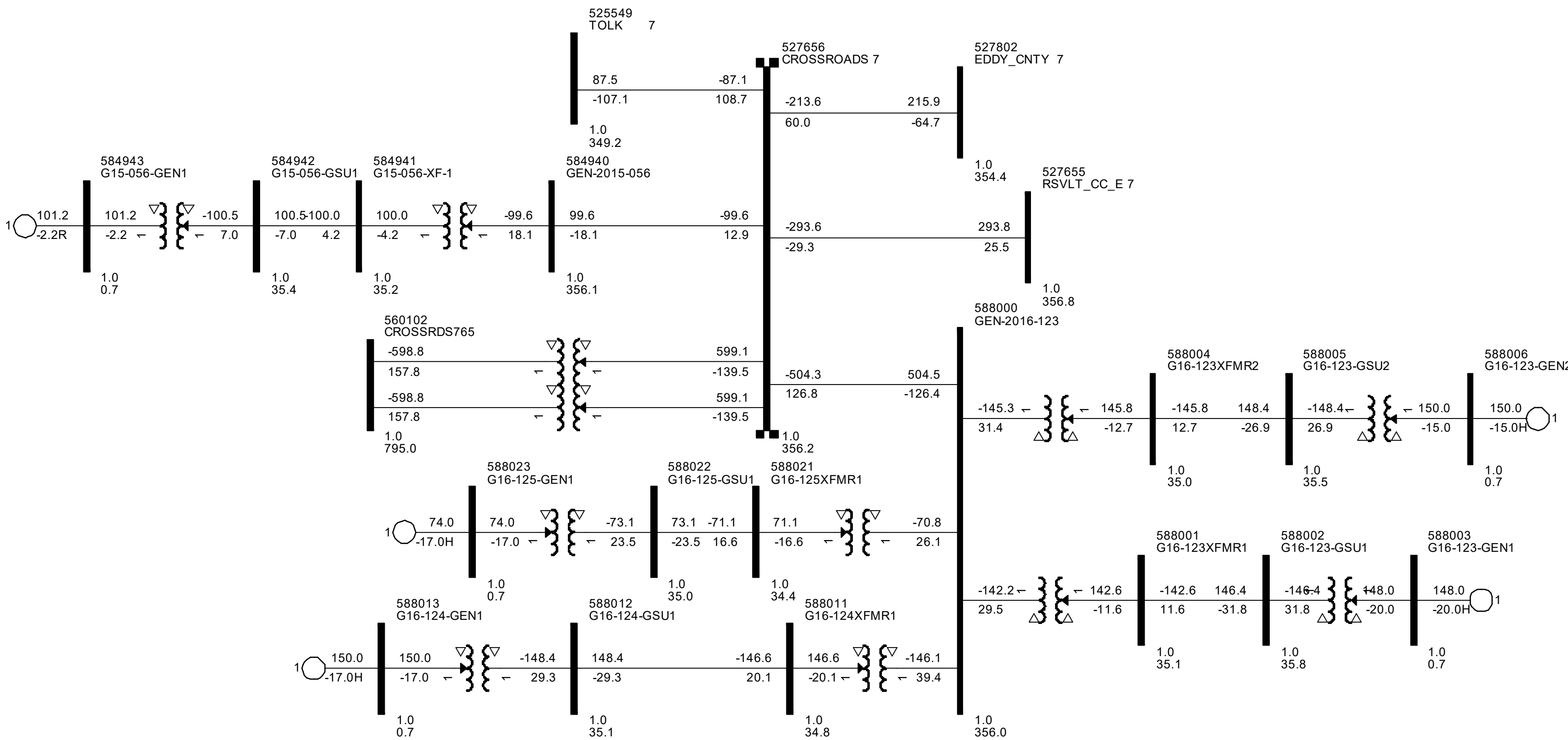


Figure 2-10. Power flow one-line diagram for interconnection project at Crossroads 345 kV (GEN-2016-123, - 124, and -125).

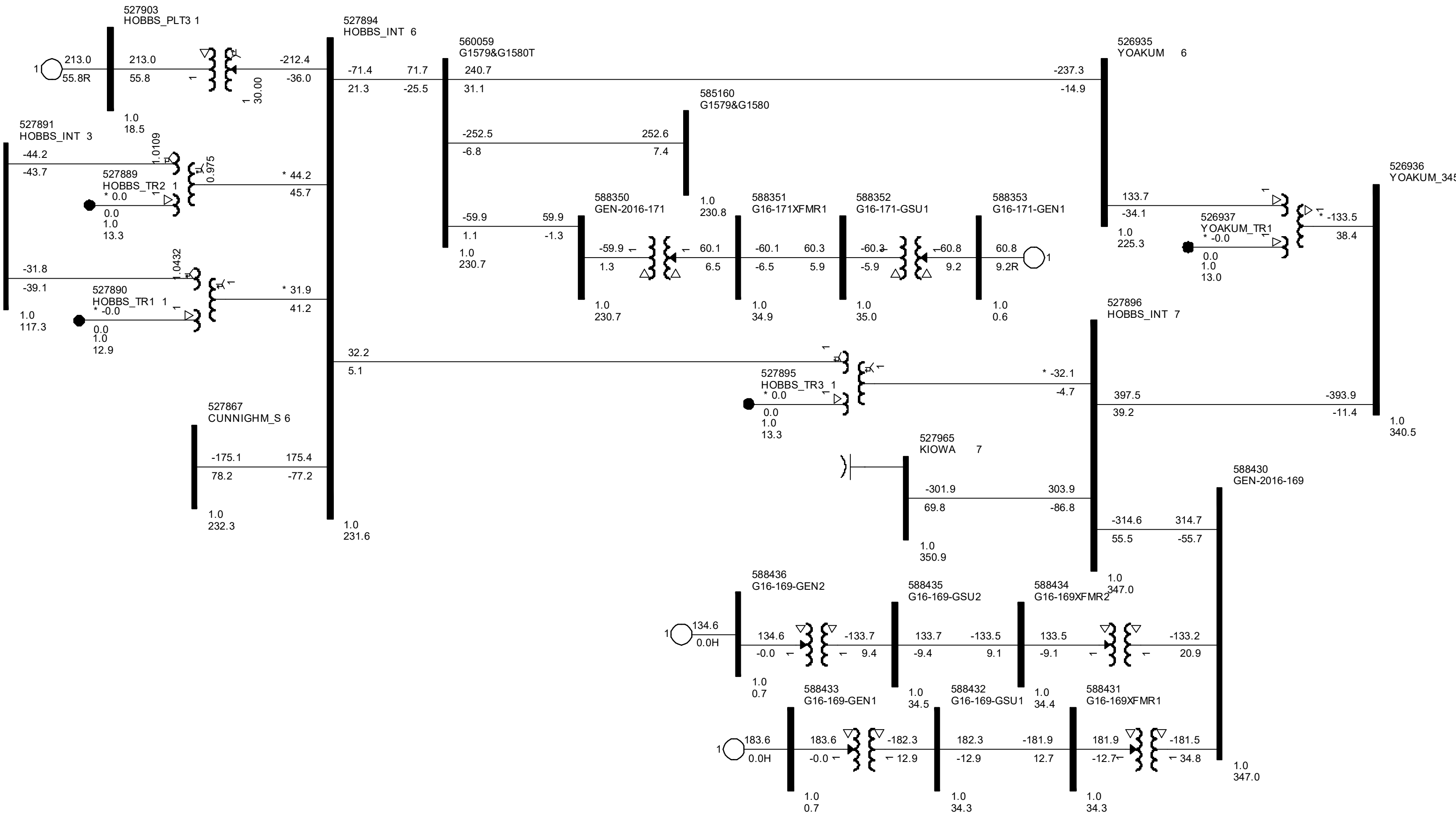


Figure 2-11. Power flow one-line diagram for interconnection project at Hobbs Interchange 345 kV and Hobbs to Yoakum 230 kV Tap POI (GEN-2016-169 and GEN-2016-171).

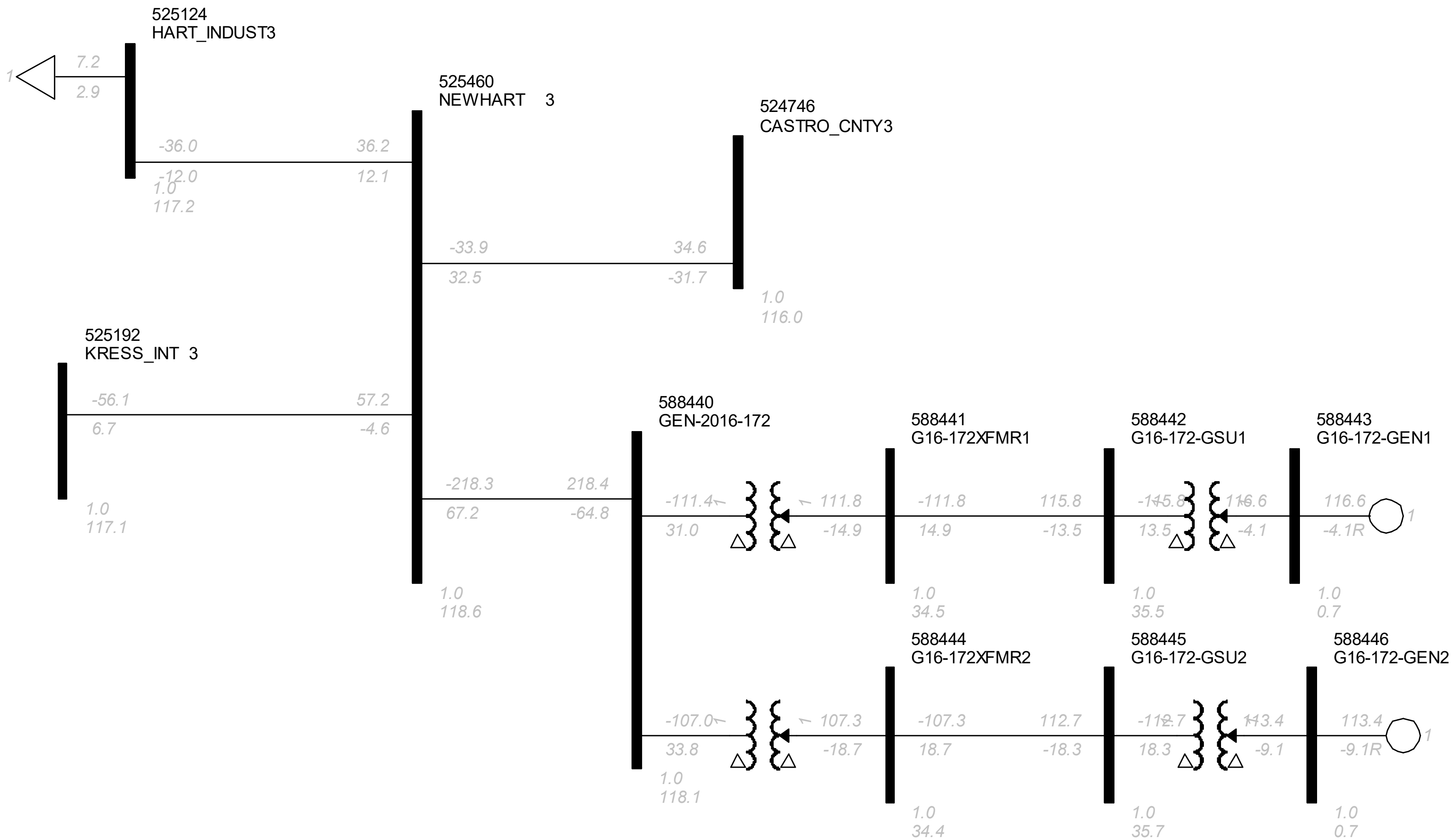


Figure 2-12. Power flow one-line diagram for interconnection project at Newhart 115 kV (GEN-2016-172).

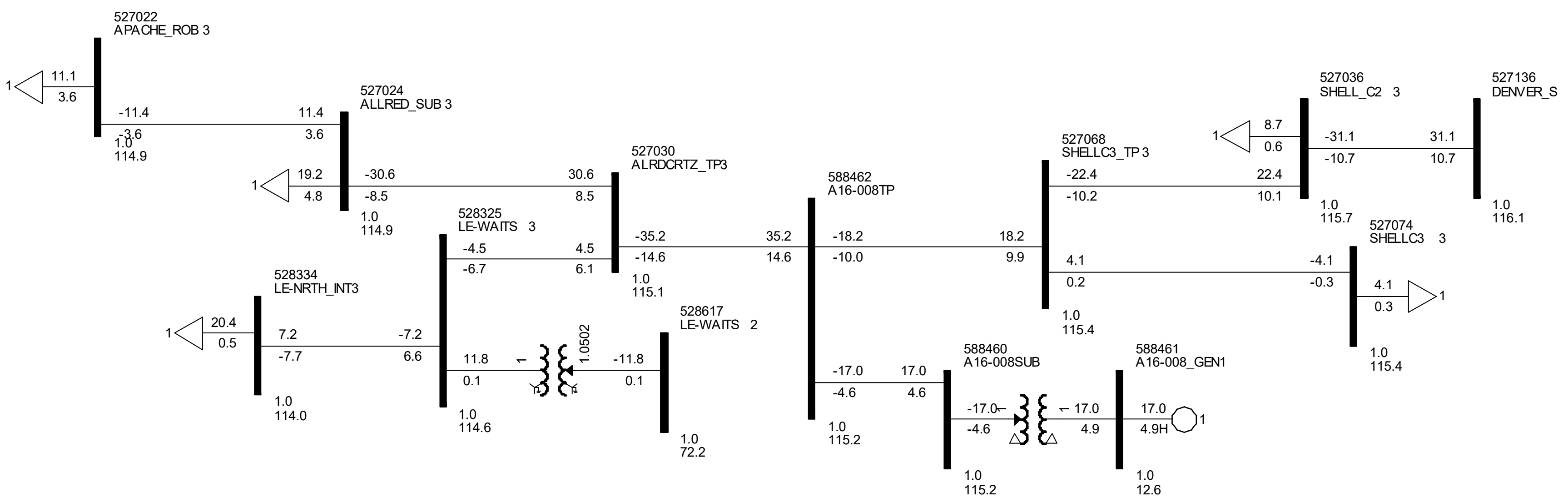


Figure 2-13. Power flow one-line diagram for interconnection project at Ink Basin to Denver City 115 kV Tap POI (GEN-2016-177 (A16-008)).

Table 2-3
Case List with Contingency Description

Cont. No.	Cont. Name	Description
1	FLT01-3PH	3 phase fault on the GEN-2016-177-Tap (588462) to ALRDCRTZ Tap (527030) 115 kV line circuit 1, near GEN-2016-177-Tap. a. Apply fault at the GEN-2016-177-Tap 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT02-3PH	3 phase fault on the GEN-2016-177-Tap (588462) to Shell Tap (527068) 115 kV line circuit 1, near GEN-2016-177-Tap. a. Apply fault at the GEN-2016-177-Tap 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
3	FLT03-3PH	3 phase fault on the Shell Tap (527068) to Shell C2 (527036) 115 kV line circuit 1, near Shell Tap. a. Apply fault at the Shell Tap 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT04-3PH	3 phase fault on the ALRDCRTZ Tap (527030) to ALLRED Sub (527024) 115 kV line circuit 1, near ALRDCRTZ Tap. a. Apply fault at the ALRDCRTZ Tap 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
5	FLT05-3PH	3 phase fault on the ALRDCRTZ Tap (527030) to LE-WAITS (528325) 115 kV line circuit 1, near ALRDCRTZ Tap. a. Apply fault at the ALRDCRTZ Tap 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT06-3PH	Removed
7	FLT07-3PH	Removed
8	FLT08-3PH	Removed
9	FLT09-3PH	Removed
10	FLT10-3PH	Removed
11	FLT11-3PH	Removed
12	FLT12-3PH	Removed

Cont. No.	Cont. Name	Description
13	FLT13-3PH	Removed
14	FLT14-SB	**Single phase fault with stuck breaker at Shell Tap (527068)** a. Apply fault at the Shell Tap 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Shell Tap (527068) – GEN-2016-177-Tap (588462) 115 kV d. Shell Tap (527068) – Shell C2 (527036) 115 kV
15	FLT15-SB	**Single phase fault with stuck breaker at ALRDCRTZ (527030)** a. Apply fault at the ALRDCRTZ 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. ALRDCRTZ (527030) – ALLRED Sub (527024) 115 kV d. ALRDCRTZ (527030) – LE-WAITS (528325) 115 kV
16	FLT16-SB	Removed
17	FLT17-SB	Removed
18	FLT18-SB	Removed
19	FLT19-PO	**Prior Outage of GEN-2016-177-Tap 115 kV (588462) to Shell Tap 115 kV (527068) circuit 1;** 3 phase fault on the LE-LOVINGTON (528618) to LE-NRTH_INT (528334) transformer, near LE-NRTH_INT. a. Apply fault at the LE-NRTH_INT 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
20	FLT20-PO	**Prior Outage of GEN-2016-177-Tap 115 kV (588462) to Shell Tap 115 kV (527068) circuit 1;** 3 phase fault on the ALRDCRTZ Tap (527030) to LE-WAITS (528325) 115 kV line circuit 1, near ALRDCRTZ Tap. a. Apply fault at the ALRDCRTZ Tap 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
21	FLT21-PO	**Prior Outage of LE-LOVINGTON (528618) to LE-NRTH_INT (528334) xfmr 1;** 3 phase fault on the ALRDCRTZ Tap (527030) to LE-WAITS (528325) 115 kV line circuit 1, near ALRDCRTZ Tap. a. Apply fault at the ALRDCRTZ Tap 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
22	FLT22-PO	**Prior Outage of LE-LOVINGTON (528618) to LE-NRTH_INT (528334) xfmr 1;** 3 phase fault on the GEN-2016-177-Tap (588462) to Shell Tap (527068) 115 kV line circuit 1, near GEN-2016-177-Tap. a. Apply fault at the GEN-2016-177-Tap 115 bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
23	FLT23-PO	**Prior Outage of LE-NRTH_INT (528334) to LE-WAITS (528325) circuit 1;** 3 phase fault on the ALRDCRTZ Tap (527030) to ALLRED Sub (527024) 115 kV line circuit 1, near ALRDCRTZ Tap. a. Apply fault at the ALRDCRTZ Tap 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
24	FLT24-PO	**Prior Outage of LE-NRTH_INT (528334) to LE-WAITS (528325) circuit 1;** 3 phase fault on the GEN-2016-177-Tap (588462) to Shell Tap (527068) 115 kV line circuit 1, near GEN-2016-177-Tap. a. Apply fault at the GEN-2016-177-Tap 115 bus. b. Clear fault after 5 cycles by tripping the faulted line.
25	FLT25-PO	Removed
26	FLT26-3PH	3 phase fault on the Wolfforth (526524) to Yuma (526475) 115 kV line, near Wolfforth a. Apply fault at the Wolfforth 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
27	FLT27-3PH	3 phase fault on the Wolfforth (526524) to Terry County (526736) 115 kV line, near Wolfforth a. Apply fault at the Wolfforth 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
28	FLT28-3PH	3 phase fault on the Wolfforth 115 kV (526524) to Wolfforth 230 kV (526525) to Wolfforth 13.2 kV (526522) XFMR CKT 1, near Wolfforth 115 kV. a. Apply fault at the Wolfforth 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
29	FLT29-3PH	3 phase fault on the Terry County (526736) to Denver North (527130) 115 kV line, near Terry County a. Apply fault at the Terry County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
30	FLT30-3PH	3 phase fault on the Terry County (526736) to LG-Clauene (526491) 115 kV line, near Terry County a. Apply fault at the Terry County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
31	FLT31-3PH	3 phase fault on the Terry County (526736) to Sulphur (527262) 115 kV line, near Terry County a. Apply fault at the Terry County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
32	FLT32-3PH	3 phase fault on the Terry County (526736) to Prentice (526792) 115 kV line, near Terry County a. Apply fault at the Terry County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
33	FLT33-3PH	3 phase fault on the Terry County 115/69/13.2 kV (526736/526735/526733) transformer circuit 1, near Terry County 115 kV. a. Apply fault at the Terry County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
34	FLT34-3PH	3 phase fault on the Yuma (526475) to SP-Wolfforth Tap (526481) 115 kV line, near Yuma a. Apply fault at the Yuma 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
35	FLT35-3PH	3 phase fault on the Wolfforth (526525) to Sundown (526435) 230 kV line, near Wolfforth a. Apply fault at the Wolfforth 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
36	FLT36-3PH	3 phase fault on the Wolfforth (526525) to Lubbock South (526269) 230 kV line, near Wolfforth a. Apply fault at the Wolfforth 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
37	FLT37-3PH	3 phase fault on the Wolfforth (526525) to Carlisle (526161) 230 kV line, near Wolfforth a. Apply fault at the Wolfforth 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
38	FLT38-3PH	3 phase fault on the SP-Wolfforth Tap (526481) to LP-Doud Tap (526162) 115 kV line, near SP-Wolfforth Tap a. Apply fault at the SP-Wolfforth Tap 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
39	FLT39-3PH	Removed
40	FLT40-SB	**Single phase fault with stuck breaker at Wolfforth (526524)** a. Apply fault at the Wolfforth 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Wolfforth (526524) – Yuma (526475) 115 kV d. Wolfforth (526524) – Terry County (526736) 115 kV
41	FLT41-SB	**Single phase fault with stuck breaker at Wolfforth (526524)** a. Apply fault at the Wolfforth 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Wolfforth 115 kV (526524)/230 kV (526525)/13.2 kV (526522) xfmr d. Wolfforth (526524) – Terry County (526736) 115 kV
42	FLT42-SB	Removed
43	FLT43-SB	**Single phase fault with stuck breaker Terry County (526736)** a. Apply fault at the Terry County 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Terry County (526736) – Prentice (526792) 115 kV d. Terry County (526736) – Sulphur (527262) 115 kV

Cont. No.	Cont. Name	Description
44	FLT44-SB	**Single phase fault with stuck breaker Terry County (526736)** a. Apply fault at the Terry County 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Terry County (526736) – Denver (527130) 115 kV d. Terry County (526736) – LG-Clauene (526491) 115 kV
45	FLT45-PO	**Prior Outage of the Wolfforth (526524) to Terry County (526736) 115 kV line circuit 1;** 3 phase fault on the Wolfforth 115 kV (526524)/230 kV (526525)/13.2 kV (526522) transformer, near Wolfforth. a. Apply fault at the Wolfforth 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
46	FLT46-PO	**Prior Outage of the Wolfforth (526524) to Terry County (526736) 115 kV line circuit 1;** 3 phase fault on the Wolfforth (526524) to Yuma (526475) 115 kV line, near Wolfforth a. Apply fault at the Wolfforth 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
47	FLT47-PO	**Prior Outage of the Wolfforth (526524) to Yuma (526475) 115 kV line circuit 1;** 3 phase fault on the Wolfforth 115 kV (526524)/230 kV (526525)/13.2 kV (526522) transformer, near Wolfforth. a. Apply fault at the Wolfforth 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
48	FLT48-PO	**Prior Outage of the Wolfforth (526524) to Yuma (526475) 115 kV line circuit 1;** 3 phase fault on the Wolfforth (526524) to Terry County (526736) 115 kV line circuit 1, near Wolfforth. a. Apply fault at the Wolfforth 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
49	FLT49-PO	**Prior Outage of the SP-Wolfforth Tap (526481) to SP-Wolfforth (526483) 115 kV line circuit 1;** 3 phase fault on the SP-Wolfforth Tap (526481) to LP-Doud (526162) 115 kV line circuit 1, near SP-Wolfforth Tap. a. Apply fault at the SP-Wolfforth Tap 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
50	FLT50-3PH	3 phase fault on the G15-039-Tap (560051) to Deaf Smith (524623) 230 kV line circuit 1, near G15-039-Tap. a. Apply fault at the G15-039-Tap 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
51	FLT51-3PH	3 phase fault on the G15-039-Tap (560051) to Plant X (525481) 230 kV line circuit 1, near G15-039-Tap. a. Apply fault at the G15-039-Tap 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
52	FLT52-3PH	3 phase fault on the Deaf Smith (524623) to Bushland (524267) 230 kV line circuit 1, near Deaf Smith. a. Apply fault at the Deaf Smith 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
53	FLT53-3PH	3 phase fault on the Deaf Smith 230/115/13.2 kV (524623/524622/524620) transformer circuit 1, near Deaf Smith 230 kV. a. Apply fault at the Deaf Smith 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
54	FLT54-3PH	3 phase fault on the Bushland (524267) to Potter County (523959) 230 kV line circuit 1, near Bushland. a. Apply fault at the Bushland 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
55	FLT55-3PH	3 phase fault on the Plant X (525481) to Tolk East (525524) 230 kV line circuit 2, near Plant X. a. Apply fault at the Plant X 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
56	FLT56-3PH	3 phase fault on the Plant X (525481) to Newhart (525461) 230 kV line circuit 1, near Plant X. a. Apply fault at the Plant X 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
57	FLT57-3PH	3 phase fault on the Plant X (525481) to Tolk West (525531) 230 kV line circuit 1, near Plant X. a. Apply fault at the Plant X 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
58	FLT58-3PH	3 phase fault on the Plant X (525481) to Sundown (526435) 230 kV line circuit 1, near Plant X. a. Apply fault at the Plant X 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
59	FLT59-3PH	3 phase fault on the Plant X 230/115/13.2 kV (525481/525480/525479) transformer circuit 1, near Plant X 230 kV. a. Apply fault at the Plant X 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
60	FLT60-SB	**Single phase fault with stuck breaker** on the Tolk West (525531) to Plant X (525481) 230 kV circuit 1 line, near Tolk West. a. Apply fault at the Tolk West 230 kV bus. b. Run 5 cycles, and then open Plant X end of the faulted line. c. Run 10 cycles, and then clear the fault and disconnect Tolk West 230 kV bus (525531).
61	FLT61- SB	**Single phase fault with stuck breaker** on the Tolk East (525524) to Plant X (525481) 230 kV line circuit 2, near Tolk East. a. Apply fault at the Tolk East 230 kV bus. b. Run 5 cycles, and then open Plant X end of the faulted line. c. Run 10 cycles, and then clear the fault and disconnect Tolk East 230 kV bus (525524).
62	FLT62- SB	**Single phase fault with stuck breaker at Deaf Smith (524623) 230 kV** a. Apply fault at the Deaf Smith 230 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Deaf Smith (524623) - Bushland (524267) 230 kV d. Deaf Smith (524623) – G15-039-Tap (560051) 230 kV

Cont. No.	Cont. Name	Description
63	FLT63- SB	**Single phase fault with stuck breaker at Plant X (525481) 230 kV** a. Apply fault at the Plant X 230 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Plant X (525481) – G15-039-Tap (560051) 230 kV d. Plant X (525481) – Newhart (525461) 230 kV
64	FLT64- SB	**Single phase fault with stuck breaker at Plant X (525481) 230 kV** a. Apply fault at the Plant X 230 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Plant X (525481) – Tolk West (525531) 230 kV d. Plant X (525481) – Sundown (526435) 230 kV
65	FLT65- SB	**Single phase fault with stuck breaker at Plant X (525481) 230 kV** a. Apply fault at the Plant X 230 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Plant X 230/115/13.2 kV (525481/525480/525479) transformer d. Plant X (525481) – Newhart (525461) 230 kV
66	FLT66-PO	**Prior Outage of the Plant X 230/115/13.2 kV (525481/525480/525479) transformer circuit 1;** 3 phase fault on the Plant X 230 kV (525481) to Sundown (526435) 230 kV line circuit 1, near Plant X. a. Apply fault at the Plant X 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
67	FLT67- PO	**Prior Outage of the Plant X 230/115/13.2 kV (525481/525480/525479) transformer circuit 1;** 3 phase fault on the G15-039-Tap (560051) to Deaf Smith (524623) 230 kV line circuit 1, near G15-039-Tap. a. Apply fault at the G15-039-Tap 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line
68	FLT68- PO	**Prior Outage of the Plant X (525481) to Sundown (526435) 230 kV Line;** 3 phase fault on the Plant X 230 kV (525481) to Tolk East (525524) 230 kV line circuit 2, near Plant X. a. Apply fault at the Plant X 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
69	FLT69- PO	**Prior Outage of the Plant X (525481) to Sundown (526435) 230 kV Line;** 3 phase fault on the G15-039-Tap (560051) to Deaf Smith (524623) 230 kV line circuit 1, near G15-039-Tap. a. Apply fault at the G15-039-Tap 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line

Cont. No.	Cont. Name	Description
70	FLT70- PO	**Prior Outage of the Deaf Smith (524623) to Bushland (524267) 230 kV Line;** 3 phase fault on the Deaf Smith 230 kV to G15-039-Tap (560051) 230 kV line circuit 1, near Deaf Smith. a. Apply fault at the D 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
71	FLT71-PO	**Prior Outage of the Deaf Smith (524623) to Bushland (524267) 230 kV Line;** 3 phase fault on the G15-039-Tap (560051) to Plant X (525481) 230 kV line circuit 1, near G15-039-Tap. a. Apply fault at the G15-039-Tap 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
72	FLT72-3PH	3 phase fault on the Mustang (527149) to Amoco Wasson (526784) 230 kV line circuit 1, near Mustang. a. Apply fault at the Mustang 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
73	FLT73-3PH	3 phase fault on the Mustang 230/115/13.2 kV (527149/527146/527143) transformer circuit 1, near Mustang 230 kV. a. Apply fault at the Mustang 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
74	FLT74-3PH	3 phase fault on the Mustang (527149) to Yoakum (526935) 230 kV line circuit 1, near Mustang. a. Apply fault at the Mustang 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
75	FLT75-3PH	3 phase fault on the Mustang (527149) to Seminole (527276) 230 kV line circuit 1, near Mustang. a. Apply fault at the Mustang 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
76	FLT76-3PH	3 phase fault on the Seminole 230/115/13.2 kV (527276/527275/527273) transformer circuit 1, near Seminole 230 kV. a. Apply fault at the Seminole 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.

Cont. No.	Cont. Name	Description
77	FLT77-3PH	3 phase fault on the Yoakum (526935) to G13-027-TAP (562480) 230 kV line, near Yoakum. a. Apply fault at the Yoakum 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
78	FLT78-3PH	3 phase fault on the Yoakum (526935) to Amoco (526460) 230 kV line, near Yoakum. a. Apply fault at the Yoakum 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
79	FLT79-3PH	3 phase fault on the Yoakum (526935) to G1579&G1580T (560059) 230 kV line, near Yoakum. a. Apply fault at the Yoakum 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
80	FLT80-3PH	3 phase fault on the Yoakum (526935) to OxyBru Tap (527009) 230 kV line, near Yoakum. a. Apply fault at the Yoakum 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
81	FLT81-3PH	3 phase fault on the Yoakum 230/115/13.2 kV (526935/526935/526931) transformer circuit 1, near Yoakum 230 kV. a. Apply fault at the Yoakum 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
82	FLT82-3PH	3 phase fault on the Amoco Wasson (526784) to OxyBru Tap (527009) 230 kV line circuit 1, near Amoco Wasson. a. Apply fault at the Amoco Wasson 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
83	FLT83-3PH	3 phase fault on the Mustang (527146) to Denver North (527130) 115 kV line circuit 1, near Mustang. a. Apply fault at the Mustang 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
84	FLT84-3PH	3 phase fault on the Mustang (527146) to Seagraves (527202) 115 kV line circuit 1, near Mustang. a. Apply fault at the Mustang 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
85	FLT85-3PH	3 phase fault on the Mustang (527146) to Denver South (527136) 115 kV line circuit 1, near Mustang. a. Apply fault at the Mustang 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
86	FLT86-3PH	3 phase fault on the Mustang (527146) to Shell Co (527062) 115 kV line circuit 1, near Mustang. a. Apply fault at the Mustang 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
87	FLT87-3PH	3 phase fault on the Seagraves (527202) to LG-PLSHILL (527194) 115 kV line circuit 1, near Seagraves. a. Apply fault at the Seagraves 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
88	FLT88-3PH	3 phase fault on the Seagraves (527202) to Sulphur (527262) 115 kV line circuit 1, near Seagraves. a. Apply fault at the Seagraves 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
89	FLT89-3PH	3 phase fault on the Denver North (527136) to Shell (527036) 115 kV line circuit 1, near Denver North. a. Apply fault at the Denver North 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
90	FLT90-3PH	3 phase fault on the Denver North (527136) to San Andreas (527105) 115 kV line circuit 1, near Denver North. a. Apply fault at the Denver North 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
91	FLT91-3PH	3 phase fault on the Denver North 115/69/13.2 kV (527130/527125/527122) transformer circuit 2, near Denver North. a. Apply fault at the Denver North 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
92	FLT92-SB	**Single phase fault with stuck breaker at Mustang (527149)** a. Apply fault at the Mustang 230 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Mustang 230/115/13.2 kV (527149/527146/527143) transformer d. Mustang (527149) – Amoco Wasson (526784) 230 kV
93	FLT93-SB	**Single phase fault with stuck breaker at Mustang (527149)** a. Apply fault at the Mustang 230 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Mustang (527149) – Seminole (527276) 230 kV d. Mustang (527149) – Amoco Wasson (526784) 230 kV
94	FLT94-SB	**Single phase fault with stuck breaker** on the Yoakum (526935) to G13-027-Tap (562480) 230 kV line, near Yoakum. a. Apply fault at the Yoakum 230 kV bus. b. Run 5 cycles, and then open G13-027-Tap end of the faulted line. c. Run 10 cycles, and then clear the fault and open Yoakum end of the line in (b) and trip Yoakum 230/115/13.2 kV (526935/526934/526931) transformer circuit 1.

Cont. No.	Cont. Name	Description
95	FLT95-SB	**Single phase fault with stuck breaker** on the Yoakum (526935) to Amoco-SS (526460) 230 kV line, near Yoakum. a. Apply fault at the Yoakum 230 kV bus. b. Run 5 cycles, and then open Amoco-SS end of the faulted line. c. Run 10 cycles, and then clear the fault and trip Yoakum 230 kV (526935) bus.
96	FLT96-SB	**Single phase fault with stuck breaker at Mustang (527146)** a. Apply fault at the Mustang 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Mustang 230/115/13.2 kV (527149/527146/527143) transformer d. Mustang (527146) – Denver South (527136) 115 kV
97	FLT97-SB	**Single phase fault with stuck breaker at Mustang (527146)** a. Apply fault at the Mustang 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Mustang (527146) – Seagraves (527202) 115 kV d. Mustang (527146) – Denver North (527130) 115 kV
98	FLT98-SB	**Single phase fault with stuck breaker at Mustang (527146)** a. Apply fault at the Mustang 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Mustang (527146) – Denver South (527136) 115 kV d. Mustang (527146) – Denver North (527130) 115 kV
99	FLT99-SB	**Single phase fault with stuck breaker at Mustang (527146)** a. Apply fault at the Mustang 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Mustang (527146) – Shell County (527062) 115 kV d. Mustang (527146) – Seagraves (527202) 115 kV
100	FLT100-PO	**Prior Outage of the Mustang (527149) to Seminole (527276) 230 kV line circuit 1;** 3 phase fault on the Mustang (527149) to Yoakum (526935) 230 kV line circuit 1, near Mustang. a. Apply fault at the Mustang 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
101	FLT101- PO	**Prior Outage of the Mustang (527149) to Seminole (527276) 230 kV line circuit 1;** 3 phase fault on the Mustang (527149) to Amoco Wasson (526784) 230 kV line circuit 1, near Mustang. a. Apply fault at the Mustang 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
102	FLT102- PO	**Prior Outage of the Mustang (527149) to Yoakum (526935) 230 kV line circuit 1;** 3 phase fault on the Mustang (527149) to Seminole (527276) 230 kV line circuit 1, near Mustang. a. Apply fault at the Mustang 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
103	FLT103- PO	**Prior Outage of the Mustang (527149) to Yoakum (526935) 230 kV line circuit 1;** 3 phase fault on the Mustang (527149) to Amoco Wasson (526784) 230 kV line circuit 1, near Mustang. a. Apply fault at the Mustang 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
104	FLT104- PO	**Prior Outage of the Mustang (527146) to Denver North (527130) 115 kV line circuit 1;** 3 phase fault on the Mustang (527146) to Denver South (527136) 115 kV line circuit 2, near Mustang. a. Apply fault at the Mustang 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
105	FLT105- PO	**Prior Outage of the Mustang (527146) to Denver North (527130) 115 kV line circuit 1;** 3 phase fault on the Mustang (527146) to Shell Co (527062) 115 kV line circuit 1, near Mustang. a. Apply fault at the Mustang 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
106	FLT106- PO	**Prior Outage of the Mustang (527149) 230 kV to Mustang (527146) 115 kV transformer, circuit 1;** 3 phase fault on the Mustang (527146) to Denver North (527130) 115 kV line circuit 1, near Mustang. a. Apply fault at the Mustang 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
107	FLT107- PO	**Prior Outage of the Mustang (527146) to Shell County (527062) 115 kV line circuit 1;** 3 phase fault on the Mustang (527146) to Denver South (527136) 115 kV line circuit 2, near Mustang. a. Apply fault at the Mustang 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
108	FLT108-3PH	3 phase fault on the Maddox (528355) to Cunningham (527864) 115 kV line circuit 1, near Maddox. a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
109	FLT109-3PH	3 phase fault on the Maddox (528355) to Hobbs Interchange (527891) 115 kV line circuit 1, near Maddox. a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
110	FLT110-3PH	3 phase fault on the Maddox (528355) to Pearle (528392) 115 kV line circuit 1, near Maddox. a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
111	FLT111-3PH	3 phase fault on the Maddox (528355) to Sanger Switch (528463) 115 kV line circuit 1, near Maddox. a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
112	FLT112-3PH	3 phase fault on the Maddox (528355) to Monument (528491) 115 kV line circuit 1, near Maddox. a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
113	FLT113-3PH	3 phase fault on the Cunningham (527864) to Monument Tap (528568) 115 kV line circuit 1, near Cunningham. a. Apply fault at the Cunningham 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
114	FLT114-3PH	3 phase fault on the Cunningham (527864) to Buckeye Tap (528348) 115 kV line circuit 1, near Cunningham. a. Apply fault at the Cunningham 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
115	FLT115-3PH	3 phase fault on the Cunningham (527864) to Quahada (528394) 115 kV line circuit 1, near Cunningham. a. Apply fault at the Cunningham 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
116	FLT116-3PH	3 phase fault on the Cunningham (527864) to Hobbs Interchange (527891) 115 kV line circuit 1, near Cunningham. a. Apply fault at the Cunningham 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
117	FLT117-3PH	3 phase fault on the Cunningham 230/115/13.2 kV (527864/527867/527863) transformer circuit 1, near Cunningham. a. Apply fault at the Cunningham 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
118	FLT118-3PH	3 phase fault on the Hobbs Interchange (527891) to LE-West (528333) 115 kV line circuit 1, near Hobbs Interchange. a. Apply fault at the Hobbs Interchange 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
119	FLT119-3PH	3 phase fault on the Hobbs Interchange (527891) to Bensing (528333) 115 kV line circuit 1, near Hobbs Interchange. a. Apply fault at the Hobbs Interchange 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
120	FLT120-3PH	3 phase fault on the Hobbs Interchange (527891) to Millen (528435) 115 kV line circuit 1, near Hobbs Interchange. a. Apply fault at the Hobbs Interchange 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
121	FLT121-3PH	3 phase fault on the Hobbs Interchange 230/115/13.2 kV (527891/527894/527890) transformer 1, near Hobbs Interchange. a. Apply fault at the Hobbs Interchange 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
122	FLT122-3PH	3 phase fault on the Monument (528491) to West Hobbs (528498) 115 kV line circuit 1, near Monument. a. Apply fault at the Monument 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
123	FLT123-SB	**Single phase fault with stuck breaker at Maddox (528355)** a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Maddox (528355) – Cunningham (527864) 115 kV d. Maddox (528355) – Hobbs Interchange (527891) 115 kV
124	FLT124-SB	**Single phase fault with stuck breaker at Maddox (528355)** a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Maddox (528355) – Cunningham (527864) 115 kV d. Maddox (528355) – Monument (528491) 115 kV
125	FLT125-SB	**Single phase fault with stuck breaker at Maddox (528355)** a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Maddox (528355) – Sanger Switch (528463) 115 kV d. Maddox (528355) – Pearle (528392) 115 kV
126	FLT126-SB	**Single phase fault with stuck breaker at Maddox (528355)** a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Maddox (528355) – Sanger Switch (528463) 115 kV d. Maddox (528355) – Monument (528491) 115 kV
127	FLT127-SB	**Single phase fault with stuck breaker at Cunningham (527864)** a. Apply fault at the Cunningham 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Cunningham (527864) – Hobbs Interchange (527891) 115 kV circuit 1 d. Cunningham (527864) – Hobbs Interchange (527891) 115 kV circuit 2

Cont. No.	Cont. Name	Description
128	FLT128-SB	**Single phase fault with stuck breaker at Cunningham (527864)** a. Apply fault at the Cunningham 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Cunningham (527864) – Buckeye Tap (528348) 115 kV d. Cunningham (527864) – Monument Tap (528568) 115 kV
129	FLT129-SB	**Single phase fault with stuck breaker at Hobbs Interchange (527891)** a. Apply fault at the Hobbs Interchange 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Hobbs Interchange (527891) – Millen (528435) 115 kV d. Hobbs Interchange (527891) – Bensing (528433) 115 kV
130	FLT130-SB	**Single phase fault with stuck breaker at Hobbs Interchange (527891)** a. Apply fault at the Hobbs Interchange 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Hobbs Interchange 230/115/13.2 kV (527891/527894/527890) transformer circuit 1 d. Hobbs Interchange 230/115/13.2 kV (527891/527894/527889) transformer circuit 2
131	FLT131-PO	**Prior Outage of the Maddox (528355) to Cunningham (527864) 115 kV line circuit 1;** 3 phase fault on the Maddox (528355) to Hobbs Interchange (527891) 115 kV line circuit 1, near Maddox. a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
132	FLT132-PO	**Prior Outage of the Maddox (528355) to Cunningham (527864) 115 kV line circuit 1;** 3 phase fault on the Maddox (528355) to Pearle (528392) 115 kV line circuit 1, near Maddox. a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
133	FLT133-PO	**Prior Outage of the Maddox (528355) to Cunningham (527864) 115 kV line circuit 1;** 3 phase fault on the Maddox (528355) to Sanger Switch (528463) 115 kV line circuit 1, near Maddox. a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
134	FLT134-PO	**Prior Outage of the Maddox (528355) to Sanger Switch (528463) 115 kV line circuit 1;** 3 phase fault on the Maddox (528355) to Cunningham (527864) 115 kV line circuit 1, near Maddox. a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
135	FLT135-PO	**Prior Outage of the Maddox (528355) to Sanger Switch (528463) 115 kV line circuit 1;** 3 phase fault on the Maddox (528355) to Hobbs Interchange (527891) 115 kV line circuit 1, near Maddox. a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
136	FLT136-PO	**Prior Outage of the Maddox (528355) to Sanger Switch (528463) 115 kV line circuit 1;** 3 phase fault on the Maddox (528355) to Monument (528491) 115 kV line circuit 1, near Maddox. a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
137	FLT137-PO	**Prior Outage of the Maddox (528355) to Sanger Switch (528463) 115 kV line circuit 1;** 3 phase fault on the Maddox (528355) to Pearle (587670) 115 kV line circuit 1, near Maddox. a. Apply fault at the Maddox 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
138	FLT138-3PH	3 phase fault on the Swisher (525212) to Kress (525192) 115 kV line circuit 1, near Swisher. a. Apply fault at the Swisher 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
139	FLT139-3PH	3 phase fault on the Swisher 230/115/13.2 kV (525213/525212/525211) transformer circuit 1, near Swisher 115 kV. a. Apply fault at the Swisher 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
140	FLT140-3PH	3 phase fault on the Kress (525192) to Kress Rural (525225) 115 kV line circuit 1, near Kress. a. Apply fault at the Kress 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
141	FLT141-3PH	3 phase fault on the Kress (525192) to Newhart (525460) 115 kV line circuit 1, near Kress. a. Apply fault at the Kress 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
142	FLT142-3PH	3 phase fault on the Kress (525192) to Tulia Tap (525179) 115 kV line circuit 1, near Kress. a. Apply fault at the Kress 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
143	FLT143-3PH	3 phase fault on the Kress (525192) to Hale County (525454) 115 kV line circuit 1, near Kress. a. Apply fault at the Kress 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
144	FLT144-3PH	3 phase fault on the Kress 115/69/13.2 kV (525192/525191/525190) transformer circuit 1, near Kress 115 kV. a. Apply fault at the Kress 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
145	FLT145-3PH	3 phase fault on the Swisher (525213) to Crawfish Draw (560021) 230 kV line circuit 1, near Swisher. a. Apply fault at the Swisher 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
146	FLT146-3PH	3 phase fault on the Swisher (525213) to Newhart (525461) 230 kV line circuit 1, near Swisher. a. Apply fault at the Swisher 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
147	FLT147-3PH	3 phase fault on the Swisher (525213) to G15-031-Tap (560050) 230 kV line circuit 1, near Swisher. a. Apply fault at the Swisher 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
148	FLT148-SB	**Single phase fault with stuck breaker at Swisher (525213) 230 kV** a. Apply fault at the Swisher 230 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Swisher (525213) – Newhart (525461) 230 kV d. Swisher 230/115/13.2 kV (525213/525212/525211) transformer
149	FLT149-SB	**Single phase fault with stuck breaker at Swisher (525213) 230 kV** a. Apply fault at the Swisher 230 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Swisher (525213) – Crawfish Draw (560021) 230 kV d. Swisher 230/115/13.2 kV (525213/525212/525211) transformer
150	FLT150-SB	**Single phase fault with stuck breaker at Swisher (525213) 230 kV** a. Apply fault at the Swisher 230 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Swisher (525213) – Newhart (525461) 230 kV d. Swisher (525213) – G15-031-Tap (560050) 230 kV
151	FLT151-SB	**Single phase fault with stuck breaker at Kress (525192) 115 kV** a. Apply fault at the Kress 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Kress (525192) – Tulia Tap (525179) 115 kV d. Kress (525192) – Kress Rural (525225) 115 kV
152	FLT152-SB	**Single phase fault with stuck breaker at Kress (525192) 115 kV** a. Apply fault at the Kress 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Kress (525192) – Newhart (525460) 115 kV d. Kress (525192) – Hale County (525454) 115 kV
153	FLT153-PO	**Prior Outage of the Swisher (525213) to Crawfish Draw (560021) 230 kV line circuit 1;** 3 phase fault on the Swisher (525212) to Kress (525192) 115 kV line circuit 1, near Swisher. a. Apply fault at the Swisher 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line
154	FLT154-PO	**Prior Outage of the Swisher (525213) to Crawfish Draw (560021) 230 kV line circuit 1;** 3 phase fault on the Swisher (525212) to Newhart (525461) 230 kV line circuit 1, near Swisher. a. Apply fault at the Swisher 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line

Cont. No.	Cont. Name	Description
155	FLT155-PO	**Prior Outage of the Swisher (525213) to Crawfish Draw (560021) 230 kV line circuit 1;** 3 phase fault on the Kress (525192) to Newhart (525460) 115 kV line circuit 1, near Swisher. a. Apply fault at the Swisher 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line
156	FLT156-PO	**Prior Outage of the Swisher (525213) to Crawfish Draw (560021) 230 kV line circuit 1;** 3 phase fault on the Kress (525192) to Tulia Tap (525179) 115 kV line circuit 1, near Swisher. a. Apply fault at the Swisher 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line
157	FLT157-PO	**Prior Outage of the Swisher (525212) to Kress (525192) 115 kV line circuit 1;** 3 phase fault on the Swisher (525213) to Newhart (525461) 230 kV line circuit 1, near Swisher. a. Apply fault at the Swisher 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line
158	FLT158-PO	**Prior Outage of the Swisher (525212) to Kress (525192) 115 kV line circuit 1;** 3 phase fault on the Swisher (525213) to Crawfish Draw (560021) 230 kV line circuit 1, near Swisher. a. Apply fault at the Swisher 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line
159	FLT159-3PH	3 phase fault on the Ozark Mahoning (526770) to Lakeview (526631) 69 kV line circuit 1, near Ozark Mahoning. a. Apply fault at the Ozark Mahoning 69 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
160	FLT160-3PH	3 phase fault on the LG-Dixon (526711) to Ozark Mahoning (526770) 69 kV line circuit 1, near LG-Dixon. a. Apply fault at the LG-Dixon 69 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
161	FLT161-3PH	3 phase fault on the Brownfield (526754) to LG-Brownfield (526747) 69 kV line circuit 1, near Brownfield. a. Apply fault at the Brownfield 69 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
162	FLT162-3PH	3 phase fault on the Brownfield (526754) to Brownfield Tap (526761) 69 kV line circuit 1, near Brownfield. a. Apply fault at the Brownfield 69 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
163	FLT163-3PH	3 phase fault on the Terry County (526735) to LG-DOCWEBR (526506) 69 kV line circuit 1, near Swisher. a. Apply fault at the Terry County 69 kV bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
164	FLT164-SB	**Single phase fault with stuck breaker at Terry County (526735) 69 kV** a. Apply fault at the Terry County 69 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Terry County (526735) – LG-DOCWEBR (526506) 69 kV d. Terry County 115/69/13.2 kV (526736/526735/526733) transformer
165	FLT165-PO	**Prior Outage of the Terry County 115/69/13.2 kV (526736/526735/526733) transformer circuit 1;** 3 phase fault on the Terry County (526735) to LG-DOCWEBR (526506) 69 kV line circuit 1, near Swisher. a. Apply fault at the Terry County 69 kV bus. b. Clear fault after 5 cycles by tripping the faulted line
166	FLT166-3PH	3 phase fault on the Bailey County (525028) to Curry (524822) 115 kV line circuit 1, near Bailey County. a. Apply fault at the Bailey County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
167	FLT167-3PH	3 phase fault on the Bailey County 115/69/13.2 kV (525028/525027/525025) transformer circuit 1, near Bailey County 115 kV. a. Apply fault at the Bailey County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
168	FLT168-3PH	3 phase fault on the Bailey County (525028) to EMU&VLY Tap (525019) 115 kV line circuit 1, near Bailey County. a. Apply fault at the Bailey County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
169	FLT169-3PH	3 phase fault on the Curry (524822) to DS#20 (524669) 115 kV line circuit 1, near Curry. a. Apply fault at the Curry 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
170	FLT170-3PH	3 phase fault on the Curry (524822) to Norris Tap (524764) 115 kV line circuit 1, near Curry. a. Apply fault at the Curry 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
171	FLT171-3PH	3 phase fault on the Curry (524822) to E_Clovis (524773) 115 kV line circuit 1, near Curry. a. Apply fault at the Curry 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
172	FLT172-3PH	3 phase fault on the Curry (524822) to FE_Clovis2 (524838) 115 kV line circuit 1, near Curry. a. Apply fault at the Curry 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
173	FLT173-3PH	3 phase fault on the Curry (524822) to Roosevelt (524908) 115 kV line circuit 2, near Curry. a. Apply fault at the Curry 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
174	FLT174-3PH	3 phase fault on the Curry 115/69/13.2 kV (524822/524821/524819) transformer circuit 1, near Curry 115 kV. a. Apply fault at the Curry 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
175	FLT175-3PH	3 phase fault on the EMU&VLY Tap (525019) to Plant X (525480) 115 kV line circuit 1, near EMU&VLY Tap. a. Apply fault at the EMU&VLY Tap 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
176	FLT176-3PH	3 phase fault on the EMU&VLY Tap (525019) to EMULESH&VLY (525019) 115 kV line circuit 1, near EMU&VLY Tap. a. Apply fault at the EMU&VLY Tap 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
177	FLT177-SB	**Single phase fault with stuck breaker at Curry 115 kV (524822)** a. Apply fault at the Curry 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Curry (524822) – Bailey County (525028) 115 kV d. Curry (524822) – FE-Clovis (524838) 115 kV
178	FLT178-SB	**Single phase fault with stuck breaker at Curry 115 kV (524822)** a. Apply fault at the Curry 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Curry (524822) – Norris TP (524764) 115 kV d. Curry (524822) – Bailey County (525028) 115 kV
179	FLT179-SB	**Single phase fault with stuck breaker at Curry 115 kV (524822)** a. Apply fault at the Curry 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Curry (524822) – Roosevelt (524908) 115 kV d. Curry (524822) – FE-Clovis (524838) 115 kV

Cont. No.	Cont. Name	Description
180	FLT180-SB	**Single phase fault with stuck breaker at Curry 115 kV (524822)** a. Apply fault at the Curry 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Curry (524822) –DS#20 (524669) 115 kV d. Curry (524822) – FE-Clovis (524838) 115 kV
181	FLT181-SB	**Single phase fault with stuck breaker at Bailey County 115 kV (525028)** a. Apply fault at the Bailey County 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Bailey County (525028) – EMU&VLY Tap (525019) 115 kV d. Bailey County (525028) – Curry (524822) 115 kV
182	FLT182-SB	**Single phase fault with stuck breaker at Bailey County 115 kV (525028)** a. Apply fault at the Bailey County 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Bailey County 115/69/13.2 kV (525028/525027/525025) transformer d. Bailey County (525028) – Curry (524822) 115 kV
183	FLT183-PO	**Prior Outage of Bailey County 115 kV (525028) to EMU&VLY Tap 115 kV (525019) circuit 1;** 3 phase fault on Bailey County 115 kV (525028) to Curry 115 kV (524822) circuit 1, near Bailey County. a. Apply fault at the Bailey County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
184	FLT184-PO	**Prior Outage of Bailey County 115 kV (525028) to EMU&VLY Tap 115 kV (525019) circuit 1;** 3 phase fault on Bailey County 115/69/13.2 kV (525028/525027/525025) transformer circuit 1, near Bailey County. a. Apply fault at the Bailey County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
185	FLT185-PO	**Prior Outage of Roosevelt 115 kV (524908) to Curry 115 kV (524822) circuit 1;** 3 phase fault on Curry 115 kV (524822) to Bailey County 115 kV (525028) circuit 1, near Curry. a. Apply fault at the Curry 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line
186	FLT186-PO	**Prior Outage of Roosevelt 115 kV (524908) to Curry 115 kV (524822) circuit 1;** 3 phase fault on Curry 115 kV (524822) to DS#20 115 kV (524669) circuit 1, near Curry. a. Apply fault at the Curry 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line

Cont. No.	Cont. Name	Description
187	FLT187-PO	**Prior Outage of Bailey County 115 kV (525028) to Curry 115 kV (524822) circuit 1;** 3 phase fault on Bailey County 115 kV (525028) to EMU&VLY Tap (525019) cicuit 1, near Bailey County. a. Apply fault at the Bailey County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
188	FLT188-PO	**Prior Outage of Bailey County 115 kV (525028) to Curry 115 kV (524822) circuit 1;** 3 phase fault on Bailey County 115/69/13.2 kV (525028/525027/525025) transformer circuit 1, near Bailey County. a. Apply fault at the Bailey County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
189	FLT189-3PH	3 phase fault on the G16-120-Tap (587964) to Crawfish Draw (560022) 345 kV line circuit 1, near G16-120-Tap. a. Apply fault at the G16-120-Tap 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
190	FLT190-3PH	3 phase fault on the G16-120-Tap (587964) to Border (515458) 345 kV line circuit 1, near G16-120-Tap. a. Apply fault at the G16-120-Tap 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
191	FLT191-3PH	3 phase fault on the Crawfish Draw (560022) to OKU (511456) 345 kV line circuit 1, near Crawfish Draw. a. Apply fault at the Crawfish Draw 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
192	FLT192-3PH	3 phase fault on the Tuco 345/230/13.2 kV (525832/525830/525824) transformer circuit 1, near Tuco 345 kV bus. a. Apply fault at the Tuco 345 kV bus. b. Clear fault after 5 cycles by tripping the transformer
193	FLT193-3PH	Removed

Cont. No.	Cont. Name	Description
194	FLT194-3PH	3 phase fault on the Tuco (525832) to Yoakum (526936) 345 kV line circuit 1, near Tuco. a. Apply fault at the Tuco 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
195	FLT195-3PH	3 phase fault on the OKU (511456) to L.E.S (511468) 345 kV line circuit 1, near OKU. a. Apply fault at the OKU 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
196	FLT196-3PH	3 phase fault on the Tuco (525830) to Crawfish Draw (560021) 230 kV line circuit 1, near Tuco. a. Apply fault at the Tuco 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
197	FLT197-3PH	3 phase fault on the Tuco (525830) to Jones (526337) 230 kV line circuit 1, near Tuco. a. Apply fault at the Tuco 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
198	FLT198-3PH	Removed
199	FLT199-3PH	3 phase fault on the Tuco (525830) to Tolk East (525524) 230 kV line circuit 1, near Tuco. a. Apply fault at the Tuco 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
200	FLT200-3PH	3 phase fault on the Tuco (525830) to Carlisle (526161) 230 kV line circuit 1, near Tuco. a. Apply fault at the Tuco 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
201	FLT201-3PH	3 phase fault on the Woodward (515375) to Thistle (539801) 345 kV line circuit 1, near Woodward. a. Apply fault at the Woodward 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
202	FLT202-3PH	3 phase fault on the Woodward (515375) to G16-003-Tap (560071) 345 kV line circuit 1, near Woodward. a. Apply fault at the Woodward 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
203	FLT203-3PH	3 phase fault on the Woodward (515375) to Tatonga (515407) 345 kV line circuit 1, near Woodward. a. Apply fault at the Woodward 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
204	FLT204-3PH	Removed
205	FLT205-3PH	3 phase fault on the Woodward 345/138/13.2 kV (515375/515376/515795) transformer circuit 1, near Woodward. a. Apply fault at the Woodward 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
206	FLT206-SB	**Single phase fault with stuck breaker at Tuco (525832)** a. Apply fault at the Tuco 345 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Tuco 345/230/13.2 kV (525832/525830/525824) transformer d. Tuco (525832) – Crawfish Draw (560022) 345 kV
207	FLT207-SB	**Single phase fault with stuck breaker at Tuco (525832)** a. Apply fault at the Tuco 345 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Tuco 345/230/13.2 kV (525832/525830/525824) transformer d. Tuco (525832) – OKU (511456) 345 kV

Cont. No.	Cont. Name	Description
208	FLT208-SB	**Single phase fault with stuck breaker at Crawfish Draw (560022)** a. Apply fault at the Crawfish Draw 345 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Crawfish Draw (560022) – G16-120-Tap (587964) 345 kV d. Crawfish Draw (560022) – OKU (511456) 345 kV
209	FLT209-SB	**Single phase fault with stuck breaker at Woodward (515375)** a. Apply fault at the Woodward 345 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Woodward (515375) – Thistle (539801) 345 kV d. Woodward (515375) – Tatonga (515407) 345 kV
210	FLT210-SB	**Single phase fault with stuck breaker at Woodward (515375)** a. Apply fault at the Woodward 345 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Woodward (515375) – Border (515458) 345 kV d. Woodward (515375) – G16-003-Tap (515407) 345 kV
211	FLT211-SB	**Single phase fault with stuck breaker at Woodward (515375)** a. Apply fault at the Woodward 345 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Woodward (515375) – Tatonga (515407) 345 kV d. Woodward (515375) – Border (515458) 345 kV
212	FLT212-PO	**Prior Outage of the Tuco 345/230/13.2 kV (525832/525830/525824) transformer circuit 1;** 3 phase fault on the G16-120-Tap (587964) to Border (515458) 345 kV line circuit 1, near G16-120-Tap. a. Apply fault at the G16-120-Tap 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
213	FLT213-PO	**Prior Outage of the Tuco 345/230/13.2 kV (525832/525830/525824) transformer circuit 1;** 3 phase fault on the Tuco (525832) to Crawfish Draw (560022) 345 kV line circuit 1, near Tuco. a. Apply fault at the Tuco 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
214	FLT214-PO	**Prior Outage of the Tuco (525832) to G16-120-Tap (587964) 345 kV line circuit 1;** 3 phase fault on the Woodward (515375) to Tatonga (515407) 345 kV line circuit 1, near Woodward. a. Apply fault at the Woodward 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
215	FLT215-PO	**Prior Outage of the Tuco (525832) to G16-120-Tap (587964) 345 kV line circuit 1;** 3 phase fault on the Woodward (515375) to Thistle (539801) 345 kV line circuit 1, near Woodward. a. Apply fault at the Woodward 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
216	FLT216-PO	**Prior Outage of the Tuco (525832) to G16-120-Tap (587964) 345 kV line circuit 1;** 3 phase fault on the Woodward (515375) to G07621119-20 (515599) 345 kV line circuit 1, near Woodward. a. Apply fault at the Woodward 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
217	FLT217-PO	**Prior Outage of the Border (515458) to G16-120-Tap (587964) 345 kV line circuit 1;** 3 phase fault on the Tuco (525832) to Crawfish Draw (560022) 345 kV line circuit 1, near Tuco. a. Apply fault at the Tuco 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
218	FLT218-PO	**Prior Outage of the Border (515458) to G16-120-Tap (587964) 345 kV line circuit 1;** 3 phase fault on the Tuco 345/230/13.2 kV (525832/525830/525824) transformer circuit 1, near Tuco 345 kV bus. a. Apply fault at the Tuco 345 kV bus. b. Clear fault after 5 cycles by tripping the transformer
219	FLT219-3PH	3 phase fault on the Roadrunner (528025) to Red Bluff (528017) 115 kV line circuit 1, near Roadrunner. a. Apply fault at the Roadrunner 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
220	FLT220-3PH	3 phase fault on the Roadrunner (528025) to Battle Axe (528040) 115 kV line circuit 1, near Roadrunner. a. Apply fault at the Roadrunner 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
221	FLT221-3PH	3 phase fault on the Roadrunner (528025) to Agave Hills (528230) 115 kV line circuit 1, near Roadrunner. a. Apply fault at the Roadrunner 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
222	FLT222-3PH	3 phase fault on the Roadrunner 345/115/13.2 kV (528025/528027/528023) transformer circuit 1, near Roadrunner. a. Apply fault at the Roadrunner 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
223	FLT223-3PH	3 phase fault on the Roadrunner (528027) to Kiowa (527965) 345 kV line circuit 1, near Roadrunner (17W fault is Roadrunner to Potash JCT (527963) 230 kV). a. Apply fault at the Roadrunner 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
224	FLT224-3PH (17W)	3 phase fault on the Potash Junction (527963) to Cunningham (527865) 230 kV line circuit 1, near Potash Junction. a. Apply fault at the Potash Junction 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
224	FLT224-3PH (18S,26S)	3 phase fault on the Kiowa (527965) to Hobbs (527896) 345 kV line circuit 1, near Kiowa. a. Apply fault at the Kiowa 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
225	FLT225-3PH (17W)	3 phase fault on the Potash Junction (527963) to Pecos (528179) 230 kV line circuit 1, near Potash Junction. a. Apply fault at the Potash Junction 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
225	FLT225-3PH (18S, 26S)	3 phase fault on the Kiowa (527965) to North Loving (528185) 345 kV line circuit 1, near Kiowa. a. Apply fault at the Kiowa 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
226	FLT226-3PH (17W)	3 phase fault on the Potash Junction 230/115/13.2 kV (527963/527962/527958) transformer circuit 1, near Potash Junction. a. Apply fault at the Potash Junction 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
226	FLT226-3PH (18S, 26S)	3 phase fault on the Kiowa 345/115/13.2 kV (527965/527962/527964) transformer circuit 1, near Kiowa. a. Apply fault at the Kiowa 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
227	FLT227-3PH	3 phase fault on the Ponderosa Tap (528239) to Ochoa (528232) 115 kV line circuit 1, near Ponderosa Tap. a. Apply fault at the Ponderosa Tap 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
228	FLT228-3PH	3 phase fault on the Red Bluff (528018) to Wolf Camp Tap (528235) 115 kV line circuit 1, near Red Bluff. a. Apply fault at the Red Bluff 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
229	FLT229-3PH	3 phase fault on the Red Bluff (528018) to Sand Dunes (528016) 115 kV line circuit 1, near Red Bluff. a. Apply fault at the Red Bluff 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
230	FLT230-SB	**Single phase fault with stuck breaker at Roadrunner (528025)** a. Apply fault at the Roadrunner 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Roadrunner (528025) – Red Bluff (528018) 115 kV d. Roadrunner (528025) – Agave Hills (528230) 115 kV

Cont. No.	Cont. Name	Description
231	FLT231-SB	**Single phase fault with stuck breaker at Roadrunner (528025)** a. Apply fault at the Roadrunner 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Roadrunner 345/115/13.2 kV (528025/528027/528023) transformer d. Roadrunner (528025) – Agave Hills (528230) 115 kV
232	FLT232-SB	**Single phase fault with stuck breaker at Roadrunner (528025)** a. Apply fault at the Roadrunner 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Roadrunner 345/115/13.2 kV (528025/528027/528023) transformer d. Roadrunner (528025) – Battle Axe (528040) 115 kV
233	FLT233-PO	**Prior Outage of the Roadrunner (528025) to Agave Hill (528230) 115 kV line circuit 1;** 3 phase fault on the Roadrunner (528025) to Battle Axe (528040) 115 kV line circuit 1, near Roadrunner. a. Apply fault at the Roadrunner 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
234	FLT234-PO	**Prior Outage of the Roadrunner (528025) to Agave Hill (528230) 115 kV line circuit 1;** 3 phase fault on the Roadrunner (528025) to Red Bluff (528018) 115 kV line circuit 1, near Roadrunner. a. Apply fault at the Roadrunner 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
235	FLT235-PO	**Prior Outage of the Roadrunner (528025) to Agave Hill (528230) 115 kV line circuit 1;** 3 phase fault on the Roadrunner 345/115/13.2 kV (528025/528027/528023) transformer circuit 1, near Roadrunner. a. Apply fault at the Roadrunner 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
236	FLT236-PO	**Prior Outage of the Roadrunner (528025) to Red Bluff (528018) 115 kV line circuit 1;** 3 phase fault on the Roadrunner (528025) to Battle Axe (528040) 115 kV line circuit 1, near Roadrunner. a. Apply fault at the Roadrunner 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
237	FLT237-PO	**Prior Outage of the Roadrunner (528025) to Red Bluff (528018) 115 kV line circuit 1;** 3 phase fault on the Roadrunner (528025) to Agave Hill (528230) 115 kV line circuit 1, near Roadrunner. a. Apply fault at the Roadrunner 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
238	FLT238-PO	**Prior Outage of the Roadrunner (528025) to Red Bluff (528018) 115 kV line circuit 1;** 3 phase fault on the Roadrunner 345/115/13.2 kV (528025/528027/528023) transformer circuit 1, near Roadrunner. a. Apply fault at the Roadrunner 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
239	FLT239-3PH	3 phase fault on the Crossroads (527656) to Tolk (525549) 345 kV line circuit 1, near Crossroads. a. Apply fault at the Crossroads 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
240	FLT240-3PH	Removed
241	FLT241-3PH	3 phase fault on the Crossroads (527656) to Eddy County (527802) 345 kV line circuit 1, near Crossroads. a. Apply fault at the Crossroads 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
242	FLT242-3PH	3 phase fault on the Tolk East (525524) to Roosevelt (524911) 230 kV line circuit 1, near Tolk East. a. Apply fault at the Tolk East 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
243	FLT243-3PH	Removed
244	FLT244-3PH	3 phase fault on the Eddy North (527799) to 7-Rivers (528095) 230 kV line circuit 1, near Eddy North. a. Apply fault at the Eddy North 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
245	FLT245-3PH	3 phase fault on the Eddy North (527799) to Cunningham (527865) 230 kV line circuit 1, near Eddy North. a. Apply fault at the Eddy North 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
246	FLT246-3PH	3 phase fault on the Eddy North (527799) to Chaves County (527483) 230 kV line circuit 1, near Eddy North. a. Apply fault at the Eddy North 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
247	FLT247-3PH	3 phase fault on the Eddy North 230/115/13.2 kV (527799/527798/527797) transformer circuit 1, near Eddy North. a. Apply fault at the Eddy North 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
248	FLT248-SB	**Single phase fault with stuck breaker at Crossroads (527656)** a. Apply fault at the Crossroads 345 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Crossroads (527656) – Tolk (525549) 345 kV d. Crossroads (527656) 345/765 kV transformer circuit 1
249	FLT249-SB	**Single phase fault with stuck breaker at Crossroads (527656)** a. Apply fault at the Crossroads 345 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Crossroads (527656) – Tolk (525549) 345 kV d. Crossroads (527656) – Eddy County (527802) 345 kV
250	FLT250SB	**Single phase fault with stuck breaker at Crossroads (527656)** a. Apply fault at the Crossroads 345 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Crossroads (527656) – Eddy County (527802) 345 kV d. Crossroads (527656) 345/765 kV transformer circuit 1
251	FLT251-PO	**Prior Outage of the Crossroads (527656) to Tolk (525549) 345 kV line circuit 1;** 3 phase fault on the Crossroads (527656) to Eddy County (527802) 345 kV line circuit 1, near Crossroads. a. Apply fault at the Crossroads 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
252	FLT252-PO	**Prior Outage of the Crossroads (527656) to Tolk (525549) 345 kV line circuit 1;** 3 phase fault on the Crossroads (560102) to Crawfish Draw (560100) 765 kV line circuit 1, near Crossroads. a. Apply fault at the Crossroads 765 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
253	FLT253-PO	**Prior Outage of the Crossroads (527656) to Eddy County (527802) 345 kV line circuit 1;** 3 phase fault on the Crossroads (527656) to Tolk (525549) 345 kV line circuit 1, near Crossroads. a. Apply fault at the Crossroads 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
254	FLT254-PO	**Removed**
255	FLT255-PO	**Removed**
256	FLT256-PO	**Removed**
257	FLT257-3PH	3 phase fault on the Hobbs (527896) to Yoakum (526936) 345 kV line circuit 1, near Hobbs. a. Apply fault at the Hobbs 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
258	FLT258-3PH	3 phase fault on the Hobbs (527896) to Kiowa (527965) 345 kV line circuit 1, near Hobbs. a. Apply fault at the Hobbs 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
259	FLT259-3PH	3 phase fault on the Hobbs 345/230/13.2 kV (527896/527894/527895) transformer circuit 1, near Hobbs. a. Apply fault at the Hobbs 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
260	FLT260-3PH	3 phase fault on the Hobbs (527896) to Gaines Gen Tap (528611) 345 kV line circuit 1, near Hobbs. a. Apply fault at the Hobbs 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
261	FLT261-3PH	3 phase fault on the Yoakum (526936) to Hobbs (527896) 345 kV line circuit 1, near Yoakum. a. Apply fault at the Yoakum 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
262	FLT262-3PH	3 phase fault on the Gaines Gen Tap (528611) to Andrews (528604) 345 kV line circuit 1, near Hobbs. a. Apply fault at the Hobbs 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
263	FLT263-3PH	3 phase fault on the Andrews 345/115/13.2 kV (528604/528602/528601) transformer circuit 1, near Andrews 345. a. Apply fault at the Andrews 345 kV bus. b. Clear fault after 5 cycles by tripping the transformer
264	FLT264-3PH	3 phase fault on the G1579&G1580T (560059) to Yoakum (526935) 230 kV line circuit 1, near G1579&G1580T. a. Apply fault at the G1579&G1580T 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
265	FLT265-3PH	3 phase fault on the G1579&G1580T (560059) to Hobbs (527894) 230 kV line circuit 1, near G1579&G1580T. a. Apply fault at the G1579&G1580T 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
266	FLT266-SB	**Single phase fault with stuck breaker at Hobbs (527894) 230 kV** a. Apply fault at the Hobbs 230 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Hobbs (527894) – Cunningham (527867) 230 kV d. Hobbs 230/115/13.2 kV (527894/527891/527889) transformer
267	FLT267-SB	**Single phase fault with stuck breaker at Hobbs (527894) 230 kV** a. Apply fault at the Hobbs 230 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Hobbs (527894) – G1579&G1580T (560059) 230 kV d. Hobbs 230/115/13.2 kV (527894/527891/527889) transformer

Cont. No.	Cont. Name	Description
268	FLT268-SB	**Single phase fault with stuck breaker at Hobbs (527894) 230 kV** a. Apply fault at the Hobbs 230 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Hobbs (527894) – G1579&G1580T (560059) 230 kV d. Hobbs (527894) – Cunningham (527867) 230 kV
269	FLT269-SB	**Single phase fault with stuck breaker at Hobbs (527896) 345 kV** a. Apply fault at the Hobbs 345 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Hobbs (527896) – Yoakum (526936) 345 kV d. Hobbs (527896) – Kiowa (527965) 345 kV
270	FLT270-PO	**Prior Outage of the Hobbs (527894) to Cunningham (527865) 230 kV line circuit 1;** 3 phase fault on the Hobbs 230/115/13.2 kV (527894/527891/527890) transformer 1, near Hobbs. a. Apply fault at the Hobbs 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
271	FLT271-PO	**Prior Outage of the Hobbs (527894) to Cunningham (527865) 230 kV line circuit 1;** 3 phase fault on the G1579&G1580T (560059) to Hobbs (527894) 230 kV line circuit 1, near G1579&G1580T. a. Apply fault at the G1579&G1580T 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
272	FLT272-PO	**Prior Outage of the Hobbs (527894) to Cunningham (527865) 230 kV line circuit 1;** 3 phase fault on the G1579&G1580T (560059) to Yoakum (526935) 230 kV line circuit 1, near G1579&G1580T. a. Apply fault at the G1579&G1580T 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
273	FLT273-PO	**Prior Outage of the Hobbs (527896) to Gaines Gen Tap (528611) 345 kV line circuit 1;** 3 phase fault on the Hobbs 230/115/13.2 kV (527894/527891/527890) transformer 1, near Hobbs. a. Apply fault at the Hobbs 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
274	FLT274-PO	**Prior Outage of the Hobbs (527896) to Gaines Gen Tap (528611) 345 kV line circuit 1;** 3 phase fault on the G1579&G1580T (560059) to Hobbs (527894) 230 kV line circuit 1, near G1579&G1580T. a. Apply fault at the G1579&G1580T 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
275	FLT275-PO	**Prior Outage of the Hobbs (527896) to Gaines Gen Tap (528611) 345 kV line circuit 1;** 3 phase fault on the G1579&G1580T (560059) to Yoakum (526935) 230 kV line circuit 1, near G1579&G1580T. a. Apply fault at the G1579&G1580T 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
276	FLT276-PO	**Prior Outage of the Hobbs (527896) to Yoakum (526936) 345 kV line circuit 1;** 3 phase fault on the Hobbs (527896) to Kiowa (527965) 345 kV line circuit 1, near Hobbs. a. Apply fault at the Hobbs 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
277	FLT277-PO	**Prior Outage of the Hobbs (527896) to Yoakum (526936) 345 kV line circuit 1;** 3 phase fault on the Hobbs 345/230/13.2 kV (527896/527894/527895) transformer circuit 1, near Hobbs. a. Apply fault at the Hobbs 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
278	FLT278-PO	**Prior Outage of the Hobbs (527896) to Kiowa (527965) 345 kV line circuit 1;** 3 phase fault on the Hobbs (527896) to Yoakum (526936) 345 kV line circuit 1, near Hobbs. a. Apply fault at the Hobbs 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
279	FLT279-PO	**Prior Outage of the Hobbs (527896) to Kiowa (527965) 345 kV line circuit 1;** 3 phase fault on the Hobbs 345/230/13.2 kV (527896/527894/527895) transformer circuit 1, near Hobbs. a. Apply fault at the Hobbs 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
280	FLT280-3PH	3 phase fault on the Newhart (525460) to Kress (525192) 115 kV line circuit 1, near Newhart. a. Apply fault at the Newhart 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
281	FLT281-3PH	3 phase fault on the Newhart (525460) to Castro County (524746) 115 kV line circuit 1, near Newhart. a. Apply fault at the Newhart 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
282	FLT282-3PH	3 phase fault on the Newhart (525460) to Hart Industries (525124) 115 kV line circuit 1, near Newhart. a. Apply fault at the Newhart 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
283	FLT283-3PH	3 phase fault on the Newhart 230/115/13.2 kV (525460/525461/525459) transformer circuit 1, near Newhart. a. Apply fault at the Newhart 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
284	FLT284-3PH	3 phase fault on the Newhart (525461) to Swisher (525461) 230 kV line circuit 1, near Newhart. a. Apply fault at the Newhart 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
285	FLT285-3PH	3 phase fault on the Newhart (525461) to Plant X (525481) 230 kV line circuit 1, near Newhart. a. Apply fault at the Newhart 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
286	FLT286-3PH	3 phase fault on the Newhart (525461) to Potter County (523959) 230 kV line circuit 1, near Newhart. a. Apply fault at the Newhart 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
287	FLT287-3PH	3 phase fault on the Castro County (524746) to DS#21 (524734) 115 kV line circuit 1, near Castro County. a. Apply fault at the Castro County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
288	FLT288-3PH	Removed

Cont. No.	Cont. Name	Description
289	FLT289-3PH	3 phase fault on the Castro County (524746) to DS#22 (534694) 115 kV line circuit 1, near Castro County. a. Apply fault at the Castro County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
290	FLT290-3PH	3 phase fault on the Castro County (524746) to BC-Kelly (525050) 115 kV line circuit 1, near Castro County. a. Apply fault at the Castro County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
291	FLT291-3PH	3 phase fault on the Castro County 115/69/13.2 kV (524746/524745/524744) transformer circuit 1, near Castro County. a. Apply fault at the Castro County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
292	FLT292-SB	**Single phase fault with stuck breaker at Newhart (525460) 115 kV** a. Apply fault at the Newhart 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Newhart (525460) – Kress (525192) 115 kV d. Newhart 230/115/13.2 kV (525461/565460/525459) transformer
293	FLT293-SB	**Single phase fault with stuck breaker at Newhart (525460) 115 kV** a. Apply fault at the Newhart 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Newhart (525460) – Hart Industries (525124) 115 kV d. Newhart (525460) – Castro County (524746) 115 kV
294	FLT294-SB	**Single phase fault with stuck breaker at Castro County (524746) 115 kV** a. Apply fault at the Castro County 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Castro County (524746) – DS#21 (524734) 115 kV d. Castro County (524746) – DS#22 (524694) 115 kV
295	FLT295-SB	**Single phase fault with stuck breaker at Castro County (524746) 115 kV** a. Apply fault at the Castro County 115 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Castro County (524746) – Newhart (525460) 115 kV d. Castro County (524746) – BC-Kelly (525050) 115 kV

Cont. No.	Cont. Name	Description
296	FLT296-PO	**Prior Outage of the Newhart (525460) to Hart Industries (525124) 115 kV line circuit 1;** 3 phase fault on the Newhart (525460) to Castro County (524746) 115 kV line circuit 1, near Newhart. a. Apply fault at the Newhart 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
297	FLT297-PO	**Prior Outage of the Newhart (525460) to Hart Industries (525124) 115 kV line circuit 1;** 3 phase fault on the Newhart (525460) to Kress (525192) 115 kV line circuit 1, near Castro County. a. Apply fault at the Castro County 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
298	FLT298-PO	**Prior Outage of the Newhart (525460) to Hart Industries (525124) 115 kV line circuit 1;** 3 phase fault on the Newhart 230/115/13.2 kV (525460/525461/525459) transformer circuit 1, near Newhart. a. Apply fault at the Newhart 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
299	FLT299-PO	**Prior Outage of the Newhart (525460) to Castro County (524746) 115 kV line circuit 1;** 3 phase fault on the Newhart (525460) to Hart Industries (525124) 115 kV line circuit 1, near Newhart. a. Apply fault at the Newhart 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
300	FLT300-PO	**Prior Outage of the Newhart (525460) to Castro County (524746) 115 kV line circuit 1;** 3 phase fault on the Newhart (525460) to Kress (525192) 115 kV line circuit 1, near Newhart. a. Apply fault at the Newhart 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
301	FLT301-PO	**Prior Outage of the Newhart (525460) to Castro County (524746) 115 kV line circuit 1;** 3 phase fault on the Newhart 230/115/13.2 kV (525460/525461/525459) transformer circuit 1, near Newhart. a. Apply fault at the Newhart 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
302	FLT302-PO	**Prior Outage of the Newhart 230/115/13.2 kV (525461/525460/525459) transformer circuit 1;** 3 phase fault on the Newhart (525460) to Hart Industries (525124) 115 kV line circuit 1, near Newhart. a. Apply fault at the Newhart 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
303	FLT303-PO	**Prior Outage of the Newhart 230/115/13.2 kV (525461/525460/525459) transformer circuit 1;** 3 phase fault on the Newhart (525460) to Kress (525192) 115 kV line circuit 1, near Newhart. a. Apply fault at the Newhart 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
304	FLT304-PO	**Prior Outage of the Newhart 230/115/13.2 kV (525461/525460/525459) transformer circuit 1;** 3 phase fault on the Newhart (525460) to Castro County (524746) 115 kV line circuit 1, near Newhart. a. Apply fault at the Newhart 115 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
305	FLT305-3PH	3 phase fault on the Crawfish Draw (560022) to Border (515458) 345 kV line circuit 1, near Crawfish Draw. a. Apply fault at the Crawfish Draw 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
306	FLT306-3PH	3 phase fault on the Crawfish Draw (560022) to Tuco (525832) 345 kV line circuit 1, near Crawfish Draw. a. Apply fault at the Crawfish Draw 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
307	FLT307-3PH	3 phase fault on the Crawfish Draw 345/230/13.2 kV (560022/560021/560023) transformer circuit 1, near Crawfish Draw. a. Apply fault at the Crawfish Draw 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
308	FLT308-3PH	3 phase fault on the Crawfish Draw 765/345 kV (560100/560022) transformer circuit 1, near Crawfish Draw 765 kV. a. Apply fault at the Crawfish Draw 765 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
309	FLT309-3PH	3 phase fault on the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 1, near Crawfish Draw. a. Apply fault at the Crawfish Draw 765 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
310	FLT310-3PH	3 phase fault on the Crawfish Draw Tap (560103) to Seminole (560101) 765 kV line circuit 1, near Seminole. a. Apply fault at the Seminole 765 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
311	FLT311-3PH	3 phase fault on the Seminole 765/345 kV (560100/560022) transformer circuit 1, near Seminole 765 kV. a. Apply fault at the Seminole 765 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
312	FLT312-3PH	3 phase fault on the Crawfish Draw (560021) to Tuco (525830) 230 kV line circuit 1, near Crawfish Draw. a. Apply fault at the Crawfish Draw 230 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
313	FLT313-SB	**Single phase fault with stuck breaker at Crawfish Draw (560022) 345 kV** a. Apply fault at the Crawfish Draw 345 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Crawfish Draw (560021) – Border (515458) 345 kV d. Crawfish Draw (560021) – Tolk (525549) 345 kV
314	FLT314-SB	**Single phase fault with stuck breaker at Crawfish Draw (560022) 345 kV** a. Apply fault at the Crawfish Draw 345 kV bus. b. Clear fault after 16 cycles and trip the following elements c. Crawfish Draw (560021) – Tuco (525832) 345 kV d. Crawfish Draw (560021) – Tolk (525549) 345 kV
315	FLT315-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 1;** 3 phase fault on the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 2, near Crawfish Draw. a. Apply fault at the Crawfish Draw 765 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
316	FLT316-3PH	3 phase fault on the Potter County (523961) to Tolk (525549) 345 kV line circuit 1, near Potter County. a. Apply fault at the Potter County 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
317	FLT317-3PH	3 phase fault on the Potter County (523961) to Grapevine (560035) 345 kV line circuit 1, near Potter County. a. Apply fault at the Potter County 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
318	FLT318-3PH	3 phase fault on the Potter County (523961) to Hitchland (523097) 345 kV line circuit 1, near Potter County. a. Apply fault at the Potter County 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
319	FLT319-3PH	3 phase fault on the Potter County 345/230/13 kV (523961/523959/523957) transformer circuit 1, near Potter County. a. Apply fault at the Potter County 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
320	FLT320-3PH	3 phase fault on the Chisholm (511553) to Grapevine (560035) 345 kV line circuit 1, near Chisholm. a. Apply fault at the Chisholm 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
321	FLT321-3PH	3 phase fault on the Chisholm (511553) to Border (515458) 345 kV line circuit 1, near Chisholm. a. Apply fault at the Chisholm 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
322	FLT322-3PH	3 phase fault on the Chisholm (511553) to G16-037-Tap (560078) 345 kV line circuit 1, near Chisholm. a. Apply fault at the Chisholm 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
323	FLT323-3PH	3 phase fault on the Border (515458) to Chisholm (511553) 345 kV line circuit 1, near Border. a. Apply fault at the Border 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
324	FLT324-3PH	3 phase fault on the Border (515458) to Woodward (515375) 345 kV line circuit 1, near Border. a. Apply fault at the Border 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
325	FLT325-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 1;** 3 phase fault on the Potter County (523961) to Tolk (525549) 345 kV line circuit 1, near Potter County. a. Apply fault at the Potter County 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
326	FLT326-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 1;** 3 phase fault on the Potter County (523961) to Grapevine (560035) 345 kV line circuit 1, near Potter County. a. Apply fault at the Potter County 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
327	FLT327-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103)765 kV line circuit 1;** 3 phase fault on the Potter County (523961) to Hitchland (523097) 345 kV line circuit 1, near Potter County. a. Apply fault at the Potter County 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
328	FLT328-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103)765 kV line circuit 1;** 3 phase fault on the Chisholm (511553) to Grapevine (560035) 345 kV line circuit 1, near Chisholm. a. Apply fault at the Chisholm 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
329	FLT329-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 1;** 3 phase fault on the Chisholm (511553) to Border (515458) 345 kV line circuit 1, near Chisholm. a. Apply fault at the Chisholm 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
330	FLT330-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103)765 kV line circuit 1;** 3 phase fault on the Chisholm (511553) to G16-037-Tap (560078) 345 kV line circuit 1, near Chisholm. a. Apply fault at the Chisholm 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
331	FLT331-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103)765 kV line circuit 1;** 3 phase fault on the Border (515458) to Chisholm (511553) 345 kV line circuit 1, near Border. a. Apply fault at the Border 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
332	FLT332-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 1;** 3 phase fault on the Border (515458) to Woodward (515375) 345 kV line circuit 1, near Border. a. Apply fault at the Border 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
333	FLT333-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 1;** 3 phase fault on the Crawfish Draw (560022) to Border (515458) 345 kV line circuit 2, near Crawfish Draw. a. Apply fault at the Crawfish Draw 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
334	FLT334-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 1;** 3 phase fault on the Crawfish Draw (560022) to OKU (511456) 345 kV line circuit 1, near Crawfish Draw. a. Apply fault at the Crawfish Draw 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
335	FLT335-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 1;** 3 phase fault on the Crawfish Draw (560022) to Tolk (525549) 345 kV line circuit 1, near Crawfish Draw. a. Apply fault at the Crawfish Draw 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
336	FLT336-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 1;** 3 phase fault on the Crawfish Draw (560022) to TUCO (525832) 345 kV line circuit 1, near Crawfish Draw. a. Apply fault at the Crawfish Draw 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
337	FLT337-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 1;** 3 phase fault on the Crawfish Draw (560022) to G16-120-Tap (587964) 345 kV line circuit 1, near Crawfish Draw. a. Apply fault at the Crawfish Draw 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
338	FLT338-PO	**Prior Outage of the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 1;** 3 phase fault on the Crawfish Draw 345/230/13 kV (560022/560021/560023) transformer, near Crawfish Draw. a. Apply fault at the Crawfish Draw 345 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
339	FLT339-3PH	3 phase fault on the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 1, near Crawfish Draw Tap. a. Apply fault at the Crawfish Draw 765 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
340	FLT340-3PH	3 phase fault on the Seminole (560101) to Crawfish Draw Tap (560103) 765 kV line circuit 1, near Crawfish Draw Tap. a. Apply fault at the Crawfish Draw Tap 765 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
341	FLT341-PO	**Prior Outage of the Crawfish Draw 765/345 kV transformer #1 (560100/560002);** 3 phase fault on the Crawfish Draw 765/345 kV (560100/560022) transformer circuit #2, near Crawfish Draw. a. Apply fault at the Crawfish Draw 765 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
342	FLT342-PO	**Prior Outage of the Crawfish Draw (560100) to Crossroads (560102) 765 kV line circuit 1;** 3 phase fault on the Crawfish Draw 765/345 kV (560100/560022) transformer circuit #2, near Crawfish Draw. a. Apply fault at the Crawfish Draw 765 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
343	FLT343-PO	**Prior Outage of the Seminole 765/345 kV transformer #1 (560101/515045);;** 3 phase fault on the Crawfish Draw (560100) to Crawfish Draw Tap (560103) 765 kV line circuit 1, near Crawfish Draw. a. Apply fault at the Crawfish Draw 765 kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

SECTION 3: STABILITY ANALYSIS

The objective of the Stability Analysis was to determine the impacts of the generator interconnections on the stability and voltage recovery on the SPP transmission system. If problems with stability or voltage recovery were identified, the need for reactive compensation or system upgrades was investigated.

3.1 Approach

SPP provided MEPPI with the following five power flow cases:

- MDWG16-17W_DIS1602_G06
- MDWG16-18S_DIS1602_G06
- MDWG16-26S_DIS1602_G06

Each case was examined prior to the Stability Analysis to ensure the case contained the proposed study projects and any previously queued projects listed in Tables 2-1 and 2-2 respectively. There was no suspect power flow data in the study area. The dynamic datasets were also verified and stable initial system conditions (i.e., “flat lines”) were achieved. Three-phase and single phase-to-ground faults listed in Table 2-3 were examined. Single-phase fault impedances were calculated for each season to result in a voltage of approximately 60% of the pre-fault voltage. Refer to Table 3-1 for a list of the calculated single-phase fault impedances utilized.

Table 3-1
Calculated Single-Phase Fault Impedances

Cont. No.*	Cont. Name	Single-Phase Fault Impedance (MVA)			Cont. No.*	Cont. Name	Single-Phase Fault Impedance (MVA)		
		2017 Winter	2018 Summer	2026 Summer			2017 Winter	2018 Summer	2026 Summer
14	FLT14_SB	-1375.0	-1375.0	-1375.0	151	FLT151_SB	-1625.0	-1500.0	-1500.0
15	FLT15_SB	-1125.0	-1125.0	-1125.0	152	FLT152_SB	-1625.0	-1500.0	-1500.0
40	FLT40_SB	-1375.0	-1375.0	-1500.0	164	FLT164_SB	-500.0	-500.0	-562.5
41	FLT41_SB	-1375.0	-1375.0	-1500.0	177	FLT177_SB	-1375.0	-1375.0	-1375.0
43	FLT43_SB	-1250.0	-1250.0	-1375.0	178	FLT178_SB	-1375.0	-1375.0	-1375.0
44	FLT44_SB	-1250.0	-1250.0	-1375.0	179	FLT179_SB	-1375.0	-1375.0	-1375.0
60	FLT60_SB	-6062.5	-5656.3	-6062.5	180	FLT180_SB	-1375.0	-1375.0	-1375.0
61	FLT61_SB	-6062.5	-5656.3	-6062.5	181	FLT181_SB	-687.5	-625.0	-750.0
62	FLT62_SB	-1875.0	-1750.0	-1875.0	182	FLT182_SB	-687.5	-625.0	-750.0
63	FLT63_SB	-6062.5	-5656.3	-6062.5	206	FLT206_SB	-8500.0	-8906.3	-10125.0
64	FLT64_SB	-6062.5	-5656.3	-6062.5	207	FLT207_SB	-8500.0	-9312.5	-10125.0
65	FLT65_SB	-6062.5	-5656.3	-6062.5	208	FLT208_SB	-8500.0	-9312.5	-10125.0
92	FLT92_SB	-4031.3	-3828.1	-4437.5	209	FLT209_SB	-7687.5	-8500.0	-8500.0
93	FLT93_SB	-4031.3	-3828.1	-4437.5	210	FLT210_SB	-7687.5	-8500.0	-8500.0
94	FLT94_SB	-2406.3	-2203.1	-2406.3	211	FLT211_SB	-7687.5	-8500.0	-8500.0
95	FLT95_SB	-2101.6	-2101.6	-2406.3	230	FLT230_SB	-875.0	-1062.5	-1125.0
96	FLT96_SB	-2812.5	-2812.5	-3015.6	231	FLT231_SB	-875.0	-1062.5	-1125.0
97	FLT97_SB	-2812.5	-2812.5	-3015.6	232	FLT232_SB	-875.0	-1062.5	-1125.0
98	FLT98_SB	-2812.5	-2812.5	-3015.6	248	FLT248_SB	-3421.9	-3218.8	-3625.0
99	FLT99_SB	-2812.5	-2812.5	-3015.6	249	FLT249_SB	-3421.9	-3218.8	-3625.0
123	FLT123_SB	-3218.8	-3218.8	-3421.9	250	FLT250_SB	-3421.9	-3218.8	-3625.0
124	FLT124_SB	-3218.8	-3218.8	-3421.9	266	FLT266_SB	-4031.3	-4437.5	-4437.5
125	FLT125_SB	-3218.8	-3218.8	-3421.9	267	FLT267_SB	-4031.3	-4437.5	-4437.5
126	FLT126_SB	-3218.8	-3218.8	-3421.9	268	FLT268_SB	-4031.3	-4437.5	-4437.5
127	FLT127_SB	-3421.9	-3421.9	-3421.9	269	FLT269_SB	-2406.3	-2812.5	-3625.0
128	FLT128_SB	-3421.9	-3421.9	-3421.9	292	FLT292_SB	-2203.1	-2101.6	-2101.6
129	FLT129_SB	-3828.1	-4031.3	-4031.3	293	FLT293_SB	-2203.1	-2101.6	-2101.6
130	FLT130_SB	-3828.1	-4031.3	-4031.3	294	FLT294_SB	-1375.0	-1250.0	-1250.0
148	FLT148_SB	-2812.5	-2812.5	-2812.5	295	FLT295_SB	-1375.0	-1250.0	-1250.0
149	FLT149_SB	-2812.5	-2812.5	-2812.5	313	FLT313_SB	-8500.0	-9312.5	-10125.0
150	FLT150_SB	-2812.5	-2812.5	-2812.5	314	FLT314_SB	-8500.0	-9312.5	-10125.0

*Refer to Table 2-3 for a description of the contingency scenerio

Bus voltages, machine rotor angles, and previously queued generation in the study area were monitored in addition to bus voltages and machine rotor angles in the following areas:

- 520 AEPW
- 524 OKGE
- 525 WFEC
- 531 MIDW
- 534 SUNC
- 536 WERE

Requested and previously queued generation outside the above study area was also monitored.

The results of the analysis determined if reactive compensation or system upgrades were required to obtain acceptable system performance. If additional reactive compensation was required, the size, type, and location were determined. The proposed reactive reinforcements would ensure the wind or solar farm meets FERC Order 661A low voltage requirements and return the wind or solar farm to its pre-disturbance operating voltage. If the results indicated the need for fast responding reactive support, dynamic support such as an SVC or STATCOM was investigated.

3.2 Stability Analysis Results

The Stability Analysis determined that there were multiple contingencies across all seasons that resulted in system/voltage instability, generation tripping offline, and poor post-fault voltage recovery when all generation interconnection requests were at 100% output. The 17W case was observed to have many non-damped voltage oscillations for faults throughout the SPP study area. It can be observed that the 18S and 26S case, which have additional projects implemented from 17W, have improved voltage responses.

Refer to Table 3-2 for a summary of the Stability Analysis results for the contingencies listed in Table 2-3. Table 3-2 is a summary of the stability results for the 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak conditions and states whether the system remained stable or generation tripped offline, if acceptable voltage recovery was observed after the fault was cleared, and if the voltage recovered to above 0.9 p.u. and below 1.1 p.u. post fault steady-state conditions. Voltage recovery criteria includes ensuring that the transient voltage recovery is between 0.7 p.u. and 1.2 p.u. and ending in a steady-state voltage (for N-1 contingencies) at the pre-contingent level or at least above 0.9 p.u. and below 1.1. p.u.

Refer to Appendix B, Appendix C, and Appendix D for a complete set of plots for all contingencies for 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak conditions, respectively.

Table 3-2
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
1	FLT01-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
2	FLT02-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
3	FLT03-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
4	FLT04-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
5	FLT05-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
14	FLT14-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
15	FLT15-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
19	FLT19-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
20	FLT20-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
21	FLT21-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
22	FLT22-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
23	FLT23-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
24	FLT24-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
26	FLT26-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
27	FLT27-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
28	FLT28-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
29	FLT29-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
30	FLT30-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
31	FLT31-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
32	FLT32-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
33	FLT33-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
34	FLT34-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
35	FLT35-3PH	System Instability				-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable
36	FLT36-3PH	System Instability				-	-	Compliant	Stable	-	-	Compliant	Stable
37	FLT37-3PH	System Instability				-	-	Compliant	Stable	-	-	Compliant	Stable
38	FLT38-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
40	FLT40-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
41	FLT41-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
43	FLT43-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
44	FLT44-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
45	FLT45-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
46	FLT46-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
47	FLT47-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable

Note 1: Poor voltage damping
Note 2: Generator Trips

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
48	FLT48-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
49	FLT49-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
50	FLT50-3PH	System Instability				-	-	Compliant	Stable	-	-	Compliant	Stable
51	FLT51-3PH	System Instability				-	-	Compliant	Stable	-	-	Compliant	Stable
52	FLT52-3PH	System Instability				-	-	Compliant	Stable	-	-	Compliant	Stable
53	FLT53-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
54	FLT54-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
55	FLT55-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
56	FLT56-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
57	FLT57-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
58	FLT58-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
59	FLT59-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Gen Trip	-	-	Compliant	Stable
60	FLT60-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
61	FLT61-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
62	FLT62-SB	-	-	Volt Oscillations	Unstable[1,2]	-	-	V < 0.9 p.u.	Unstable[1]	-	-	Compliant	Stable
63	FLT63-SB	System Instability				-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
64	FLT64-SB	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
65	FLT65-SB	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
66	FLT66-PO	-	-	Volt Oscillations	Unstable[1]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
67	FLT67-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
68	FLT68-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
69	FLT69-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
70	FLT70- PO	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.7 p.u.	Stable	-	-	Compliant	Stable
71	FLT71-PO	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.7 p.u.	Stable	-	-	V < 0.7 p.u.	Stable
72	FLT72-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
73	FLT73-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
74	FLT74-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
75	FLT75-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
76	FLT76-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
77	FLT77-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
78	FLT78-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
79	FLT79-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
80	FLT80-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
48	FLT48-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
49	FLT49-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
50	FLT50-3PH	System Instability				-	-	Compliant	Stable	-	-	Compliant	Stable
51	FLT51-3PH	System Instability				-	-	Compliant	Stable	-	-	Compliant	Stable
52	FLT52-3PH	System Instability				-	-	Compliant	Stable	-	-	Compliant	Stable
53	FLT53-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
54	FLT54-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
55	FLT55-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
56	FLT56-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
57	FLT57-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
58	FLT58-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
59	FLT59-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Gen Trip	-	-	Compliant	Stable
60	FLT60-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
61	FLT61-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
62	FLT62-SB	-	-	Volt Oscillations	Unstable[1,2]	-	-	V < 0.9 p.u.	Unstable[1]	-	-	Compliant	Stable
63	FLT63-SB	System Instability				-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
64	FLT64-SB	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
65	FLT65-SB	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
66	FLT66-PO	-	-	Volt Oscillations	Unstable[1]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
67	FLT67-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
68	FLT68-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
69	FLT69-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
70	FLT70- PO	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.7 p.u.	Stable	-	-	Compliant	Stable
71	FLT71-PO	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.7 p.u.	Stable	-	-	V < 0.7 p.u.	Stable
72	FLT72-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
73	FLT73-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
74	FLT74-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
75	FLT75-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
76	FLT76-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
77	FLT77-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
78	FLT78-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
79	FLT79-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
80	FLT80-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable

Note 1: Poor voltage damping
Note 2: Generator Trips

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
81	FLT81-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
82	FLT82-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
83	FLT83-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
84	FLT84-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
85	FLT85-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
86	FLT86-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
87	FLT87-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
88	FLT88-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
89	FLT89-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
90	FLT90-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
91	FLT91-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
92	FLT92-SB	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
94	FLT94-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
95	FLT95-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
96	FLT96-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
97	FLT97-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
98	FLT98-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
99	FLT99-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
100	FLT100-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
101	FLT101-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
102	FLT102-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
103	FLT103-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
104	FLT104-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
105	FLT105-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
106	FLT106-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
107	FLT107-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
108	FLT108-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
109	FLT109-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
110	FLT110-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
111	FLT111-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
112	FLT112-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
113	FLT113-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable

Note 1: Poor voltage damping

Note 2: Generator Trips

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
114	FLT114-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
115	FLT115-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
116	FLT116-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
117	FLT117-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
118	FLT118-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
119	FLT119-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
120	FLT120-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
121	FLT121-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
122	FLT122-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
123	FLT123-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
124	FLT124-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
125	FLT125-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
126	FLT126-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
127	FLT127-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
128	FLT128-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
129	FLT129-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
130	FLT130-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
131	FLT131-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
132	FLT132-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
133	FLT133-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
134	FLT134-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
135	FLT135-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
136	FLT136-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
137	FLT137-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
138	FLT138-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
139	FLT139-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
140	FLT140-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
141	FLT141-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
142	FLT142-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
143	FLT143-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
144	FLT144-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
145	FLT145-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
146	FLT146-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable

Note 1: Poor voltage damping

Note 2: Generator Trips

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
147	FLT147-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
148	FLT148-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
149	FLT149-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
150	FLT150-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
151	FLT151-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
152	FLT152-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
153	FLT153-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
154	FLT154-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
155	FLT155-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
156	FLT156-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
157	FLT157-PO	-	-	Compliant	Stable	-	-	V > 1.1 p.u.	Gen Trip	-	-	V > 1.1 p.u.	Gen Trip
158	FLT158-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
159	FLT159-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
160	FLT160-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
161	FLT161-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
162	FLT162-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
163	FLT163-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
164	FLT164-SB	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
165	FLT165-PO	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
166	FLT166-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
167	FLT167-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
168	FLT168-3PH	-	-	Compliant	Gen Trip	-	-	V < 0.9 p.u.	Gen Trip	-	-	Compliant	Stable
169	FLT169-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
170	FLT170-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
171	FLT171-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
172	FLT172-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
173	FLT173-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
174	FLT174-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
175	FLT175-3PH	-	-	Compliant	Gen Trip	-	-	V < 0.7 p.u.	Gen Trip	-	-	Compliant	Stable
176	FLT176-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
177	FLT177-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
178	FLT178-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
179	FLT179-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable

Note 1: Poor voltage damping

Note 2: Generator Trips

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
180	FLT180-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
181	FLT181-SB	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
182	FLT182-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
183	FLT183-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
184	FLT184-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
185	FLT185-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
186	FLT186-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
187	FLT187-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
188	FLT188-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
189	FLT189-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	V > 1.1 p.u.	Gen Trip	-	-	Compliant	Stable
190	FLT190-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
191	FLT191-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
192	FLT192-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
193	FLT193-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
194	FLT194-3PH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	-	Compliant	Stable
195	FLT195-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
196	FLT196-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable
197	FLT197-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable
199	FLT199-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable
200	FLT200-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable
201	FLT201-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
202	FLT202-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
203	FLT203-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
205	FLT205-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
206	FLT206-SB	-	-	V > 1.2 p.u.	Gen Trip	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
207	FLT207-SB	-	-	V > 1.2 p.u.	Gen Trip	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
208	FLT208-SB	-	-	V > 1.2 p.u.	Gen Trip	-	-	Volt Oscillations	Unstable[1]	-	-	V > 1.1 p.u.	Stable
209	FLT209-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
210	FLT210-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
211	FLT211-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable

Note 1: Poor voltage damping
Note 2: Generator Trips

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
212	FLT212-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
213	FLT213-PO	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
214	FLT214-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
215	FLT215-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
216	FLT216-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
217	FLT217-PO	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
218	FLT218-PO	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
219	FLT219-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
220	FLT220-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
221	FLT221-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
222	FLT222-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
223	FLT223-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
224	FLT224-3PH (17W)	-	-	Volt Oscillations	Unstable[1,2]	N/A	N/A	N/A	N/A	-	-	Compliant	Stable
224	FLT224-3PH (18S,26S)	N/A	N/A	N/A	N/A	-	-	Compliant	Stable	-	-	Compliant	Stable
225	FLT225-3PH (17W)	-	-	Volt Oscillations	Unstable[1,2]	N/A	N/A	N/A	N/A	-	-	Compliant	Stable
225	FLT225-3PH (18S, 26S)	N/A	N/A	N/A	N/A	-	-	Compliant	Stable	-	-	Compliant	Stable
226	FLT226-3PH (17W)	-	-	Volt Oscillations	Unstable[1,2]	N/A	N/A	N/A	N/A	-	-	Compliant	Stable
226	FLT226-3PH (18S, 26S)	N/A	N/A	N/A	N/A	-	-	Compliant	Stable	-	-	Compliant	Stable
227	FLT227-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
228	FLT228-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
229	FLT229-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
230	FLT230-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
231	FLT231-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
232	FLT232-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
233	FLT233-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
234	FLT234-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
235	FLT235-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable

Note 1: Poor voltage damping
Note 2: Generator Trips

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
236	FLT236-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
237	FLT237-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
238	FLT238-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
239	FLT239-3PH	System Instability				-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable
241	FLT241-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
242	FLT242-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
244	FLT244-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
245	FLT245-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
246	FLT246-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
247	FLT247-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
248	FLT248-SB	System Instability				System Instability				-	-	Volt Oscillations	Unstable[1]
249	FLT249-SB	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
250	FLT250-SB	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
251	FLT251-PO	Steady-State Divergence				-	-	Compliant	Stable	-	-	Compliant	Stable
252	FLT252-PO	Steady-State Divergence				-	-	Compliant	Stable	-	-	Compliant	Stable
253	FLT253-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
257	FLT257-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
258	FLT258-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
259	FLT259-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
260	FLT260-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
261	FLT261-3PH	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	-	Compliant	Stable
262	FLT262-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
263	FLT263-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Stable	-	-	Compliant	Stable
264	FLT264-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
265	FLT265-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
266	FLT266-SB	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
267	FLT267-SB	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
268	FLT268-SB	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
269	FLT269-SB	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	-	Compliant	Stable
270	FLT270-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
271	FLT271-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
272	FLT272-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
273	FLT273-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable

Note 1: Poor voltage damping
Note 2: Generator Trips

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
274	FLT274-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
275	FLT275-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
276	FLT276-PO	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	-	Compliant	Stable
277	FLT277-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
278	FLT278-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
279	FLT279-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
280	FLT280-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
281	FLT281-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
282	FLT282-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
283	FLT283-3PH	-	-	Compliant	Stable	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
284	FLT284-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
285	FLT285-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
286	FLT286-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
287	FLT287-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
289	FLT289-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
290	FLT290-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
291	FLT291-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
292	FLT292-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
293	FLT293-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
294	FLT294-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
295	FLT295-SB	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
296	FLT296-PO	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
297	FLT297-PO	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
298	FLT298-PO	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
299	FLT299-PO	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
300	FLT300-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
301	FLT301-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
302	FLT302-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
303	FLT303-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
304	FLT304-PO	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
305	FLT305-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
306	FLT306-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
307	FLT307-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable

Note 1: Poor voltage damping

Note 2: Generator Trips

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
308	FLT308-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
309	FLT309-3PH	System Instability				-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
310	FLT310-3PH	System Instability				-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
311	FLT311-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
312	FLT312-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
313	FLT313-SB	-	-	V < 0.7 p.u.	Gen Trip	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
314	FLT314-SB	-	-	V < 0.7 p.u.	Gen Trip	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
315	FLT315-PO	Steady-State Divergence				System Instability				System Instability			
316	FLT316-3PH	-	-	V < 0.7 p.u.	Gen Trip	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
317	FLT317-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
318	FLT318-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
319	FLT319-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
320	FLT320-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
321	FLT321-3PH	-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable	-	-	Compliant	Stable
322	FLT322-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
323	FLT323-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
324	FLT324-3PH	-	-	Volt Oscillations	Unstable[1,2]	-	-	Compliant	Stable	-	-	Compliant	Stable
325	FLT325-PO	Steady-State Divergence				-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
326	FLT326-PO	Steady-State Divergence				-	-	Compliant	Stable	-	-	Compliant	Stable
327	FLT327-PO	Steady-State Divergence				-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
328	FLT328-PO	Steady-State Divergence				-	-	Compliant	Stable	-	-	Compliant	Stable
329	FLT329-PO	Steady-State Divergence				-	-	Compliant	Stable	-	-	Compliant	Stable
330	FLT330-PO	Steady-State Divergence				-	-	Compliant	Stable	-	-	Compliant	Stable
331	FLT331-PO	Steady-State Divergence				-	-	Compliant	Stable	-	-	Compliant	Stable
332	FLT332-PO	Steady-State Divergence				-	-	Compliant	Stable	-	-	Compliant	Stable
333	FLT333-PO	Steady-State Divergence				-	-	Compliant	Stable	-	-	Compliant	Stable
334	FLT334-PO	Steady-State Divergence				-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
335	FLT335-PO	Steady-State Divergence				System Instability				-	-	Compliant	Stable
336	FLT336-PO	Steady-State Divergence				-	-	Volt Oscillations	Unstable[1]	-	-	Compliant	Stable
337	FLT337-PO	Steady-State Divergence				-	-	V > 1.1 p.u.	Stable	-	-	V > 1.1 p.u.	Stable
338	FLT338-PO	Steady-State Divergence				-	-	Compliant	Stable	-	-	Compliant	Stable
339	FLT339-3PH	Steady-State Divergence				-	-	Compliant	Stable	-	-	Compliant	Stable
340	FLT340-3PH	Steady-State Divergence				-	-	Compliant	Stable	-	-	Compliant	Stable
341	FLT341-PO	System Instability				System Instability				-	V > 1.2 p.u.	V > 1.1 p.u.	Stable
342	FLT342-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
343	FLT343-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable

Note 1: Poor voltage damping

Note 2: Generator Trips

To mitigate the system/voltage instability, voltage violations, generation tripping offline, and poor post-fault steady-state voltages, the following upgrades were provided by SPP and implemented (upgrades provided here are required for 17W season and thus, implemented in remaining years):

- Crawfish Draw SVC +600/-100 MVAR
  - For this study, the SVC size was determined at the POI. Actual SVC size may differ at the 13.8 kV bus.
- Crawfish Draw 345/230 kV transformer #2
- Crawfish Draw to Crossroads 765 kV circuit #1
- Crawfish Draw to midpoint station to Seminole 765 kV circuit #1 and #2
- Crossroads 765/345 kV transformer #1 and #2
- Crawfish Draw 765/345 kV transformer #1 and #2
- Seminole 765/345 kV transformer #1 and #2
- Hobbs to Yoakum to Tuco 345 kV circuit #1 (advancement in 17W and 18S)
- Yoakum 345/230 kV transformer #1 (advancement in 17W and 18S)
- Tolk 345/230 kV transformer #3

During the analysis, it was determined that for an outage of either Crawfish Draw to Seminole 765 kV circuit, system instability exists due to the severity of the outage on the system. A stable response without additional transmission circuits would require exceptionally large amounts of dynamic reactive support (i.e. SVC/STATCOM) at or near the Crawfish Draw 765 kV substation. It was determined that the addition of a substation tying both 765 kV circuits together at approximately 50% of the line length reduced the severity of a single circuit outage and resulted in significant reduction in the dynamic reactive equipment required to maintain system stability for outages in the Crawfish Draw/Seminole region.

Note for the following study projects, frequency transient spikes were observed in the simulations following fault clearing:

- GEN-2016-077 (TMEIC solar inverter)
- GEN-2016-078 (TMEIC solar inverter)

The frequency transient spike that was observed is a known artifact of the PSS/E software because the positive-sequence model does not estimate the actual frequency variations during and immediately following the fault fairly and thus cannot be trusted as a good indication of frequency. For these simulations, the instantaneous frequency protection was changed to incur 1 second of time delay for each of projects listed above. In addition, it is recommended the manufacturer investigates the frequency calculation of the TMEIC inverter.

FLT15-SB, a single phase fault with a stuck breaker resulting in the loss of Shell Tap to GEN-2016-177 Tap 115 kV and Shell Tap to Shell C2 115 kV, was observed to have non-damped voltage oscillations in the SPP system. Refer to Figure 3-1 for a representative comparison plot of several area buses for the 2017 Winter Peak case with and without system upgrades. It can be observed that the upgrades in the study area help dampen the voltage oscillations after the fault is cleared and the system recovered within SPP criteria.

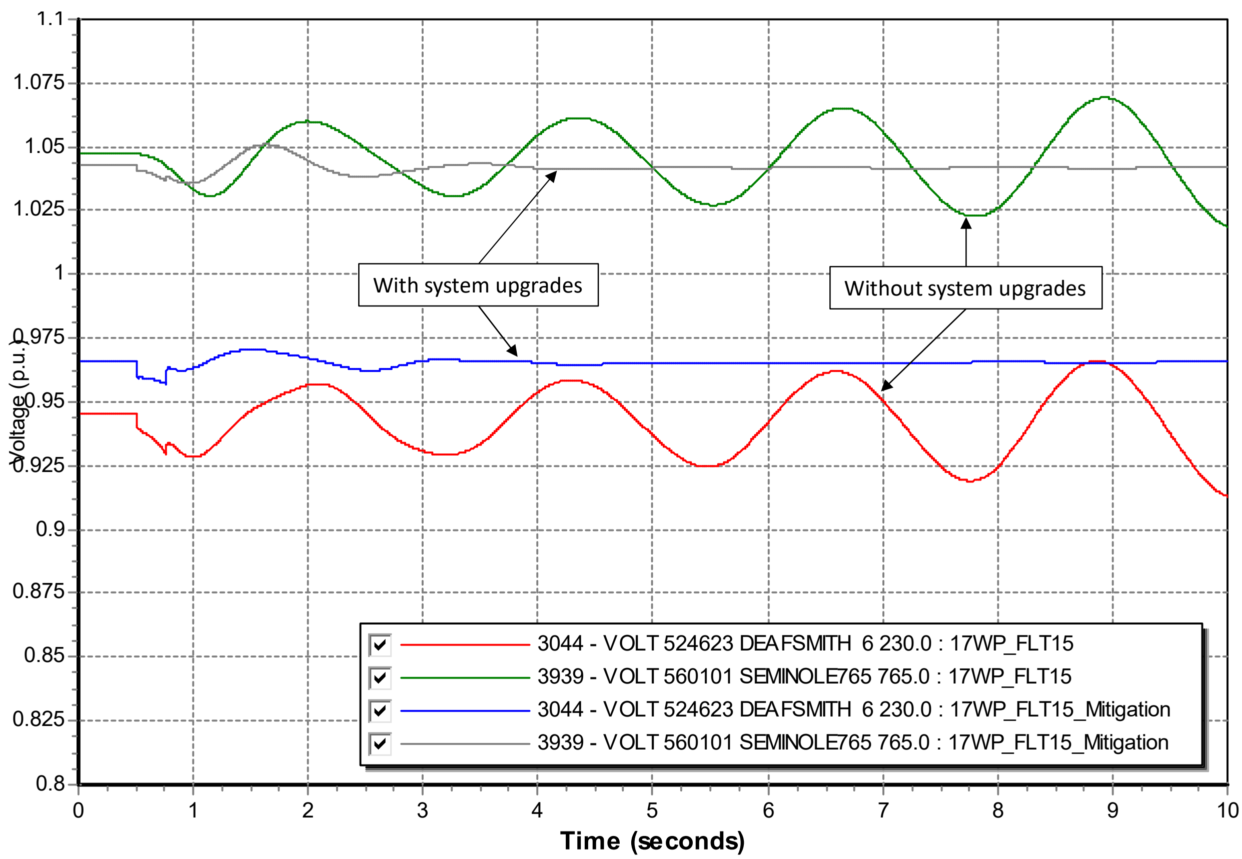


Figure 3-1: Representative plot of area voltages for 2017W conditions with and without system upgrades for FLT15.

FLT35-3PH, a three-phase fault resulting in the loss of Wolfforth to Sundown 230 kV, was observed to have voltage instability near the Sundown 230 kV and Tuco 230 kV area. Refer to Figure 3-2 for a representative comparison plot of Sundown and Tuco area voltages for the 2017W case with and without system upgrades. The upgrades identified in this section show the voltage oscillations and swings are non-existent and the area exhibits satisfactory voltage response. The system recovered within SPP criteria.

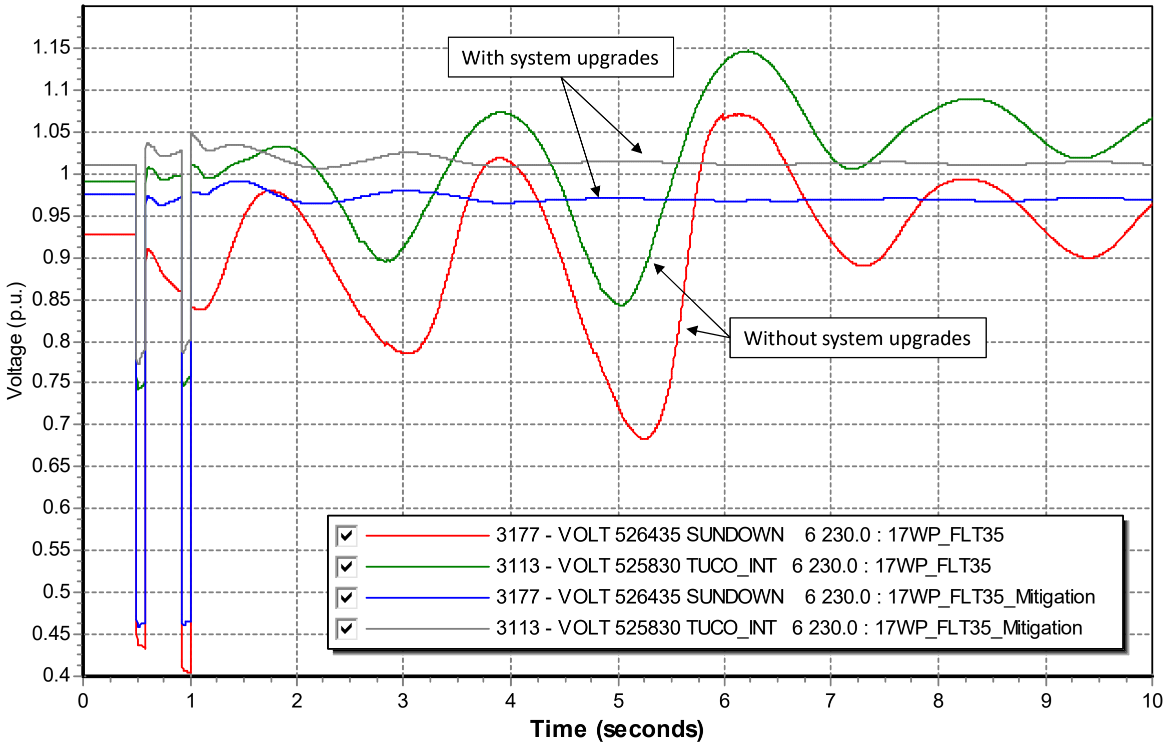


Figure 3-2: Representative plot of area voltages for 2017W conditions with and without system upgrades for FLT35.

FLT73-3PH, a three-phase fault resulting in the loss of the Mustang 230/115 kV transformer, was observed to have non-damped voltage oscillations in the SPP system and GEN-2016-077 trip offline. Refer to Figure 3-3 for a representative comparison plot of several area buses for the 2017 Winter Peak case with and without system upgrades. It can be observed that the upgrades in the study area help dampen the voltage oscillations after the fault is cleared and the system recovered within SPP criteria. Refer to Figure 3-4 for a plot of the real power output and frequency of GEN-2016-077. GEN-2016-077 has an instantaneous frequency trip protection setting of 57.8 Hz (unit trips offline when the frequency exceeds that value). It can be observed that the unit trips on the instantaneous frequency protection setting. It is a known artifact of PSS/E that the calculated frequency in positive-sequence programs cannot be trusted as a good indication of actual frequency. Because of this, the over and under frequency of GEN-2016-077 and GEN-2016-078 and other similar study projects were set to have a one (1) second time delay to avoid instantaneous tripping.

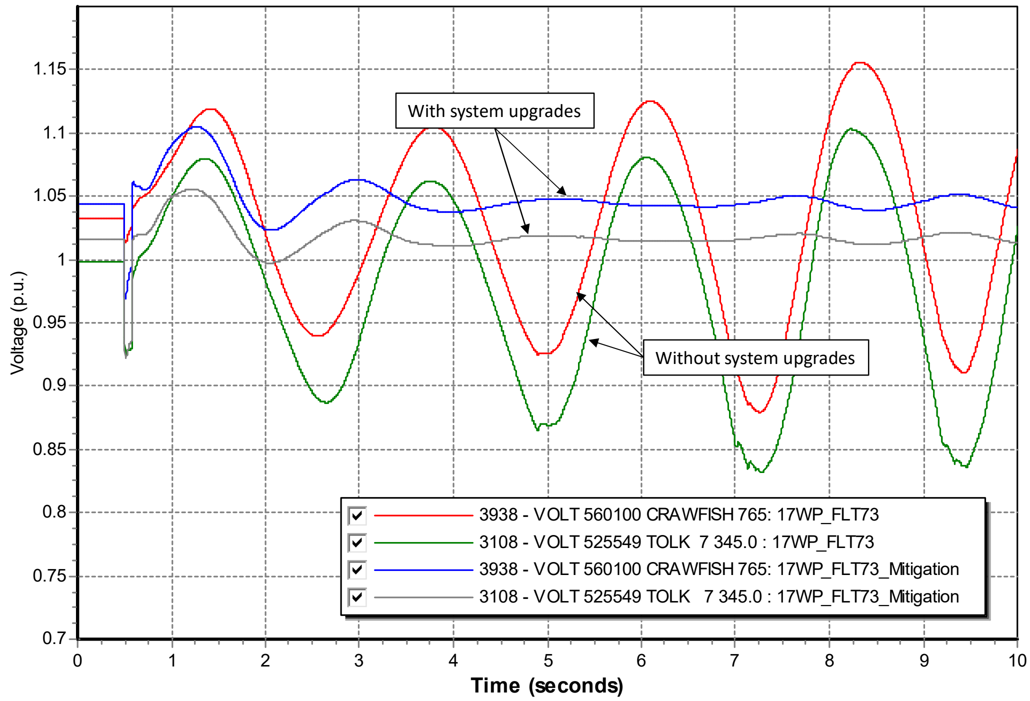


Figure 3-3: Representative plot of area voltages for 2017W conditions with and without system upgrades for FLT73.

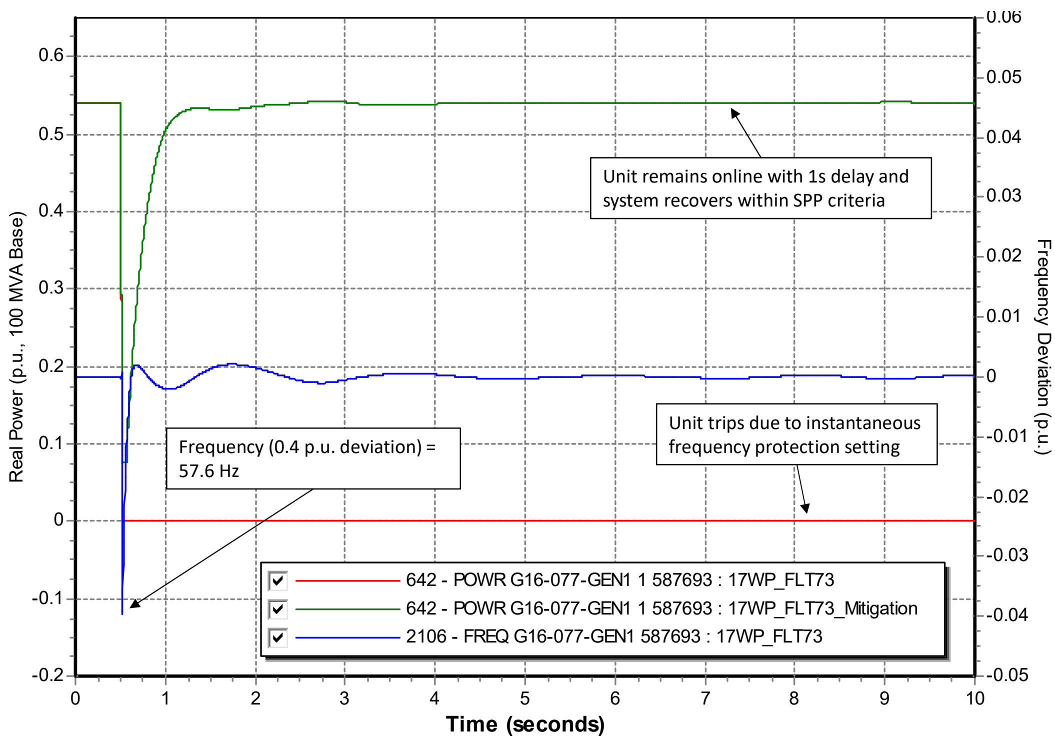


Figure 3-4: Representative plot of renewable energy models with instantaneous frequency trip protection settings.

FLT208-1PH, a single-phase stuck breaker fault resulting in the loss of Crawfish Draw to G16-120-Tap 345 kV and Crawfish Draw to OKU 345 kV line, was observed to have voltage instability, voltages recovering above 1.2 p.u., and generation tripping offline. Refer to Figure 3-5 for a representative comparison plot of Crawfish Draw and OKU area voltages for the 17W case with and without system upgrades. Refer to Figure 3-6 for comparison plot of GEN-2016-120 and GEN-2016-175's real and reactive power with and without system upgrades. Without system upgrades, the GEN-2016-120 units and GEN-2016-175 trips offline due to over voltage protection. After the upgrades were implemented, there were no additional voltage violations or generation tripping offline. The system recovered within SPP criteria.

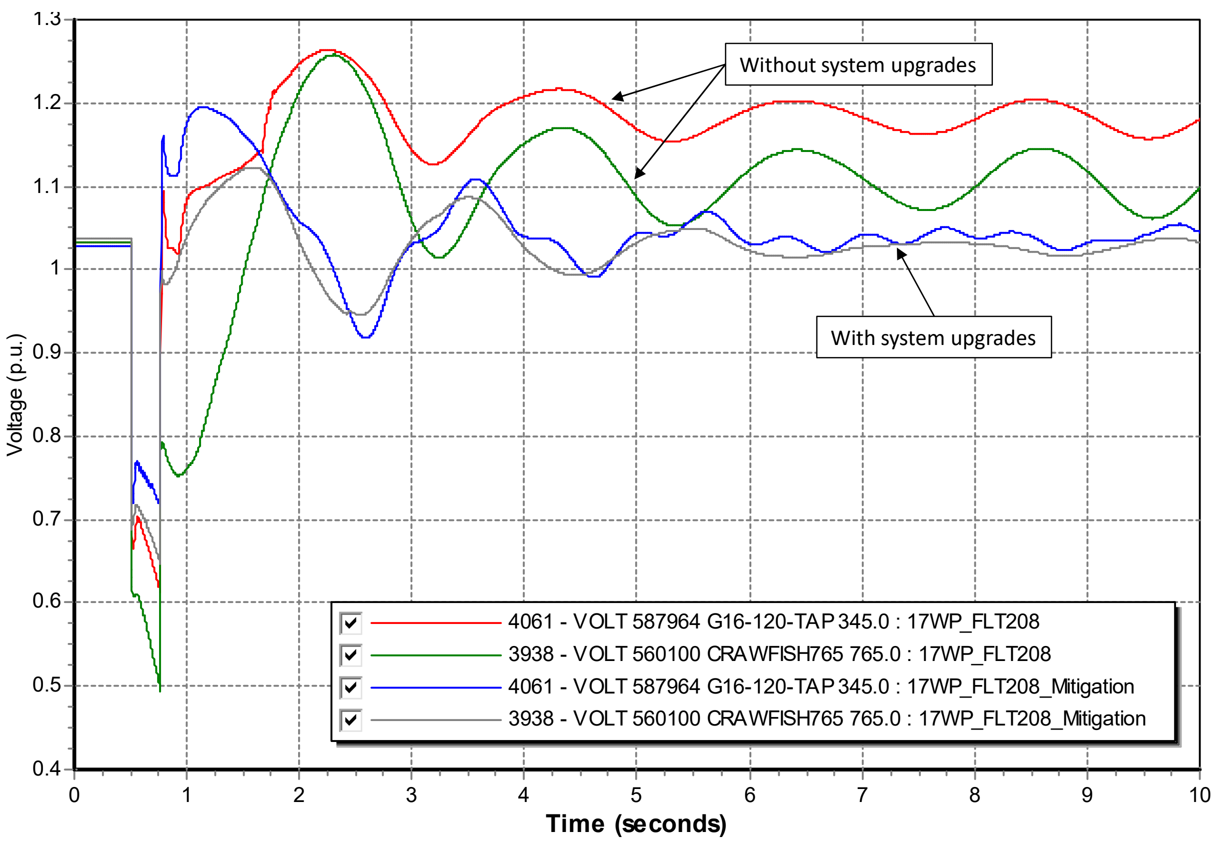


Figure 3-5: Representative plot of Crawfish Draw and OKU area voltages for 2017W conditions with and without system upgrades for FLT208

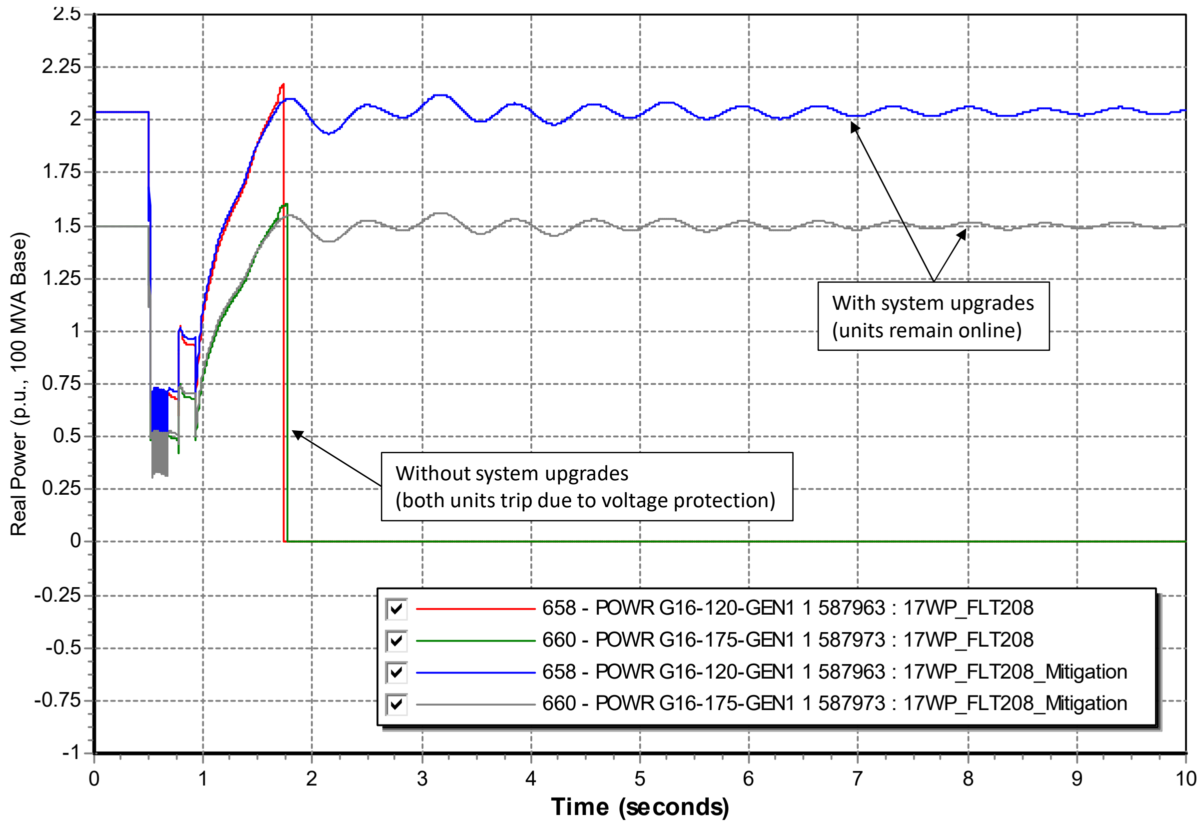


Figure 3-6: Comparison plot of GEN-2016-120's and GEN-2016-175's real power for 2017W conditions with and without system upgrades for FLT208.

FLT252-PO, a prior outage of Crossroads to Tolk 345 kV line followed by a three-phase fault resulting in the loss of Crossroads to Crawfish Draw 765 kV line (line identified as mitigation), was observed to have system instability after implemented the mitigation identified in this study. Refer to Figure 3-7 for a representative plot of Crossroads area voltages for the 17W case with the above system upgrades. It can be observed that with the system upgrades implemented, system instability still exists. Additionally, for the outage of Crossroads to Tolk 345 kV, generation curtailment was required. Study generation was required to be curtailed by the following for each seasons:

- 17W: curtail study generation by 950 MW
- 18S: curtail study generation by 750 MW
- 26S: curtail study generation by 550 MW

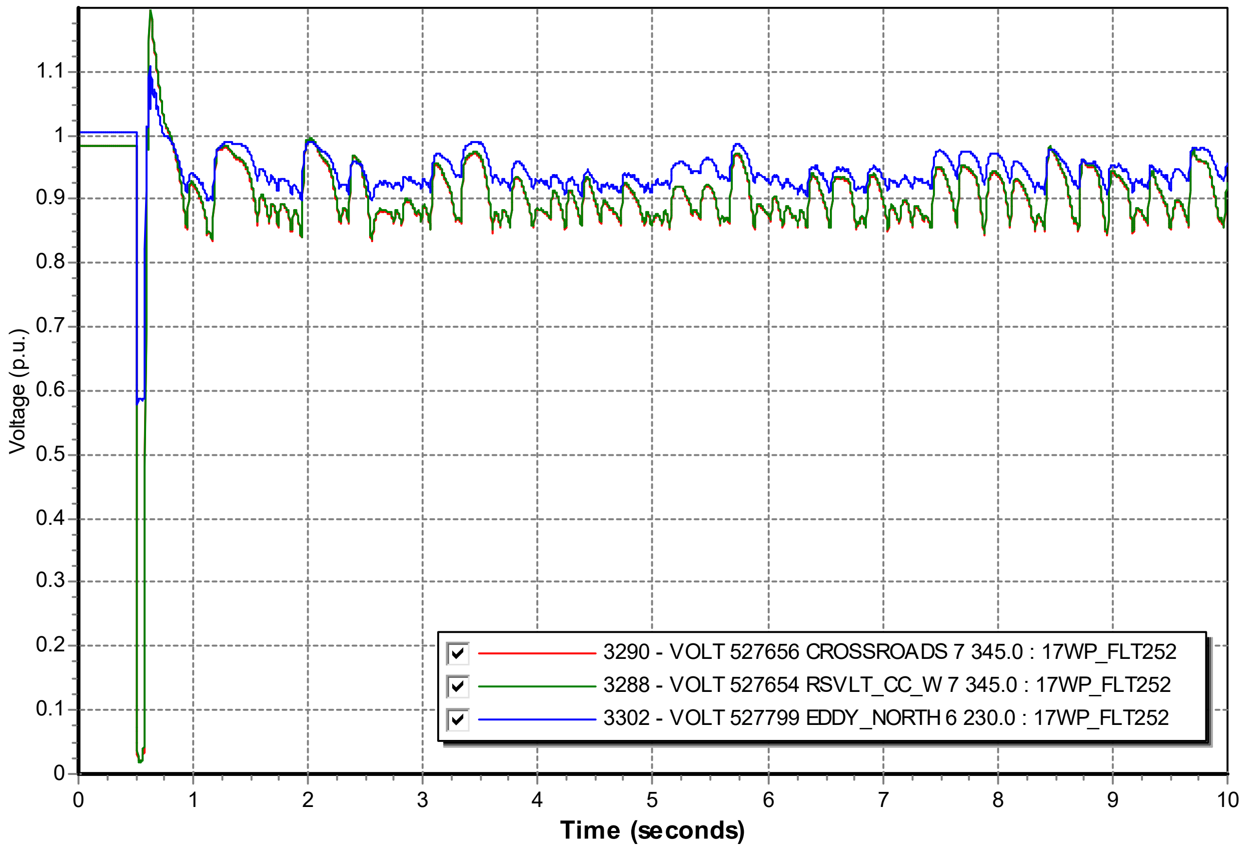


Figure 3-7: Representative plot of Crossroads area voltages for 17W conditions with system upgrades for FLT252 (normal system dispatch).

Refer to Figure 3-8 for a representative plot of Crossroads area voltages for the 17W case with the above system upgrades and generation curtailment. With this generation curtailment and system upgrades, there were no additional voltage violations or generation tripping off-line for the prior outage of Crossroads to Tolk 345 kV. The system recovered within SPP criteria.

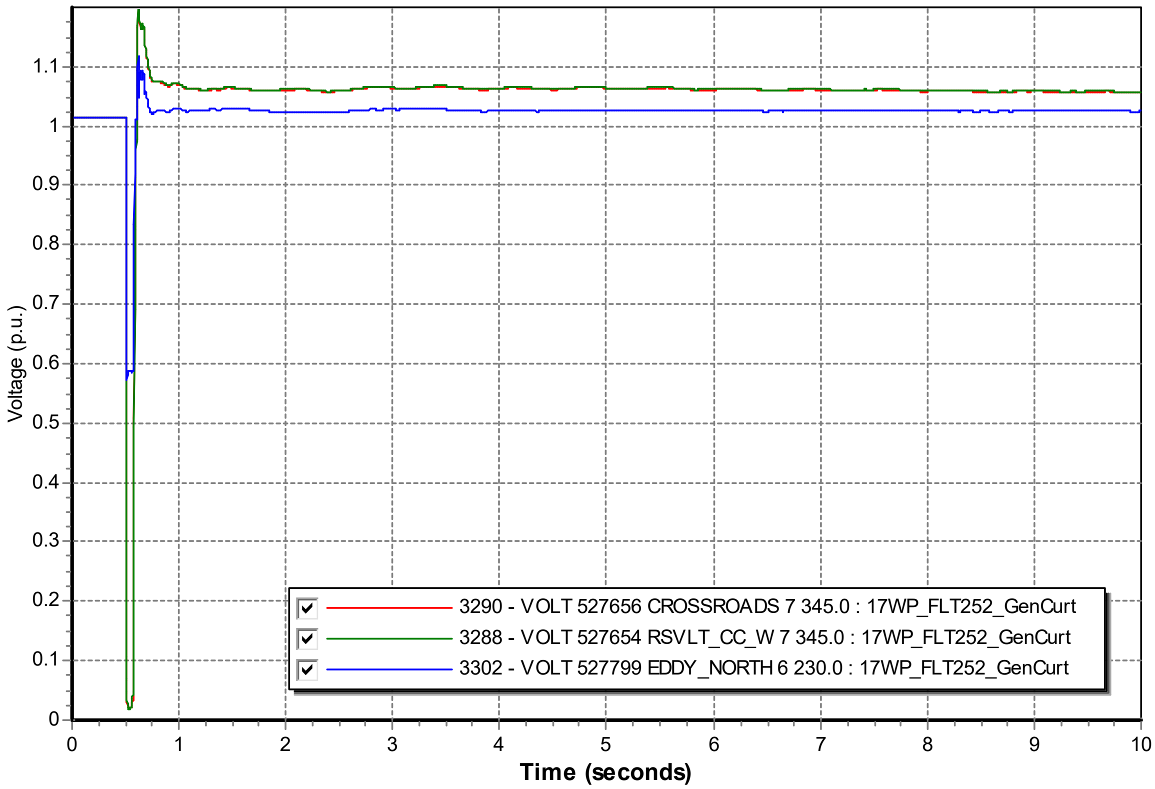


Figure 3-8: Representative plot of Crossroads area voltages for 17W conditions with system upgrades and generation curtailment for FLT252.

FLT315-PO, a prior outage of Crawfish Draw to Crawfish Draw Tap 765 kV circuit #1 followed by a three-phase fault resulting in the loss of the Crawfish Draw to Crawfish Draw Tap 765 kV circuit #2, was observed to have system instability. Refer to Figure 3-9 for a representative plot of Crawfish Draw area voltages for the 17W case with the above system upgrades. It can be observed that with the system upgrades implemented, system instability still exists. In addition to these upgrades, it was necessary to limit the line flow on the parallel circuit of the Crawfish Draw to Crawfish Draw Tap 765 kV line for the prior outage of Crawfish Draw to Crawfish Draw Tap 765 kV line (circuit #1 or circuit #2) to the following:

- 17W: Reduce from 3090 MW to 1950 MW (curtail all study generation)
- 18S: Reduce from 2645 MW to 1730 MW (curtail study generation by 2200 MW)
- 26S: Reduce from 2140 MW to 1720 MW (curtail study generation by 1000 MW)

Refer to Figure 3-10 for a representative plot of Crawfish Draw area voltages for the 17W case with the above system upgrades and generation curtailment. With this generation curtailment and system upgrades, there were no additional voltage violations or generation tripping off-line for the prior outage of Crawfish Draw to Crawfish Draw Tap 765 kV. The system recovered within SPP criteria.

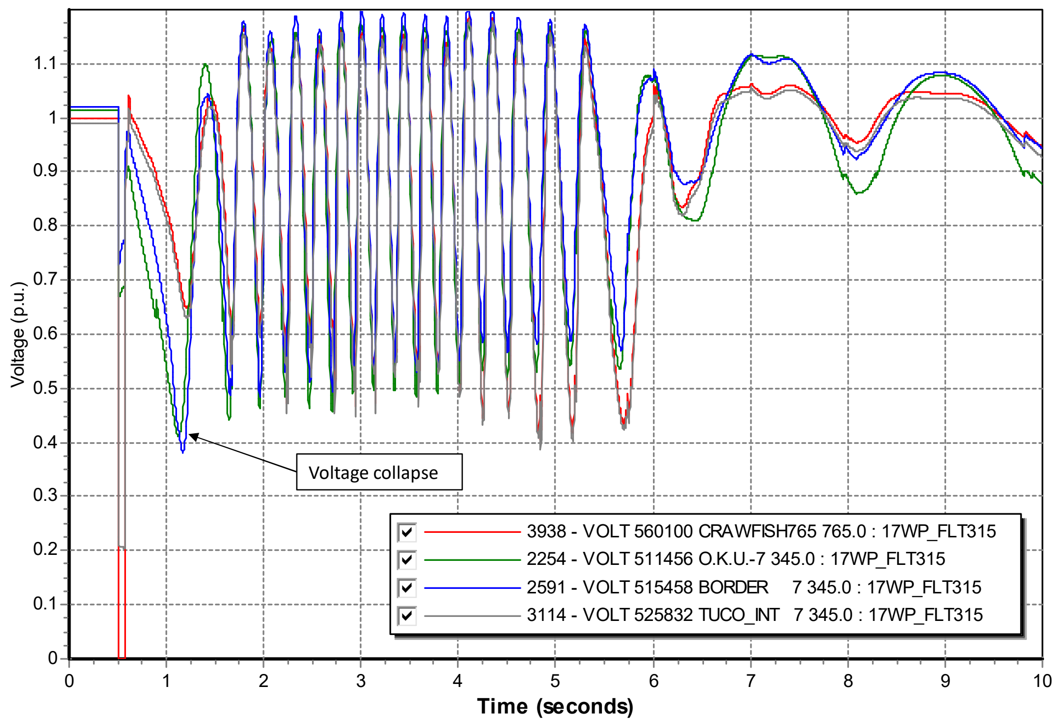


Figure 3-9: Representative plot of Crawfish Draw area voltages for 17W conditions with system upgrades for FLT315 (normal system dispatch).

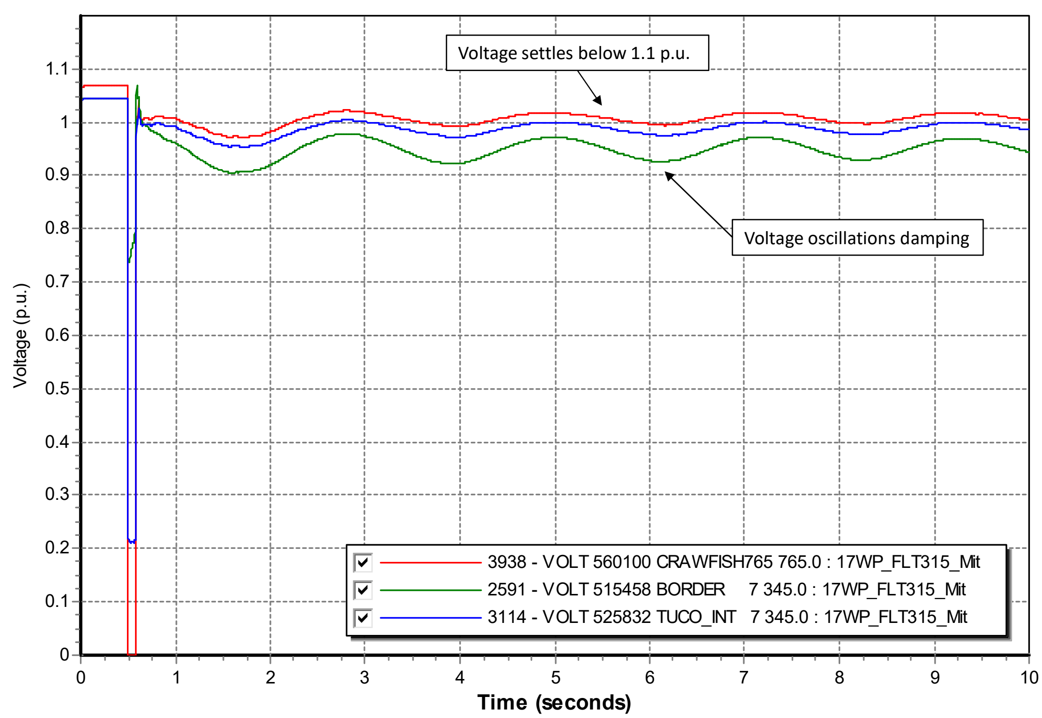


Figure 3-10: Representative plot of Crawfish Draw area voltages for 17W conditions with system upgrades and generation curtailment for FLT315.

FLT341-PO, a prior outage of the Crawfish Draw 765/345 kV transformer circuit #1 followed by a three-phase fault resulting in the loss of the second Crawfish Draw 765/345 kV transformer, was observed to have system instability after implemented the mitigation identified in this study and under normal dispatch. Refer to Figure 3-11 for a representative plot of Crawfish Draw area voltages for the 17W case with the above system upgrades. It can be observed that with the system upgrades implemented, system instability still exists. Additionally, for the outage of one of the Crawfish Draw 765/345 kV transformers, generation curtailment was required to maintain system stability. Study generation was required to be curtailed by the following for each seasons:

- 17W: curtail study generation by 700 MW
- 18S: curtail study generation by 400 MW
- 26S: No curtailment

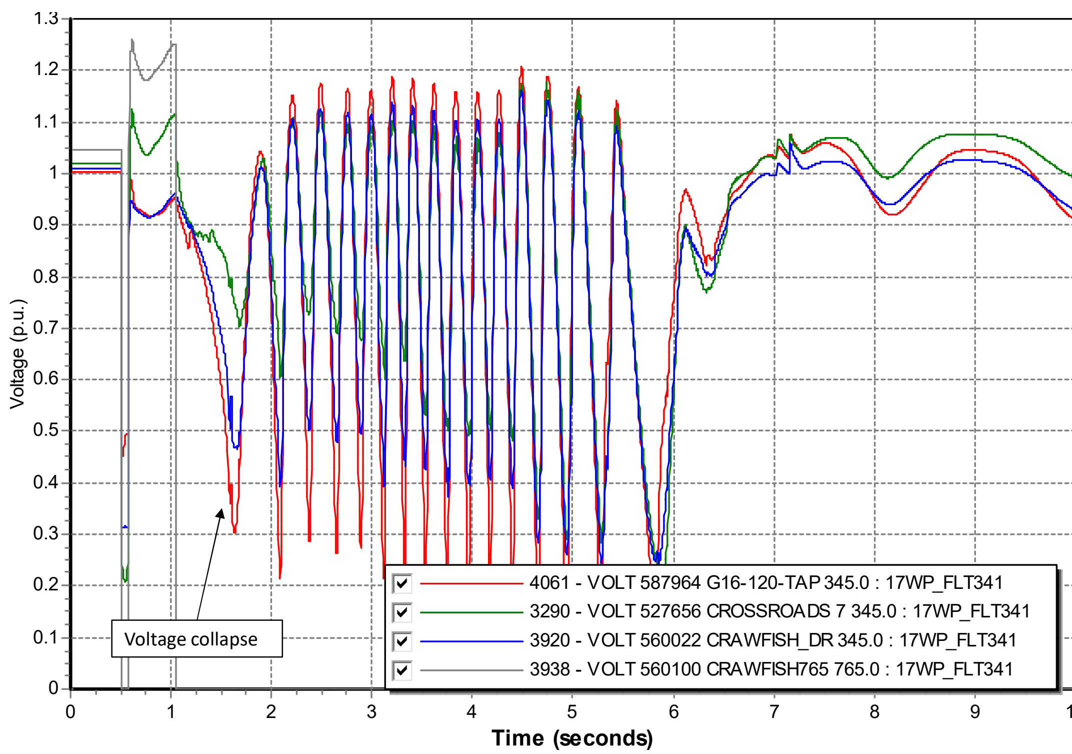


Figure 3-11: Representative plot of Crawfish Draw area voltages for 17W conditions with system upgrades for FLT341 (normal system dispatch).

With this generation curtailment and system upgrades, the voltage recovery near Crawfish Draw 765 kV exceeded the SPP performance criteria of 1.2 p.u. and therefore, additional mitigation was required. In order to limit the voltage, line reactors were required to be inserted on the Crawfish Draw and Seminole 765 kV line ends of the Crawfish Draw to Crawfish Draw Tap to Seminole 765 kV circuits. The following line reactors were switched in for each season on both circuits:

- Crawfish Draw 765 kV line end
  - 17W: 200 Mvar line reactor
  - 18S: 300 Mvar line reactor (increase of 190 Mvar)
  - 26S: 400 Mvar line reactor (increase of 150 Mvar)
- Seminole 765 kV line end
  - 17W: 150 Mvar line reactor
  - 18S: 200 Mvar line reactor (increase of 90 Mvar)
  - 26S: 350 Mvar line reactor (increase of 100 Mvar)

Refer to Figure 3-12 for a representative plot of Crawfish Draw area voltages for the 17W case with the prior system upgrades, generation curtailment, and line reactor adjustments. With these upgrades, generation curtailment and system adjustments, there were no additional voltage violations or generation tripping off-line for the prior outage of one of the Crawfish Draw 765/345 kV transformers. The system recovered within SPP criteria.

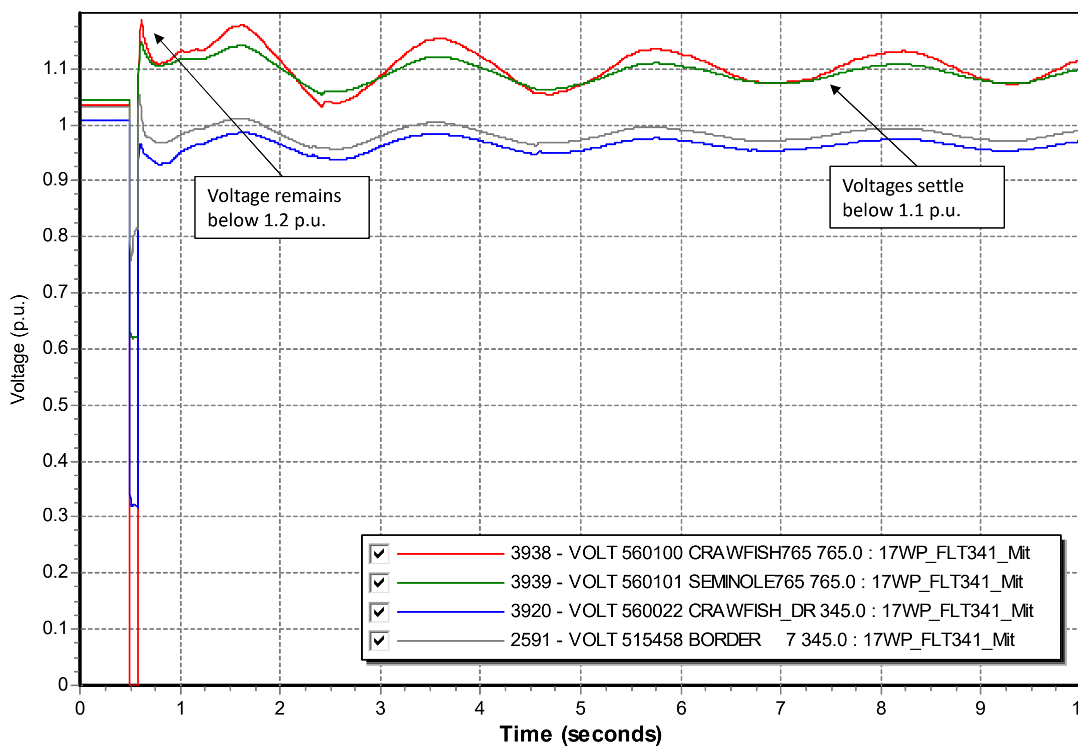


Figure 3-12: Representative plot of Crawfish Draw area voltages for 17W conditions with system upgrades, generation curtailment, and system adjustments for FLT341.

After the upgrades and system adjustments listed in this section were implemented, the Stability Analysis was re-simulated to determine system stability. With the required upgrades and system adjustments, the Stability Analysis determined that there was no wind turbine tripping or system instability as a result of interconnected all study projects at 100% output.

SECTION 4: SHORT CIRCUIT ANALYSIS

The objective of this task is to quantify the three-phase to ground fault currents for the 2018 Summer Peak and 2026 Summer Peak seasons for each interconnecting generator.

4.1 Approach

The short-circuit analysis will assess breaker adequacy and fault duties for the generator interconnection bus and five buses away from the point of interconnection. MEPPI will assume no outages to find maximum short-circuit currents that flow through the breaker. The Automatic Sequencing Fault Calculation (ASCC) function in PSS/E was utilized to perform this task. FLAT conditions were applied to pre-fault conditions and the following adjustments were utilized:

- All synchronous and asynchronous machine P and Q output was set to zero
- All transformer tap ratios were set to 1.0 p.u. and all phase shift angles were set to zero
- All generator reactance's were fixed to the subtransient reactance
- All line charging was set to zero
- All shunts were set to zero
- All loads were set to zero
- All pre-fault bus voltages were set to 1.0 p.u. and a phase shift angle of zero

Note upgrades found to be necessary for the Stability Analysis were included in the Short-Circuit Analysis.

4.2 Short Circuit Results: 2018 Summer Peak

The maximum fault current for each bus is provided for the 2018 Summer Peak conditions. The following tables show the short circuit results for the study generators for the 2018 Summer Peak condition:

- Table 4-1: Short Circuit Analysis for ASGI-2016-009 (18SP)
- Table 4-2: Short Circuit Analysis for GEN-2015-039 (18SP)
- Table 4-3: Short Circuit Analysis for GEN-2015-040 (18SP)
- Table 4-4: Short Circuit Analysis for GEN-2015-078 (18SP)
- Table 4-5: Short Circuit Analysis for GEN-2015-099 (18SP)
- Table 4-6: Short Circuit Analysis for GEN-2016-039 (18SP)
- Table 4-7: Short Circuit Analysis for GEN-2016-077 (18SP)
- Table 4-8: Short Circuit Analysis for GEN-2016-078 (18SP)
- Table 4-9: Short Circuit Analysis for GEN-2016-120 and GEN-2016-175 (18SP)
- Table 4-10: Short Circuit Analysis for GEN-2016-121 (18SP)
- Table 4-11: Short Circuit Analysis for GEN-2016-123, GEN-2016-124, and GEN-2016-125 (18SP)

- Table 4-12: Short Circuit Analysis for GEN-2016-169 (18SP)
- Table 4-13: Short Circuit Analysis for GEN-2016-171 (18SP)
- Table 4-14: Short Circuit Analysis for GEN-2016-172 (18SP)
- Table 4-15: Short Circuit Analysis for GEN-2016-177 (18SP)

Table 4-1
Short Circuit Analysis for Study Project ASGI-2016-009 (18SP)

Study Generator ASGI-2016-009											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
522823	LP-MILWAKEE6	230	11.10	526192	MURPHY 3	115	10.89	526736	TERRY_CNTY 3	115	10.42
522828	LP-MILWAKEE2	69	8.32	526199	SP-FRANKFRD3	115	9.88	526747	LG-BROWNFLD2	69	3.56
522861	LP-SOUTHEST6	230	14.62	526221	BATTON_N 2	69	1.78	526792	PRENTICE 3	115	5.90
525481	PLANT_X 6	230	24.43	526268	LUBBCK_STH 3	115	19.76	526934	YOAKUM 3	115	16.82
525524	TOLK_EAST 6	230	32.66	526269	LUBBCK_STH 6	230	18.78	527080	EL_PASO 3	115	15.62
525828	TUCO_INT 3	115	21.72	526337	JONES 6	230	21.29	527125	DENVER_CTY 2	69	8.63
525830	TUCO_INT 6	230	32.78	526434	SUNDOWN 3	115	11.08	527130	DENVER_N 3	115	20.84
525832	TUCO_INT 7	345	26.37	526435	SUNDOWN 6	230	11.27	527136	DENVER_S 3	115	20.84
525840	ANTELOPE_1 6	230	32.38	526460	AMOCO_SS 6	230	9.87	527146	MUSTANG 3	115	22.41
525957	HALE_WNDCL16	230	10.20	526469	SP-YUMA 2	69	3.05	527202	SEAGRAVES 3	115	8.53
526076	STANTON_W 3	115	9.31	526475	YUMA_INT 3	115	11.20	527212	DIAMONDBACK3	115	3.10
526109	SP-ERSKINE 3	115	11.56	526481	SP-WOLF_TP 3	115	11.38	527261	SULPHUR 2	69	3.36
526130	SP-CARLISLE2	69	2.11	526483	SP-WOLFORTH3	115	8.79	527262	SULPHUR 3	115	5.66
526146	INDIANA 3	115	9.72	526484	LG-LEVELAND3	115	9.30	527286	XTO_RUSSEL 3	115	9.96
526159	CARLISLE 2	69	2.58	526491	LG-CLAUENE 3	115	7.94	560021	CRAWFISH_DR2	230	29.24
526160	CARLISLE 3	115	13.56	526506	LG-DOCWEBR 2	69	4.94	583810	COMNIRE	115	0.37
526161	CARLISLE 6	230	11.90	526524	WOLFFORTH 3	115	11.71	584720	ASGI15021602	69	2.13
526162	LP-DOUD_TP 3	115	11.91	526525	WOLFFORTH 6	230	14.03	585120	GEN-2015-075	69	1.55
526176	LP-DOUD 3	115	9.21	526535	SP-MILWAKEE3	115	10.18	587370	GEN-2016-056	230	6.08
526184	SW_6878 2	69	2.17	526735	TERRY_CNTY 2	69	6.97				

Table 4-2
Short Circuit Analysis for Study Project GEN-2015-039 (18SP)

Study Generator GEN-2015-039											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
522823	LP-MILWAKEE6	230	11.10	524909	ROSEVELT_N 6	230	9.13	525832	TUCO_INT 7	345	26.37
522861	LP-SOUTHEST6	230	14.62	524911	ROSEVELT_S 6	230	9.13	525840	ANTELOPE_1 6	230	32.38
522870	LP-HOLLY 6	230	15.67	524915	SW_4K33 6	230	9.13	525850	ELK_CT1	345	25.81
523095	HITCHLAND 6	230	15.15	524924	PORTALES 3	115	7.29	525957	HALE_WNDCL16	230	10.20
523097	HITCHLAND 7	345	16.06	525018	EMULESH&VLY3	115	4.84	526019	HOCKLEY 2	69	5.13
523221	XIT_INTG 6	230	3.25	525019	EMU&VLY_TP 3	115	5.15	526020	HOCKLEY 3	115	5.47
523267	PRINGLE 6	230	4.28	525027	BAILEYCO 2	69	4.88	526036	LC-OPDYKE 3	115	5.76
523308	MOORE_E 3	115	11.86	525028	BAILEYCO 3	115	5.03	526076	STANTON_W 3	115	9.31
523309	MOORE_CNTY 6	230	6.99	525050	BC-KELLEY +3	115	7.77	526160	CARLISLE 3	115	13.56
523869	CHAN+TASCOS6	230	4.37	525056	BC-EARTH 3	115	8.20	526161	CARLISLE 6	230	11.90
523959	POTTER_CO 6	230	22.66	525124	HART_INDUST3	115	7.84	526268	LUBBCK_STH 3	115	19.76
523961	POTTER_CO 7	345	11.58	525179	TULIA_TP 3	115	6.57	526269	LUBBCK_STH 6	230	18.78
523977	HARRNG_WST 6	230	27.44	525191	KRESS_INT 2	69	4.54	526298	LUBBCK_EST 3	115	15.77
523978	HARRNG_MID 6	230	27.44	525192	KRESS_INT 3	115	12.41	526299	LUBBCK_EST 6	230	13.65
523979	HARRNG_EST 6	230	27.44	525212	SWISHER 3	115	11.97	526337	JONES 6	230	21.29
524007	ROLLHILLS 3	115	19.67	525213	SWISHER 6	230	11.27	526361	COCHRAN 3	115	6.83
524010	ROLLHILLS 6	230	20.52	525225	KRESS_RURAL3	115	6.53	526424	PACIFIC 3	115	9.44
524266	BUSHLAND 3	115	9.43	525272	KISER 3	115	5.21	526434	SUNDOWN 3	115	11.08
524267	BUSHLAND 6	230	9.88	525291	PLAINVW_TP 2	69	6.52	526435	SUNDOWN 6	230	11.27
524276	WILDOR_WND 6	230	5.01	525298	S_PLAINVEW 2	69	2.59	526445	AMOCO_TP 3	115	10.37
524290	WILDOR2_JUS6	230	6.71	525325	COX 2	69	3.38	526452	AMOCO_CRYO 3	115	6.43
524296	SPNSPUR_WND7	345	5.57	525326	COX 3	115	6.01	526460	AMOCO_SS 6	230	9.87
524300	HILLSIDE 3	115	12.66	525393	ROCKYFORD 3	115	8.88	526475	YUMA_INT 3	115	11.20
524306	COULTER 3	115	15.39	525413	LAMTON 2	69	5.20	526484	LG-LEVELAND3	115	9.30
524415	AMA_SOUTH 6	230	13.84	525414	LAMTON 3	115	7.72	526524	WOLFFORTH 3	115	11.71
524516	CANYON_WEST3	115	5.70	525432	SP-HALFWAY+2	69	5.90	526525	WOLFFORTH 6	230	14.03
524554	CENTRE_ST 2	69	3.81	525440	LC-S_OLTON+3	115	7.22	526677	GRASSLAND 6	230	6.61
524556	LAPLATA 3	115	6.08	525446	RKYFORD_TP 3	115	9.92	526736	TERRY_CNTY 3	115	10.42
524561	DS-MTR 2	69	6.05	525453	HALE_CNTY 2	69	6.95	526934	YOAKUM 3	115	16.82
524567	NE_HEREFORD3	115	9.60	525454	HALE_CNTY 3	115	10.30	526935	YOAKUM 6	230	18.00
524573	NE_HEREFORD2	69	6.74	525460	NEWHART 3	115	17.09	526936	YOAKUM_345	345	9.58
524590	DAWN 3	115	6.27	525461	NEWHART 6	230	11.56	527009	BRU_SUB 6	230	14.15
524597	PANDAHFD 3	115	8.94	525480	PLANT_X 3	115	18.07	527149	MUSTANG 6	230	15.79
524604	HEREFRD_SB 2	69	4.43	525481	PLANT_X 6	230	24.43	527656	CROSSROADS 7	345	16.70
524605	HEREFRD_NB 2	69	4.43	525524	TOLK_EAST 6	230	32.66	560021	CRAWFISH_DR2	230	29.24
524606	HEREFORD 3	115	10.77	525531	TOLK_WEST 6	230	32.66	560022	CRAWFISH_DR	345	27.31
524608	HERFRD_STH 2	69	4.43	525543	TOLK_TAP 6	230	32.66	560035	GRAPEVINE	345	6.52
524622	DEAFSMITH 3	115	12.02	525549	TOLK 7	345	18.26	560050	G15-031-TAP	230	9.52
524623	DEAFSMITH 6	230	7.78	525613	W_LITTLFLD 2	69	2.97	560051	G15-039-TAP	230	7.52
524629	DS-#6 3	115	6.18	525620	LTFLD_S&CTY2	69	4.18	560059	G1579&G1580T	230	9.21
524655	FRIONA 3	115	3.92	525635	LAMB_CNTY 2	69	5.92	562480	G13-027-TAP	230	9.59
524694	DS-#22 3	115	4.61	525636	LAMB_CNTY 3	115	8.51	583840	GEN-2013-027	230	9.08
524734	DS-#21 3	115	9.35	525637	LAMB_CNTY 6	230	5.47	584640	GEN-2015-022	115	11.97
524745	CASTRO_CNTY2	69	8.82	525650	LC-LTTLFLD+2	69	4.95	584750	GEN-2015-031	230	8.04
524746	CASTRO_CNTY3	115	9.87	525687	LC-LUMSCHAP2	69	4.63	584800	GEN-2015-039	230	6.37
524757	BETHEL_COL13	115	8.22	525780	FLOYD_CNTY 3	115	6.13	585060	GEN-2015-068	345	17.30
524768	PLSNT_HILL 3	115	10.08	525816	TUCO_INT2 2	69	4.73	587370	GEN-2016-056	230	6.08
524770	PLSNT_HILL 6	230	6.26	525826	TUCO_INT 2	69	8.07	587700	GEN-2016-078	69	7.87
524822	CURRY 3	115	10.64	525828	TUCO_INT 3	115	21.72	588440	GEN-2016-172	115	14.35
524875	OASIS 6	230	7.53	525830	TUCO_INT 6	230	32.78	599955	PNM-DC6	230	9.13
524908	ROOSEVELT 3	115	10.42								

Table 4-3
Short Circuit Analysis for Study Project GEN-2015-040 (18SP)

Study Generator GEN-2015-040											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
524909	ROSEVELT_N 6	230	9.13	527041	ARCO_TP 3	115	13.05	527275	SEMINOLE 3	115	11.43
525481	PLANT_X 6	230	24.43	527047	OXY_WILRD1 3	115	10.49	527276	SEMINOLE 6	230	7.28
525531	TOLK_WEST 6	230	32.66	527051	ODC_TP 3	115	13.15	527286	XTO_RUSSEL 3	115	9.96
525543	TOLK_TAP 6	230	32.66	527056	ODC 3	115	9.92	527313	MIDAMERI_TP2	69	2.15
525637	LAMB_CNTY 6	230	5.47	527062	SHELL_CO2 3	115	15.86	527321	GAINES 2	69	4.13
525830	TUCO_INT 6	230	32.78	527068	SHELLC3_TP 3	115	10.67	527322	GAINES 3	115	8.53
525832	TUCO_INT 7	345	26.37	527080	EL_PASO 3	115	15.62	527325	OXY_WSEM_TP3	115	8.44
525850	ELK_CT1	345	25.81	527099	DC_EAST 2	69	6.09	527339	DOSS 2	69	4.07
526434	SUNDOWN 3	115	11.08	527105	SAN_ANDS_TP3	115	16.47	527340	DOSS 3	115	7.14
526435	SUNDOWN 6	230	11.27	527106	SAN_ANDRES 3	115	11.72	527346	LEGACY 3	115	7.04
526460	AMOCO_SS 6	230	9.87	527111	WASSON 2	69	5.96	527363	HIGG 3	115	10.13
526491	LG-CLAUENE 3	115	7.94	527125	DENVER_CTY 2	69	8.63	527867	CUNNIGHM_S 6	230	16.87
526524	WOLFFORTH 3	115	11.71	527130	DENVER_N 3	115	20.84	527891	HOBBS_INT 3	115	30.30
526525	WOLFFORTH 6	230	14.03	527136	DENVER_S 3	115	20.84	527894	HOBBS_INT 6	230	18.18
526735	TERRY_CNTY 2	69	6.97	527146	MUSTANG 3	115	22.41	527896	HOBBS_INT 7	345	9.81
526736	TERRY_CNTY 3	115	10.42	527149	MUSTANG 6	230	15.79	527965	KIOWA 7	345	5.92
526784	AMOCOWASSON6	230	14.02	527151	GS-MUSTANG 6	230	15.79	528611	GAINESGENTP6	345	7.37
526792	PRENTICE 3	115	5.90	527183	JAYBEE 2	69	4.36	528626	LE-PLNSINT 2	69	4.39
526928	PLAINS_INT 3	115	9.82	527194	LG-PLSHILL 3	115	7.53	560022	CRAWFISH_DR	345	27.31
526934	YOAKUM 3	115	16.82	527201	SEAGRAVES 2	69	5.40	560059	G1579&G1580T	230	9.21
526935	YOAKUM 6	230	18.00	527202	SEAGRAVES 3	115	8.53	562480	G13-027-TAP	230	9.59
526936	YOAKUM_345	345	9.58	527212	DIAMONDBACK3	115	3.10	583840	GEN-2013-027	230	9.08
526944	LG-PLAINS 3	115	7.85	527217	MOSS 2	69	5.30	584810	GEN-2015-040	230	14.42
526993	LG-WELLMAN 2	69	3.06	527223	LG-MC&SMNL+2	69	2.58	585060	GEN-2015-068	345	17.30
527009	BRU_SUB 6	230	14.15	527238	ROZ 3	115	9.27	585150	GEN-2015-078	115	16.46
527010	OXYBRU 6	230	14.03	527242	AMERADA 3	115	9.38	585160	G1579&G1580	230	8.74
527018	BENNETT 3	115	13.14	527261	SULPHUR 2	69	3.36	588350	GEN-2016-171	230	8.98
527036	SHELL_C2 3	115	12.90	527262	SULPHUR 3	115	5.66	588430	GEN-2016-169	345	9.53

Table 4-4
Short Circuit Analysis for Study Project GEN-2015-078 (18SP)

Study Generator GEN-2015-078											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
524909	ROSEVELT_N 6	230	9.13	527018	BENNETT 3	115	13.14	527271	LG-FOSTER +2	69	2.71
525481	PLANT_X 6	230	24.43	527030	ALRDCRTZ_TP3	115	8.72	527275	SEMINOLE 3	115	11.43
525531	TOLK_WEST 6	230	32.66	527036	SHELL_C2 3	115	12.90	527276	SEMINOLE 6	230	7.28
525543	TOLK_TAP 6	230	32.66	527041	ARCO_TP 3	115	13.05	527284	RUSSELL 3	115	9.02
525637	LAMB_CNTY 6	230	5.47	527047	OXY_WILRD1 3	115	10.49	527286	XTO_RUSSEL 3	115	9.96
525830	TUCO_INT 6	230	32.78	527051	ODC_TP 3	115	13.15	527291	LE-KCM 2	69	2.91
525832	TUCO_INT 7	345	26.37	527056	ODC 3	115	9.92	527305	LG-SAWYERFL2	69	2.07
525850	ELK_CT1	345	25.81	527062	SHELL_CO2 3	115	15.86	527313	MIDAMERI_TP2	69	2.15
526161	CARLISLE 6	230	11.90	527068	SHELLC3_TP 3	115	10.67	527321	GAINES 2	69	4.13
526269	LUBBCK_STH 6	230	18.78	527074	SHELLC3 3	115	9.59	527322	GAINES 3	115	8.53
526434	SUNDOWN 3	115	11.08	527080	EL_PASO 3	115	15.62	527325	OXY_WSEM_TP3	115	8.44
526435	SUNDOWN 6	230	11.27	527093	SW_7848 2	69	4.22	527331	RILEY 2	69	3.84
526445	AMOCO_TP 3	115	10.37	527096	OXY_DC_WST 2	69	4.50	527339	DOSS 2	69	4.07
526460	AMOCO_SS 6	230	9.87	527099	DC_EAST 2	69	6.09	527340	DOSS 3	115	7.14
526469	SP-YUMA 2	69	3.05	527105	SAN_ANDS_TP3	115	16.47	527346	LEGACY 3	115	7.04
526475	YUMA_INT 3	115	11.20	527106	SAN_ANDRES 3	115	11.72	527360	MAPCO 3	115	10.24
526481	SP-WOLF_TP 3	115	11.38	527111	WASSON 2	69	5.96	527362	JOHNSON_DRW3	115	10.47
526484	LG-LEVELAND3	115	9.30	527117	SW_7814 2	69	3.13	527363	HIGG 3	115	10.13
526491	LG-CLAUENE 3	115	7.94	527125	DENVER_CTY 2	69	8.63	527867	CUNNIGHM_S 6	230	16.87
526499	LG-MEADOW 2	69	3.71	527130	DENVER_N 3	115	20.84	527891	HOBBS_INT 3	115	30.30
526506	LG-DOCWEBR 2	69	4.94	527136	DENVER_S 3	115	20.84	527894	HOBBS_INT 6	230	18.18
526524	WOLFFORTH 3	115	11.71	527146	MUSTANG 3	115	22.41	527896	HOBBS_INT 7	345	9.81
526525	WOLFFORTH 6	230	14.03	527149	MUSTANG 6	230	15.79	527965	KIOWA 7	345	5.92
526735	TERRY_CNTY 2	69	6.97	527151	GS-MUSTANG 6	230	15.79	528413	TAYLOR 3	115	14.17
526736	TERRY_CNTY 3	115	10.42	527183	JAYBEE 2	69	4.36	528433	BENSING 3	115	7.94
526747	LG-BROWNFLD2	69	3.56	527189	LG-SEAGRAVE2	69	3.73	528611	GAINESGENTP6	345	7.37
526754	BROWNFIELD 2	69	3.05	527194	LG-PLSHILL 3	115	7.53	528626	LE-PLNSINT 2	69	4.39
526784	AMOCOWASSON6	230	14.02	527201	SEAGRAVES 2	69	5.40	528775	LE-ERF 3	115	10.47
526792	PRENTICE 3	115	5.90	527202	SEAGRAVES 3	115	8.53	528778	LE-ROZ 2	69	3.41
526928	PLAINS_INT 3	115	9.82	527211	DIAMONDBACK2	69	2.76	560022	CRAWFISH_DR	345	27.31
526934	YOAKUM 3	115	16.82	527212	DIAMONDBACK3	115	3.10	560059	G1579&G1580T	230	9.21
526935	YOAKUM 6	230	18.00	527217	MOSS 2	69	5.30	562480	G13-027-TAP	230	9.59
526936	YOAKUM_345	345	9.58	527223	LG-MC&SMNL+2	69	2.58	583840	GEN-2013-027	230	9.08
526944	LG-PLAINS 3	115	7.85	527228	RILEY_TP 2	69	3.98	584810	GEN-2015-040	230	14.42
526965	KINNEY 2	69	2.41	527229	OZRK_MAH02 2	69	2.59	585060	GEN-2015-068	345	17.30
526971	TOKIO_TP 2	69	3.64	527235	LG-ASHMORE 2	69	2.18	585150	GEN-2015-078	115	16.46
526979	LG-JS_SMITH2	69	2.10	527238	ROZ 3	115	9.27	585160	G1579&G1580	230	8.74
526985	WELLMAN 2	69	2.85	527242	AMERADA 3	115	9.38	588350	GEN-2016-171	230	8.98
526993	LG-WELLMAN 2	69	3.06	527247	CEDARLAKE 2	69	2.45	588430	GEN-2016-169	345	9.53
526999	UNION_TX 2	69	2.38	527253	ADAIR 2	69	2.62	588460	A16-008SUB	115	9.23
527009	BRU_SUB 6	230	14.15	527261	SULPHUR 2	69	3.36	588462	A16-008TP	115	9.23
527010	OXYBRU 6	230	14.03	527262	SULPHUR 3	115	5.66				

Table 4-5
Short Circuit Analysis for Study Project GEN-2015-099 (18SP)

Study Generator GEN-2015-099											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
525832	TUCO_INT 7	345	26.37	527999	INTREPDW_TP3	115	12.44	528480	OXY_S_HOBBS3	115	10.51
526460	AMOCO_SS 6	230	9.87	528027	RDRUNNER 7	345	3.90	528484	SW_4J44 3	115	11.14
526934	YOAKUM 3	115	16.82	528095	7-RIVERS 6	230	6.30	528491	MONUMENT 3	115	15.08
526935	YOAKUM 6	230	18.00	528145	NATPOT_TP 2	69	8.76	528498	W_HOBBS 3	115	11.72
526936	YOAKUM_345	345	9.58	528151	FIESTA 3	115	9.79	528512	EUNICE 3	115	6.35
527009	BRU_SUB 6	230	14.15	528159	CARLSBAD 2	69	4.88	528533	DRINKARD_TP3	115	8.23
527030	ALRDCRTZ_TP3	115	8.72	528160	CARLSBAD 3	115	11.28	528552	OIL_CENTER 3	115	5.82
527130	DENVER_N 3	115	20.84	528178	PECOS 3	115	11.93	528554	COOPER_RNCH3	115	6.22
527149	MUSTANG 6	230	15.79	528179	PECOS 6	230	6.62	528568	MONUMNT_TP 3	115	9.84
527284	RUSSELL 3	115	9.02	528185	N_LOVING 7	345	4.63	528575	OXYPERMIAN 3	115	14.87
527286	XTO_RUSSEL 3	115	9.96	528317	ENRON_TP 3	115	6.77	528582	BYRD 3	115	7.59
527325	OXY_WSEM_TP3	115	8.44	528318	ENRON 3	115	5.89	528589	DRINKARD 3	115	8.51
527360	MAPCO 3	115	10.24	528325	LE-WAITS 3	115	6.70	528596	CARDINAL 3	115	8.41
527362	JOHNSON_DRW3	115	10.47	528333	LE-WEST_SUB3	115	8.34	528603	NA_ENRICH 3	115	12.04
527363	HIGG 3	115	10.13	528334	LE-NRTH_INT3	115	8.26	528604	ANDREWS 6	345	6.67
527483	CHAVES_CNTY6	230	4.44	528341	LE-SANANDRS3	115	6.33	528610	GAINES_GEN 6	230	9.34
527793	EDDY_STH 3	115	11.65	528348	BUCKEYE_TP 3	115	8.15	528611	GAINESGENTP6	345	7.37
527798	EDDY_NTH 3	115	11.65	528353	MADDOXG23 3	115	25.30	528617	LE-WAITS 2	69	3.28
527799	EDDY_NORTH 6	230	8.63	528355	MADDOX 3	115	25.30	528618	LE-LOVINTON2	69	7.09
527802	EDDY_CNTY 7	345	5.11	528385	BUCKEYE 3	115	7.33	528622	LE-SANANDRS2	69	5.22
527864	CUNNINHAM 3	115	26.68	528392	PEARLE 3	115	6.28	528627	LE-TXACO_TP3	115	7.02
527865	CUNNIGHM_N 6	230	16.87	528394	QUAHADA 3	115	8.06	528638	LE-SAUNDRTP2	69	3.56
527867	CUNNIGHM_S 6	230	16.87	528399	LEA_NATIONL3	115	6.81	528667	LE-MHOON 2	69	4.37
527891	HOBBS_INT 3	115	30.30	528406	MALJMAR1&2 3	115	3.22	528675	LE-FAMARISS2	69	3.32
527894	HOBBS_INT 6	230	18.18	528413	TAYLOR 3	115	14.17	528679	LE-TATUM_SW2	69	4.88
527896	HOBBS_INT 7	345	9.81	528420	ZIA 3	115	6.53	528699	LE-GRAY 2	69	4.13
527929	PCA 2	69	6.23	528422	DCP_ZIA TP 3	115	6.99	528775	LE-ERF 3	115	10.47
527930	PCA 3	115	11.15	528423	DCP_ZIA 3	115	6.63	528792	LE-TEXACO 3	115	6.37
527935	CV-SKELLY 3	115	3.21	528433	BENSING 3	115	7.94	560059	G1579&G1580T	230	9.21
527943	CV-LUSK 2	69	2.24	528435	MILLEN 3	115	11.37	562480	G13-027-TAP	230	9.59
527947	CV-LUSK 3	115	3.45	528442	NE_HOBBS 3	115	11.66	585160	G1579&G1580	230	8.74
527948	CV-LUSK_TP 3	115	4.17	528449	W_BENDER 3	115	14.39	587670	GEN-2015-099	115	16.44
527961	POTASH_JCT 2	69	8.80	528456	N_HOBBS 3	115	8.90	588350	GEN-2016-171	230	8.98
527962	POTASH_JCT 3	115	14.80	528463	SANGER_SW 3	115	15.47	588430	GEN-2016-169	345	9.53
527963	POTASH_JCT 6	230	7.31	528470	E_SANGER 3	115	12.43	599960	EPTNP-D6	230	8.63
527965	KIOWA 7	345	5.92	528477	S_HOBBS 3	115	10.35				

Table 4-6
Short Circuit Analysis for Study Project GEN-2016-039 (18SP)

Study Generator GEN-2016-039											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
511456	O.K.U.-7	345	5.58	525028	BAILEYCO 3	115	5.03	525780	FLOYD_CNTY 3	115	6.13
511468	L.E.S.-7	345	13.23	525050	BC-KELLEY +3	115	7.77	525816	TUCO_INT2 2	69	4.73
511553	CHISHOLM7	345	12.97	525056	BC-EARTH 3	115	8.20	525826	TUCO_INT 2	69	8.07
511565	OKLAUN HVDC7	345	5.56	525124	HART_INDUST3	115	7.84	525828	TUCO_INT 3	115	21.72
515375	WWRDEHV7	345	19.97	525132	LC-N_OLTON 2	69	3.09	525830	TUCO_INT 6	230	32.78
515458	BORDER 7	345	12.63	525143	HAPPY_CTYTP2	69	4.04	525832	TUCO_INT 7	345	26.37
522800	MU-TULIA 3	115	5.27	525153	HAPPY_INT 2	69	4.47	525840	ANTELOPE_1 6	230	32.38
522823	LP-MILWAKEE6	230	11.10	525154	HAPPY_INT 3	115	5.52	525850	ELK_CT1	345	25.81
522870	LP-HOLLY 6	230	15.67	525179	TULIA_TP 3	115	6.57	525853	LH-WIL&ELN+2	69	2.60
523095	HITCHLAND 6	230	15.15	525191	KRESS_INT 2	69	4.54	525885	SP-NEWDEAL 2	69	3.34
523097	HITCHLAND 7	345	16.06	525192	KRESS_INT 3	115	12.41	525926	CROSBY 3	115	4.54
523221	XIT_INTG 6	230	3.25	525203	SW-KRESS 2	69	4.54	525957	HALE_WNDCL16	230	10.20
523267	PRINGLE 6	230	4.28	525212	SWISHER 3	115	11.97	526020	HOCKLEY 3	115	5.47
523308	MOORE_E 3	115	11.86	525213	SWISHER 6	230	11.27	526076	STANTON_W 3	115	9.31
523309	MOORE_CNTY 6	230	6.99	525224	KRESS_RURL 2	69	2.54	526146	INDIANA 3	115	9.72
523551	HUTCHISON 6	230	7.26	525225	KRESS_RURAL3	115	6.53	526160	CARLISLE 3	115	13.56
523771	GRAPEVINE 6	230	5.84	525249	LH-PLW&FNY+2	69	1.61	526161	CARLISLE 6	230	11.90
523869	CHAN+TASCOS6	230	4.37	525256	SW_9748 2	69	3.11	526268	LUBBCK_STH 3	115	19.76
523959	POTTER_CO 6	230	22.66	525257	N_PLAINVEW 3	115	5.21	526269	LUBBCK_STH 6	230	18.78
523961	POTTER_CO 7	345	11.58	525271	KISER 2	69	3.49	526297	LUBBCK_EST 2	69	8.13
523977	HARRNG_WST 6	230	27.44	525272	KISER 3	115	5.21	526298	LUBBCK_EST 3	115	15.77
523978	HARRNG_MID 6	230	27.44	525284	WESTRIDGE 2	69	4.28	526299	LUBBCK_EST 6	230	13.65
523979	HARRNG_EST 6	230	27.44	525291	PLAINVW_TP 2	69	6.52	526337	JONES 6	230	21.29
524007	ROLLHILLS 3	115	19.67	525298	S_PLAINVEW 2	69	2.59	526434	SUNDOWN 3	115	11.08
524010	ROLLHILLS 6	230	20.52	525307	E_PLAINVEW 2	69	2.45	526435	SUNDOWN 6	230	11.27
524043	NICHOLS 3	115	31.16	525316	LH-PROVDNCE2	69	3.38	526460	AMOCO_SS 6	230	9.87
524044	NICHOLS 6	230	26.56	525325	COX 2	69	3.38	526525	WOLFFORTH 6	230	14.03
524266	BUSHLAND 3	115	9.43	525326	COX 3	115	6.01	526677	GRASSLAND 6	230	6.61
524267	BUSHLAND 6	230	9.88	525339	AIKEN_RURL 2	69	2.45	526936	YOAKUM_345	345	9.58
524290	WILDOR2_JUS6	230	6.71	525393	ROCKYFORD 3	115	8.88	527656	CROSSROADS 7	345	16.70
524296	SPNSPUR_WND7	345	5.57	525404	LC-OLTON 2	69	4.51	560021	CRAWFISH_DR2	230	29.24
524364	RANDALL 3	115	21.55	525413	LAMTON 2	69	5.20	560022	CRAWFISH_DR	345	27.31
524365	RANDALL 6	230	14.77	525414	LAMTON 3	115	7.72	560035	GRAPEVINE	345	6.52
524377	FARMERS 3	115	15.32	525425	CORNER 2	69	3.64	560050	G15-031-TAP	230	9.52
524397	ARROWHEAD 3	115	13.69	525432	SP-HALFWAY+2	69	5.90	560051	G15-039-TAP	230	7.52
524404	OWENSCORN 3	115	15.00	525440	LC-S_OLTON+3	115	7.22	560100	CRAWFISH765	765	11.46
524414	AMA_SOUTH 3	115	16.86	525446	RKYFORD_TP 3	115	9.92	560102	CROSSRDS765	765	7.68
524415	AMA_SOUTH 6	230	13.84	525453	HALE_CNTY 2	69	6.95	560103	CRAW_TAP	765	9.33
524530	PALO_DURO 3	115	6.81	525454	HALE_CNTY 3	115	10.30	562004	G11-025-TAP	115	4.65
524544	SPRING_DRW 3	115	6.40	525460	NEWHART 3	115	17.09	562480	G13-027-TAP	230	9.59
524622	DEAFSMITH 3	115	12.02	525461	NEWHART 6	230	11.56	583090	G1149&G1504	345	9.90
524623	DEAFSMITH 6	230	7.78	525480	PLANT_X 3	115	18.07	584640	GEN-2015-022	115	11.97
524694	DS-#22 3	115	4.61	525481	PLANT_X 6	230	24.43	584750	GEN-2015-031	230	8.04
524714	CASTRO_TP 2	69	3.54	525524	TOLK_EAST 6	230	32.66	584800	GEN-2015-039	230	6.37
524721	DS-#15&#19+2	69	3.56	525531	TOLK_WEST 6	230	32.66	585060	GEN-2015-068	345	17.30
524728	DS-CASTRO 2	69	4.28	525543	TOLK_TAP 6	230	32.66	587250	GEN-2016-039	115	11.97
524734	DS-#21 3	115	9.35	525549	TOLK 7	345	18.26	587370	GEN-2016-056	230	6.08
524745	CASTRO_CNTY2	69	8.82	525635	LAMB_CNTY 2	69	5.92	587570	ASGI1604	115	6.81
524746	CASTRO_CNTY3	115	9.87	525636	LAMB_CNTY 3	115	8.51	587960	GEN-2016-120	345	6.46
524757	BETHEL_COL13	115	8.22	525637	LAMB_CNTY 6	230	5.47	587964	G16-120-TAP	345	8.72
524909	ROSEVELT_N 6	230	9.13	525731	SP-ABERNTHY2	69	3.04	587970	GEN-2016-175	345	5.18
524911	ROSEVELT_S 6	230	9.13	525738	HALECENTER 2	69	2.48	588440	GEN-2016-172	115	14.35
525018	EMULESH&VLY3	115	4.84	525745	LH-HALECTR 2	69	2.45	599891	OKLAUN 7	345	4.04
525019	EMU&VLY_TP 3	115	5.15	525779	FLOYD_CNTY 2	69	5.35				

Table 4-7
Short Circuit Analysis for Study Project GEN-2016-077 (18SP)

Study Generator GEN-2016-077											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
522892	MU-BROWNFLD2	69	2.73	526655	LYNN_CNTY 2	69	3.77	526777	GOODPASTURE2	69	2.40
526491	LG-CLAUENE 3	115	7.94	526711	LG-DIXON 2	69	2.50	526792	PRENTICE 3	115	5.90
526499	LG-MEADOW 2	69	3.71	526735	TERRY_CNTY 2	69	6.97	526979	LG-JS_SMITH2	69	2.10
526506	LG-DOCWEBR 2	69	4.94	526736	TERRY_CNTY 3	115	10.42	526985	WELLMAN 2	69	2.85
526524	WOLFFORTH 3	115	11.71	526747	LG-BROWNFLD2	69	3.56	527130	DENVER_N 3	115	20.84
526631	LAKEVIEW 2	69	1.50	526754	BROWNFIELD 2	69	3.05	527262	SULPHUR 3	115	5.66
526638	LG-NEWMOORE2	69	1.71	526761	BROWNFLD_TP2	69	2.83	587690	GEN-2016-077	69	2.49
526645	LG-NH&WILN+2	69	2.80	526770	OZARK_MAHO 2	69	1.79				

Table 4-8
Short Circuit Analysis for Study Project GEN-2016-078 (18SP)

Study Generator GEN-2016-078											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
523959	POTTER_CO 6	230	22.66	524935	KILGORE 3	115	5.97	525453	HALE_CNTY 2	69	6.95
524486	CAPROCK 3	115	3.20	524941	PORTALES#1 2	69	5.51	525454	HALE_CNTY 3	115	10.30
524502	NORTON 3	115	3.28	524963	S_PORTALES 3	115	5.62	525460	NEWHART 3	115	17.09
524509	FE-TUCMCARI3	115	2.19	524977	GREYHOUND 3	115	5.54	525461	NEWHART 6	230	11.56
524623	DEAFSMITH 6	230	7.78	524987	LARIAT 2	69	2.10	525480	PLANT_X 3	115	18.07
524648	CARGILL 3	115	3.91	524994	BC-LARIAT 2	69	2.31	525481	PLANT_X 6	230	24.43
524662	PARMER_CO 3	115	4.10	524996	BC-PROGRSS+2	69	2.70	525524	TOLK_EAST 6	230	32.66
524664	DS-#24 +3	115	4.04	525001	W_MULESHOE 2	69	3.83	525531	TOLK_WEST 6	230	32.66
524669	DS-#20 3	115	4.82	525008	MULESH_CTY 2	69	3.98	525543	TOLK_TAP 6	230	32.66
524746	CASTRO_CNTY3	115	9.87	525017	EMULESH&VLY2	69	3.99	525592	SUDANRURAL 2	69	1.81
524764	NORRIS_TP 3	115	10.61	525018	EMULESH&VLY3	115	4.84	525613	W_LITTLFLD 2	69	2.97
524768	PLSNT_HILL 3	115	10.08	525019	EMU&VLY_TP 3	115	5.15	525620	LTFLD_S&CTY2	69	4.18
524770	PLSNT_HILL 6	230	6.26	525023	BC-BAIL_MTR2	69	4.88	525635	LAMB_CNTY 2	69	5.92
524773	E_CLOVIS 3	115	8.56	525027	BAILEYCO 2	69	4.88	525636	LAMB_CNTY 3	115	8.51
524776	N_CLOVIS_TP3	115	7.25	525028	BAILEYCO 3	115	5.03	525637	LAMB_CNTY 6	230	5.47
524777	N_CLOVIS 3	115	6.56	525038	BAILEY_PMP 2	69	2.70	525650	LC-LTTLFLD+2	69	4.95
524783	W_CLOVIS 2	69	2.42	525045	LC-BECK +2	69	1.95	525687	LC-LUMSCHAP2	69	4.63
524797	PERIMETER 3	115	6.38	525050	BC-KELLEY +3	115	7.77	525780	FLOYD_CNTY 3	115	6.13
524801	NORRIS 3	115	9.74	525056	BC-EARTH 3	115	8.20	525816	TUCO_INT2 2	69	4.73
524808	FE-CLVS_INT3	115	6.76	525124	HART_INDUST3	115	7.84	525826	TUCO_INT 2	69	8.07
524821	CURRY 2	69	4.35	525179	TULIA_TP 3	115	6.57	525828	TUCO_INT 3	115	21.72
524822	CURRY 3	115	10.64	525191	KRESS_INT 2	69	4.54	525830	TUCO_INT 6	230	32.78
524831	FE-HOLLAND 3	115	8.83	525192	KRESS_INT 3	115	12.41	526019	HOCKLEY 2	69	5.13
524838	FE-CLOVIS2+3	115	10.10	525212	SWISHER 3	115	11.97	526020	HOCKLEY 3	115	5.47
524846	FARWELL 2	69	2.12	525213	SWISHER 6	230	11.27	526036	LC-OPDYKE 3	115	5.76
524853	DS-#10 +2	69	1.70	525225	KRESS_RURAL3	115	6.53	526076	STANTON_W 3	115	9.31
524863	FE-CHZPLT 3	115	7.70	525272	KISER 3	115	5.21	526298	LUBBCK_EST 3	115	15.77
524874	OASIS 3	115	9.67	525291	PLAINVW_TP 2	69	6.52	526434	SUNDOWN 3	115	11.08
524875	OASIS 6	230	7.53	525298	S_PLAINVEW 2	69	2.59	526435	SUNDOWN 6	230	11.27
524908	ROOSEVELT 3	115	10.42	525325	COX 2	69	3.38	526460	AMOCO_SS 6	230	9.87
524909	ROSEVELT_N 6	230	9.13	525326	COX 3	115	6.01	526525	WOLFFORTH 6	230	14.03
524911	ROSEVELT_S 6	230	9.13	525393	ROCKYFORD 3	115	8.88	560051	G15-039-TAP	230	7.52
524915	SW_4K33 6	230	9.13	525413	LAMTON 2	69	5.20	562480	G13-027-TAP	230	9.59
524923	PORTALES 2	69	7.15	525414	LAMTON 3	115	7.72	584620	GEN-2015-020	115	9.42
524924	PORTALES 3	115	7.29	525432	SP-HALFWAY+2	69	5.90	584800	GEN-2015-039	230	6.37
524929	RO-PORT_MTR2	69	7.15	525440	LC-S_OLTON+3	115	7.22	587700	GEN-2016-078	69	7.87
524934	ZODIAC 2	69	5.32	525446	RKYFORD_TP 3	115	9.92	599955	PNM-DC6	230	9.13

Table 4-9
Short Circuit Analysis for Study Project GEN-2016-120 and GEN-2016-175 (18SP)

Study Generator GEN-2016-120 and GEN-2016-175											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
511423	FLE TAP4	138	8.77	523309	MOORE_CNTY 6	230	6.99	528611	GAINESGENTP6	345	7.37
511437	COMANC-4	138	18.01	523779	STLN-DEMARC6	230	7.65	532782	BUFFALO7	345	21.53
511439	LWSTAP 4	138	11.41	523823	WALKEMEYER 7	345	8.30	532783	KINGMAN7	345	6.86
511456	O.K.U.-7	345	5.58	523869	CHAN+TASCOS6	230	4.37	532796	WICHITA7	345	25.89
511458	ELKCTY-4	138	11.09	523959	POTTER_CO 6	230	22.66	539638	FLATRDG4	138	15.41
511466	L.E.S.-2	69	16.50	523961	POTTER_CO 7	345	11.58	539800	CLARKCOUNTY7	345	13.50
511467	L.E.S.-4	138	24.43	523979	HARRNG_EST 6	230	27.44	539801	THISTLE7	345	16.26
511468	L.E.S.-7	345	13.23	524010	ROLLHILLS 6	230	20.52	539804	THISTLE4	138	17.38
511474	SHERID4	138	12.20	524267	BUSHLAND 6	230	9.88	560010	G14-037-TAP	345	15.71
511486	ELGINJT4	138	9.90	524296	SPNSPUR_WND7	345	5.57	560021	CRAWFISH_DR2	230	29.24
511490	ELKCITY6	230	7.16	524415	AMA_SOUTH 6	230	13.84	560022	CRAWFISH_DR	345	27.31
511494	COMMTAP4	138	21.37	524909	ROSEVELT_N 6	230	9.13	560035	GRAPEVINE	345	6.52
511541	SWEETWT6	230	8.72	524911	ROSEVELT_S 6	230	9.13	560050	G15-031-TAP	230	9.52
511542	BUFFCK6	230	6.21	525192	KRESS_INT 3	115	12.41	560059	G1579&G1580T	230	9.21
511544	DEMPSEY6	230	5.25	525212	SWISHER 3	115	11.97	560071	G16-003-TAP	345	15.12
511547	ROARK6	230	4.74	525213	SWISHER 6	230	11.27	560072	G16-005-TAP	345	12.77
511553	CHISHOLM7	345	12.97	525454	HALE_CNTY 3	115	10.30	560078	G16-037-TAP	345	9.81
511557	CHISHOLM6	230	11.85	525460	NEWHART 3	115	17.09	560100	CRAWFISH765	765	11.46
511565	OKLAUN HVDC7	345	5.56	525461	NEWHART 6	230	11.56	560101	SEMINOLE765	765	11.68
511568	TERRYRD7	345	9.95	525481	PLANT_X 6	230	24.43	560102	CROSSRDS765	765	7.68
511571	RUSHSPR7	345	6.37	525524	TOLK_EAST 6	230	32.66	560103	CRAW_TAP	765	9.33
514782	WODWRD 2	69	10.78	525531	TOLK_WEST 6	230	32.66	562480	G13-027-TAP	230	9.59
514785	WOODWRD4	138	12.84	525543	TOLK_TAP 6	230	32.66	576395	GEN-2010-014	345	11.65
514787	DEWEY 4	138	7.42	525549	TOLK 7	345	18.26	583090	G1149&G1504	345	9.90
514796	IODINE-4	138	7.25	525637	LAMB_CNTY 6	230	5.47	584640	GEN-2015-022	115	11.97
514801	MINCO 7	345	17.55	525780	FLOYD_CNTY 3	115	6.13	584700	GEN-2015-029	345	9.64
514880	NORTWST7	345	32.53	525816	TUCO_INT2 2	69	4.73	584750	GEN-2015-031	230	8.04
514901	CIMARON7	345	33.20	525826	TUCO_INT 2	69	8.07	584940	GEN-2015-056	345	11.73
515045	SEMINOL7	345	32.83	525828	TUCO_INT 3	115	21.72	585060	GEN-2015-068	345	17.30
515136	SUNNYSD7	345	10.82	525830	TUCO_INT 6	230	32.78	585080	GEN-2015-071	345	10.72
515363	CENT 4	138	3.08	525832	TUCO_INT 7	345	26.37	585190	GEN-2015-082	345	7.02
515375	WWRDEHV7	345	19.97	525840	ANTELOPE_1 6	230	32.38	585270	GEN-2015-093	345	9.94
515376	WWRDEHV4	138	23.02	525850	ELK_CT1	345	25.81	585410	GREAT_WESTRN	345	9.98
515394	KEENAN 4	138	8.02	525957	HALE_WNDCL16	230	10.20	585420	COWBOY_RIDGE	345	7.69
515398	OUSPRT 4	138	8.81	526076	STANTON_W 3	115	9.31	585430	PRSIMN_CRK1	345	11.66
515407	TATONGA7	345	16.02	526160	CARLISLE 3	115	13.56	585440	PRSIMN_CRK2	345	10.65
515425	WWDPST 4	138	17.01	526161	CARLISLE 6	230	11.90	587020	GEN-2016-003	345	15.12
515448	CRSRDSW7	345	11.15	526269	LUBBCK_STH 6	230	18.78	587040	GEN-2016-005	345	10.53
515458	BORDER 7	345	12.63	526298	LUBBCK_EST 3	115	15.77	587230	GEN-2016-037	345	8.60
515497	MATHWSN7	345	32.04	526299	LUBBCK_EST 6	230	13.65	587300	G16-045-SUB1	345	1.56
515554	BVRCNTY7	345	14.55	526337	JONES 6	230	21.29	587304	G16-045-SUB2	345	1.52
515582	SLNGWND7	345	7.25	526460	AMOCO_SS 6	230	9.87	587370	GEN-2016-056	230	6.08
515585	MAMTHPW7	345	12.64	526525	WOLFFORTH 6	230	14.03	587380	G16-057-SUB1	345	1.53
515599	G07621119-20	345	13.26	526677	GRASSLAND 6	230	6.61	587384	G16-057-SUB2	345	1.47
515677	BADGER 7	345	13.64	526934	YOAKUM 3	115	16.82	587500	GEN-2016-073	345	15.63
515686	GEN-2011-014	345	12.20	526935	YOAKUM 6	230	18.00	587740	GEN-2016-091	345	13.24
515785	WINDFRM4	138	18.82	526936	YOAKUM_345	345	9.58	587744	G16-091-TAP	345	14.92
515800	GRACMNT7	345	17.45	527009	BRU_SUB 6	230	14.15	587770	GEN-2016-095	345	10.95
515802	GRACMNT4	138	27.09	527149	MUSTANG 6	230	15.79	587960	GEN-2016-120	345	6.46
515875	REDNGTN7	345	18.08	527654	RSVLT_CC_W 7	345	10.80	587964	G16-120-TAP	345	8.72
522823	LP-MILWAKEE6	230	11.10	527655	RSVLT_CC_E 7	345	13.26	587970	GEN-2016-175	345	5.18
522870	LP-HOLLY 6	230	15.67	527656	CROSSROADS 7	345	16.70	588000	GEN-2016-123	345	16.07
523095	HITCHLAND 6	230	15.15	527799	EDDY_NORTH 6	230	8.63	588430	GEN-2016-169	345	9.53
523097	HITCHLAND 7	345	16.06	527802	EDDY_CNTY 7	345	5.11	590001	OKLEHV24	138	4.79
523101	NOBLE_WND 7	345	15.99	527894	HOBBS_INT 6	230	18.18	590003	OKLEHV14	138	4.80
523112	NOVUS1 7	345	15.75	527896	HOBBS_INT 7	345	9.81	599891	OKLAUN 7	345	4.04
523215	FREWHELCOL17	345	9.48	527965	KIOWA 7	345	5.92				

Table 4-10
Short Circuit Analysis for Study Project GEN-2016-121 (18SP)

Study Generator GEN-2016-121											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
525832	TUCO_INT 7	345	26.37	528000	INTREPIDWST3	115	10.65	528223	CHINA_DRAW 7	345	3.75
526935	YOAKUM 6	230	18.00	528009	WIPP 3	115	6.58	528226	HOPI_SUB 3	115	6.72
526936	YOAKUM_345	345	9.58	528016	SAND_DUNES 3	115	6.12	528228	WOOD_DRAW 3	115	4.72
527865	CUNNIGHM_N 6	230	16.87	528018	RED_BLUFF 3	115	6.69	528230	AGAVE_RHILL3	115	8.39
527867	CUNNIGHM_S 6	230	16.87	528020	BOPCO_PKRLK3	115	5.05	528232	OCHOA 3	115	8.27
527891	HOBBS_INT 3	115	30.30	528022	MISSCHEM#2 2	69	6.74	528235	WOLFCAMP_TP3	115	5.19
527894	HOBBS_INT 6	230	18.18	528025	RDRUNNER 3	115	8.67	528236	WOLFCAMP 3	115	5.01
527896	HOBBS_INT 7	345	9.81	528027	RDRUNNER 7	345	3.90	528239	PNDEROSATP 3	115	6.59
527929	PCA 2	69	6.23	528035	IMC_#1_TP 3	115	9.02	528240	PONDEROSA 3	115	4.49
527930	PCA 3	115	11.15	528040	BATTLE_AXE 3	115	2.82	528394	QUAHADA 3	115	8.06
527948	CV-LUSK_TP 3	115	4.17	528145	NATPOT_TP 2	69	8.76	528519	WARD 3	115	5.38
527953	LIVSTNRIDGE3	115	7.16	528151	FIESTA 3	115	9.79	528540	WHITTEN 3	115	6.79
527955	SAGE_BRUSH 3	115	5.10	528159	CARLSBAD 2	69	4.88	528547	S_JAL 3	115	6.21
527961	POTASH_JCT 2	69	8.80	528160	CARLSBAD 3	115	11.28	528604	ANDREWS 6	345	6.67
527962	POTASH_JCT 3	115	14.80	528178	PECOS 3	115	11.93	528610	GAINES_GEN 6	230	9.34
527963	POTASH_JCT 6	230	7.31	528179	PECOS 6	230	6.62	528611	GAINESGENTP6	345	7.37
527965	KIOWA 7	345	5.92	528182	NORTH_LOVNG3	115	8.60	560059	G1579&G1580T	230	9.21
527980	DUVAL_#1 2	69	5.77	528185	N_LOVING 7	345	4.63	587990	GEN-2016-121	115	8.24
527996	KERMAC 2	69	2.96	528222	CHINA_DRAW 3	115	7.50	588430	GEN-2016-169	345	9.53
527999	INTREPDW_TP3	115	12.44								

Table 4-11
Short Circuit Analysis for Study Project GEN-2016-123, GEN-2016-124, and GEN-2016-125 (18SP)

Study Generator GEN-2016-123, GEN-2016-124, GEN-2016-125											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
511456	O.K.U.-7	345	5.58	525212	SWISHER 3	115	11.97	527867	CUNNIGHM_S 6	230	16.87
511467	L.E.S.-4	138	24.43	525213	SWISHER 6	230	11.27	527894	HOBBS_INT 6	230	18.18
511468	L.E.S.-7	345	13.23	525460	NEWHART 3	115	17.09	527896	HOBBS_INT 7	345	9.81
511553	CHISHOLM7	345	12.97	525461	NEWHART 6	230	11.56	527962	POTASH_JCT 3	115	14.80
511557	CHISHOLM6	230	11.85	525480	PLANT_X 3	115	18.07	527963	POTASH_JCT 6	230	7.31
511565	OKLAUN HVDC7	345	5.56	525481	PLANT_X 6	230	24.43	528070	CV-AZMESA 3	115	7.51
511568	TERRYRD7	345	9.95	525524	TOLK_EAST 6	230	32.66	528093	7-RIVERS 2	69	2.40
515045	SEMINOL7	345	32.83	525531	TOLK_WEST 6	230	32.66	528094	7-RIVERS 3	115	8.41
515375	WWRDEHV7	345	19.97	525543	TOLK_TAP 6	230	32.66	528095	7-RIVERS 6	230	6.30
515376	WWRDEHV4	138	23.02	525549	TOLK 7	345	18.26	528109	CV-LAKEWOOD3	115	6.49
515407	TATONGA7	345	16.02	525636	LAMB_CNTY 3	115	8.51	528132	OCOTILLO 3	115	6.19
515458	BORDER 7	345	12.63	525637	LAMB_CNTY 6	230	5.47	528137	N_CANAL 3	115	8.72
515554	BVRCNTY7	345	14.55	525828	TUCO_INT 3	115	21.72	528160	CARLSBAD 3	115	11.28
515599	G07621119-20	345	13.26	525830	TUCO_INT 6	230	32.78	528178	PECOS 3	115	11.93
523093	HITCHLAND 3	115	17.97	525832	TUCO_INT 7	345	26.37	528179	PECOS 6	230	6.62
523095	HITCHLAND 6	230	15.15	525840	ANTELOPE_1 6	230	32.38	528226	HOPI_SUB 3	115	6.72
523097	HITCHLAND 7	345	16.06	525850	ELK_CT1	345	25.81	539801	THISTLE7	345	16.26
523101	NOBLE_WND 7	345	15.99	525957	HALE_WNDCL16	230	10.20	560010	G14-037-TAP	345	15.71
523103	NOBLE_WND 3	115	10.79	526161	CARLISLE 6	230	11.90	560021	CRAWFISH_DR2	230	29.24
523111	NOVUS1 3	115	19.73	526337	JONES 6	230	21.29	560022	CRAWFISH_DR	345	27.31
523112	NOVUS1 7	345	15.75	526435	SUNDOWN 6	230	11.27	560035	GRAPEVINE	345	6.52
523155	OCHILTREE 6	230	4.23	526935	YOAKUM 6	230	18.00	560050	G15-031-TAP	230	9.52
523215	FREWHELCOL17	345	9.48	526936	YOAKUM_345	345	9.58	560051	G15-039-TAP	230	7.52
523221	XIT_INTG 6	230	3.25	527455	RSWL_SLRCOL3	115	6.96	560071	G16-003-TAP	345	15.12
523267	PRINGLE 6	230	4.28	527470	CHVS_SLRCOL3	115	6.66	560078	G16-037-TAP	345	9.81
523308	MOORE_E 3	115	11.86	527482	CHAVES_CNTY3	115	7.03	560100	CRAWFISH765	765	11.46
523309	MOORE_CNTY 6	230	6.99	527483	CHAVES_CNTY6	230	4.44	560101	SEMINOLE765	765	11.68
523821	WALKEMEYER 3	115	10.38	527501	URTON 3	115	5.83	560102	CROSSRDS765	765	7.68
523823	WALKEMEYER 7	345	8.30	527509	PRICE_TAP 3	115	5.38	560103	CRAW_TAP	765	9.33
523853	FINNEY 7	345	10.23	527546	SAMSON 3	115	5.49	562480	G13-027-TAP	230	9.59
523869	CHAN+TASCOS6	230	4.37	527564	ROSWLL_INT 3	115	5.74	576395	GEN-2010-014	345	11.65
523959	POTTER_CO 6	230	22.66	527597	TWEEDY 3	115	5.29	576396	G10-014-XFMR	115	13.46
523961	POTTER_CO 7	345	11.58	527654	RSVLT_CC_W 7	345	10.80	583090	G1149&G1504	345	9.90
523977	HARRNG_WST 6	230	27.44	527655	RSVLT_CC_E 7	345	13.26	583840	GEN-2013-027	230	9.08
523978	HARRNG_MID 6	230	27.44	527656	CROSSROADS 7	345	16.70	583960	G14034G14035	115	6.62
523979	HARRNG_EST 6	230	27.44	527707	ARTESIA 3	115	6.89	584210	GEN-2014-037	345	11.20
524007	ROLLHILLS 3	115	19.67	527710	EAGLE_CREEK2	69	2.33	584940	GEN-2015-056	345	11.73
524010	ROLLHILLS 6	230	20.52	527711	EAGLE_CREEK3	115	7.50	585060	GEN-2015-068	345	17.30
524266	BUSHLAND 3	115	9.43	527715	NAVAJO_2TP 3	115	7.14	585080	GEN-2015-071	345	10.72
524267	BUSHLAND 6	230	9.88	527736	NAVAJO_5TP 3	115	7.10	587470	GEN-2016-069	115	6.79
524290	WILDOR2_JUS6	230	6.71	527786	ATOKA 3	115	7.21	587744	G16-091-TAP	345	14.92
524296	SPNSPUR_WND7	345	5.57	527793	EDDY_STH 3	115	11.65	587960	GEN-2016-120	345	6.46
524623	DEAFSMITH 6	230	7.78	527798	EDDY_NTH 3	115	11.65	587964	G16-120-TAP	345	8.72
524770	PLSNT_HILL 6	230	6.26	527799	EDDY_NORTH 6	230	8.63	587970	GEN-2016-175	345	5.18
524875	OASIS 6	230	7.53	527802	EDDY_CNTY 7	345	5.11	588000	GEN-2016-123	345	16.07
524885	SN_JUAN_TAP6	230	4.82	527809	CV-8_MILE 3	115	5.41	590001	OKLEHV24	138	4.79
524889	SN_JUAN_WND6	230	4.61	527821	CV-DAYTON +3	115	7.11	590003	OKLEHV14	138	4.80
524908	ROOSEVELT 3	115	10.42	527822	CV-TURKYTRK3	115	3.45	599891	OKLAUN 7	345	4.04
524909	ROSEVELT_N 6	230	9.13	527864	CUNNINHAM 3	115	26.68	599955	PNM-DC6	230	9.13
524911	ROSEVELT_S 6	230	9.13	527865	CUNNIGHM_N 6	230	16.87	599960	EPTNP-D6	230	8.63
524915	SW_4K33 6	230	9.13								

Table 4-12
Short Circuit Analysis for Study Project GEN-2016-169 (18SP)

Study Generator GEN-2016-169											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
511456	O.K.U.-7	345	5.58	527275	SEMINOLE 3	115	11.43	528232	OCHOA 3	115	8.27
511468	L.E.S.-7	345	13.23	527276	SEMINOLE 6	230	7.28	528235	WOLFCAMP_TP3	115	5.19
511553	CHISHOLM7	345	12.97	527284	RUSSELL 3	115	9.02	528317	ENRON_TP 3	115	6.77
511565	OKLAUN HVDC7	345	5.56	527286	XTO_RUSSEL 3	115	9.96	528325	LE-WAITS 3	115	6.70
515375	WWRDEHV7	345	19.97	527362	JOHNSON_DRW3	115	10.47	528333	LE-WEST_SUB3	115	8.34
515458	BORDER 7	345	12.63	527363	HIGG 3	115	10.13	528334	LE-NRTH_INT3	115	8.26
522823	LP-MILWAKEE6	230	11.10	527483	CHAVES_CNTY6	230	4.44	528348	BUCKEYE_TP 3	115	8.15
522870	LP-HOLLY 6	230	15.67	527656	CROSSROADS 7	345	16.70	528353	MADDOXG23 3	115	25.30
523961	POTTER_CO 7	345	11.58	527793	EDDY_STH 3	115	11.65	528355	MADDOX 3	115	25.30
524909	ROSEVELT_N 6	230	9.13	527798	EDDY_NTH 3	115	11.65	528385	BUCKEYE 3	115	7.33
524911	ROSEVELT_S 6	230	9.13	527799	EDDY_NORTH 6	230	8.63	528392	PEARLE 3	115	6.28
525213	SWISHER 6	230	11.27	527802	EDDY_CNTY 7	345	5.11	528394	QUAHADA 3	115	8.06
525454	HALE_CNTY 3	115	10.30	527864	CUNNINHAM 3	115	26.68	528399	LEA_NATIONL3	115	6.81
525481	PLANT_X 6	230	24.43	527865	CUNNIGHM_N 6	230	16.87	528413	TAYLOR 3	115	14.17
525524	TOLK_EAST 6	230	32.66	527867	CUNNIGHM_S 6	230	16.87	528422	DCP_ZIA TP 3	115	6.99
525531	TOLK_WEST 6	230	32.66	527891	HOBBS_INT 3	115	30.30	528433	BENSING 3	115	7.94
525543	TOLK_TAP 6	230	32.66	527894	HOBBS_INT 6	230	18.18	528435	MILLEN 3	115	11.37
525549	TOLK 7	345	18.26	527896	HOBBS_INT 7	345	9.81	528442	NE_HOBBS 3	115	11.66
525637	LAMB_CNTY 6	230	5.47	527929	PCA 2	69	6.23	528463	SANGER_SW 3	115	15.47
525780	FLOYD_CNTY 3	115	6.13	527930	PCA 3	115	11.15	528484	SW_4J44 3	115	11.14
525816	TUCO_INT2 2	69	4.73	527935	CV-SKELLY 3	115	3.21	528491	MONUMENT 3	115	15.08
525826	TUCO_INT 2	69	8.07	527943	CV-LUSK 2	69	2.24	528498	W_HOBBS 3	115	11.72
525828	TUCO_INT 3	115	21.72	527947	CV-LUSK 3	115	3.45	528568	MONUMNT_TP 3	115	9.84
525830	TUCO_INT 6	230	32.78	527948	CV-LUSK_TP 3	115	4.17	528575	OXYPERMIAN 3	115	14.87
525832	TUCO_INT 7	345	26.37	527953	LIVSTNRIDGE3	115	7.16	528582	BYRD 3	115	7.59
525840	ANTELOPE_1 6	230	32.38	527961	POTASH_JCT 2	69	8.80	528589	DRINKARD 3	115	8.51
525850	ELK_CT1	345	25.81	527962	POTASH_JCT 3	115	14.80	528602	ANDREWS 3	115	12.77
525957	HALE_WNDCL16	230	10.20	527963	POTASH_JCT 6	230	7.31	528603	NA_ENRICH 3	115	12.04
526076	STANTON_W 3	115	9.31	527965	KIOWA 7	345	5.92	528604	ANDREWS 6	345	6.67
526160	CARLISLE 3	115	13.56	527980	DUVAL_#1 2	69	5.77	528605	TARGA 3	115	9.26
526161	CARLISLE 6	230	11.90	527989	NMPOTASH 2	69	2.54	528610	GAINES_GEN 6	230	9.34
526269	LUBBCK_STH 6	230	18.78	527996	KERMAC 2	69	2.96	528611	GAINESGENTP6	345	7.37
526298	LUBBCK_EST 3	115	15.77	527999	INTREPDW_TP3	115	12.44	528618	LE-LOVINTON2	69	7.09
526299	LUBBCK_EST 6	230	13.65	528000	INTREPIDWST3	115	10.65	528626	LE-PLNSINT 2	69	4.39
526337	JONES 6	230	21.29	528016	SAND_DUNES 3	115	6.12	528627	LE-TXACO_TP3	115	7.02
526434	SUNDOWN 3	115	11.08	528018	RED_BLUFF 3	115	6.69	560021	CRAWFISH_DR2	230	29.24
526435	SUNDOWN 6	230	11.27	528022	MISSCHEM#2 2	69	6.74	560022	CRAWFISH_DR	345	27.31
526460	AMOCO_SS 6	230	9.87	528025	RDRUNNER 3	115	8.67	560059	G1579&G1580T	230	9.21
526525	WOLFFORTH 6	230	14.03	528027	RDRUNNER 7	345	3.90	560100	CRAWFISH765	765	11.46
526677	GRASSLAND 6	230	6.61	528029	IMC_#2 2	69	4.26	560102	CROSSRDS765	765	7.68
526736	TERRY_CNTY 3	115	10.42	528035	IMC_#1_TP 3	115	9.02	560103	CRAW_TAP	765	9.33
526784	AMOCOWASSON6	230	14.02	528037	IMC_#1 3	115	8.10	562480	G13-027-TAP	230	9.59
526792	PRENTICE 3	115	5.90	528040	BATTLE_AXE 3	115	2.82	583090	G1149&G1504	345	9.90
526928	PLAINS_INT 3	115	9.82	528070	CV-AZMESA 3	115	7.51	583840	GEN-2013-027	230	9.08
526934	YOAKUM 3	115	16.82	528095	7-RIVERS 6	230	6.30	584810	GEN-2015-040	230	14.42
526935	YOAKUM 6	230	18.00	528132	OCOTILLO 3	115	6.19	585060	GEN-2015-068	345	17.30
526936	YOAKUM_345	345	9.58	528137	N_CANAL 3	115	8.72	585150	GEN-2015-078	115	16.46
526944	LG-PLAINS 3	115	7.85	528145	NATPOT_TP 2	69	8.76	585160	G1579&G1580	230	8.74
527009	BRU_SUB 6	230	14.15	528151	FIESTA 3	115	9.79	587110	GEN-2016-015	345	6.36
527010	OXYBRU 6	230	14.03	528159	CARLSBAD 2	69	4.88	587370	GEN-2016-056	230	6.08
527018	BENNETT 3	115	13.14	528160	CARLSBAD 3	115	11.28	587420	GEN-2016-062	345	5.18
527041	ARCO_TP 3	115	13.05	528178	PECOS 3	115	11.93	587670	GEN-2015-099	115	16.44
527047	OXY_WILRD1 3	115	10.49	528179	PECOS 6	230	6.62	587960	GEN-2016-120	345	6.46
527062	SHELL_CO2 3	115	15.86	528182	NORTH_LOVNG3	115	8.60	587964	G16-120-TAP	345	8.72
527130	DENVER_N 3	115	20.84	528185	N_LOVING 7	345	4.63	587970	GEN-2016-175	345	5.18
527136	DENVER_S 3	115	20.84	528190	S_LOVING_TP2	69	3.00	587990	GEN-2016-121	115	8.24
527146	MUSTANG 3	115	22.41	528222	CHINA_DRAW 3	115	7.50	588350	GEN-2016-171	230	8.98
527149	MUSTANG 6	230	15.79	528223	CHINA_DRAW 7	345	3.75	588430	GEN-2016-169	345	9.53
527151	GS-MUSTANG 6	230	15.79	528226	HOPI_SUB 3	115	6.72	599891	OKLAUN 7	345	4.04
527194	LG-PLSHILL 3	115	7.53	528228	WOOD_DRAW 3	115	4.72	599960	EPTNP-D6	230	8.63
527202	SEAGRAVES 3	115	8.53	528230	AGAVE_RHILL3	115	8.39				

Table 4-13
Short Circuit Analysis for Study Project GEN-2016-171 (18SP)

Study Generator GEN-2016-171											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
511456	O.K.U.-7	345	5.58	527051	ODC_TP 3	115	13.15	528317	ENRON_TP 3	115	6.77
515458	BORDER 7	345	12.63	527062	SHELL_CO2 3	115	15.86	528325	LE-WAITS 3	115	6.70
524908	ROOSEVELT 3	115	10.42	527080	EL_PASO 3	115	15.62	528333	LE-WEST_SUB3	115	8.34
524909	ROOSEVELT_N 6	230	9.13	527105	SAN_ANDS_TP3	115	16.47	528334	LE-NRTH_INT3	115	8.26
524911	ROOSEVELT_S 6	230	9.13	527125	DENVER_CTY 2	69	8.63	528348	BUCKEYE_TP 3	115	8.15
524915	SW_4K33 6	230	9.13	527130	DENVER_N 3	115	20.84	528353	MADDOXG23 3	115	25.30
525461	NEWHART 6	230	11.56	527136	DENVER_S 3	115	20.84	528355	MADDOX 3	115	25.30
525480	PLANT_X 3	115	18.07	527146	MUSTANG 3	115	22.41	528385	BUCKEYE 3	115	7.33
525481	PLANT_X 6	230	24.43	527149	MUSTANG 6	230	15.79	528392	PEARLE 3	115	6.28
525524	TOLK_EAST 6	230	32.66	527151	GS-MUSTANG 6	230	15.79	528394	QUAHADA 3	115	8.06
525531	TOLK_WEST 6	230	32.66	527194	LG-PLSHILL 3	115	7.53	528399	LEA_NATIONL3	115	6.81
525543	TOLK_TAP 6	230	32.66	527201	SEAGRAVES 2	69	5.40	528413	TAYLOR 3	115	14.17
525549	TOLK 7	345	18.26	527202	SEAGRAVES 3	115	8.53	528422	DCP_ZIA TP 3	115	6.99
525636	LAMB_CNTY 3	115	8.51	527238	ROZ 3	115	9.27	528433	BENSING 3	115	7.94
525637	LAMB_CNTY 6	230	5.47	527242	AMERADA 3	115	9.38	528435	MILLEN 3	115	11.37
525828	TUCO_INT 3	115	21.72	527262	SULPHUR 3	115	5.66	528442	NE_HOBBS 3	115	11.66
525830	TUCO_INT 6	230	32.78	527275	SEMINOLE 3	115	11.43	528463	SANGER_SW 3	115	15.47
525832	TUCO_INT 7	345	26.37	527276	SEMINOLE 6	230	7.28	528484	SW_4J44 3	115	11.14
525840	ANTELOPE_1 6	230	32.38	527284	RUSSELL 3	115	9.02	528491	MONUMENT 3	115	15.08
525850	ELK_CT1	345	25.81	527286	XTO_RUSSEL 3	115	9.96	528498	W_HOBBS 3	115	11.72
525957	HALE_WNDCL16	230	10.20	527322	GAINES 3	115	8.53	528568	MONUMNT_TP 3	115	9.84
526036	LC-OPDYKE 3	115	5.76	527340	DOSS 3	115	7.14	528575	OXYPERMIAN 3	115	14.87
526161	CARLISLE 6	230	11.90	527362	JOHNSON_DRW3	115	10.47	528582	BYRD 3	115	7.59
526269	LUBBCK_STH 6	230	18.78	527363	HIGG 3	115	10.13	528602	ANDREWS 3	115	12.77
526337	JONES 6	230	21.29	527483	CHAVES_CNTY6	230	4.44	528604	ANDREWS 6	345	6.67
526350	LEHMAN_TP 3	115	5.87	527793	EDDY_STH 3	115	11.65	528610	GAINES_GEN 6	230	9.34
526424	PACIFIC 3	115	9.44	527798	EDDY_NTH 3	115	11.65	528611	GAINESGENTP6	345	7.37
526434	SUNDOWN 3	115	11.08	527799	EDDY_NORTH 6	230	8.63	528618	LE-LOVINTON2	69	7.09
526435	SUNDOWN 6	230	11.27	527802	EDDY_CNTY 7	345	5.11	528626	LE-PLNSINT 2	69	4.39
526445	AMOCO_TP 3	115	10.37	527864	CUNNINHAM 3	115	26.68	528627	LE-TXACO_TP3	115	7.02
526460	AMOCO_SS 6	230	9.87	527865	CUNNIGHM_N 6	230	16.87	528740	LE-PLANS_TP2	69	3.65
526491	LG-CLAUENE 3	115	7.94	527867	CUNNIGHM_S 6	230	16.87	560021	CRAWFISH_DR2	230	29.24
526524	WOLFFORTH 3	115	11.71	527891	HOBBS_INT 3	115	30.30	560022	CRAWFISH_DR	345	27.31
526525	WOLFFORTH 6	230	14.03	527894	HOBBS_INT 6	230	18.18	560051	G15-039-TAP	230	7.52
526735	TERRY_CNTY 2	69	6.97	527896	HOBBS_INT 7	345	9.81	560059	G1579&G1580T	230	9.21
526736	TERRY_CNTY 3	115	10.42	527930	PCA 3	115	11.15	560100	CRAWFISH765	765	11.46
526784	AMOCOWASSON6	230	14.02	527961	POTASH_JCT 2	69	8.80	562480	G13-027-TAP	230	9.59
526792	PRENTICE 3	115	5.90	527962	POTASH_JCT 3	115	14.80	583840	GEN-2013-027	230	9.08
526928	PLAINS_INT 3	115	9.82	527963	POTASH_JCT 6	230	7.31	584810	GEN-2015-040	230	14.42
526934	YOAKUM 3	115	16.82	527965	KIOWA 7	345	5.92	585060	GEN-2015-068	345	17.30
526935	YOAKUM 6	230	18.00	527999	INTREPDW_TP3	115	12.44	585150	GEN-2015-078	115	16.46
526936	YOAKUM_345	345	9.58	528025	RDRUNNER 3	115	8.67	585160	G1579&G1580	230	8.74
526944	LG-PLAINS 3	115	7.85	528027	RDRUNNER 7	345	3.90	587110	GEN-2016-015	345	6.36
527009	BRU_SUB 6	230	14.15	528095	7-RIVERS 6	230	6.30	587420	GEN-2016-062	345	5.18
527010	OXYBRU 6	230	14.03	528160	CARLSBAD 3	115	11.28	587670	GEN-2015-099	115	16.44
527018	BENNETT 3	115	13.14	528179	PECOS 6	230	6.62	587964	G16-120-TAP	345	8.72
527036	SHELL_C2 3	115	12.90	528182	NORTH_LOVNG3	115	8.60	588350	GEN-2016-171	230	8.98
527041	ARCO_TP 3	115	13.05	528185	N_LOVING 7	345	4.63	588430	GEN-2016-169	345	9.53
527047	OXY_WILRD1 3	115	10.49	528223	CHINA_DRAW 7	345	3.75	599960	EPTNP-D6	230	8.63

Table 4-14
Short Circuit Analysis for Study Project GEN-2016-172 (18SP)

Study Generator GEN-2016-172											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
511456	O.K.U.-7	345	5.58	524714	CASTRO_TP 2	69	3.54	525524	TOLK_EAST 6	230	32.66
511553	CHISHOLM7	345	12.97	524721	DS-#15&#19+2	69	3.56	525531	TOLK_WEST 6	230	32.66
515458	BORDER 7	345	12.63	524728	DS-CASTRO 2	69	4.28	525543	TOLK_TAP 6	230	32.66
522800	MU-TULIA 3	115	5.27	524734	DS-#21 3	115	9.35	525549	TOLK 7	345	18.26
523093	HITCHLAND 3	115	17.97	524745	CASTRO_CNTY2	69	8.82	525635	LAMB_CNTY 2	69	5.92
523095	HITCHLAND 6	230	15.15	524746	CASTRO_CNTY3	115	9.87	525636	LAMB_CNTY 3	115	8.51
523097	HITCHLAND 7	345	16.06	524757	BETHEL_COL13	115	8.22	525637	LAMB_CNTY 6	230	5.47
523101	NOBLE_WND 7	345	15.99	524770	PLSNT_HILL 6	230	6.26	525731	SP-ABERNTHY2	69	3.04
523112	NOVUS1 7	345	15.75	524908	ROOSEVELT 3	115	10.42	525738	HALECENTER 2	69	2.48
523155	OCHILTREE 6	230	4.23	524909	ROSEVELT_N 6	230	9.13	525745	LH-HALECTR 2	69	2.45
523177	RB-SPURLCK+3	115	5.87	524911	ROSEVELT_S 6	230	9.13	525779	FLOYD_CNTY 2	69	5.35
523215	FREWHELCOL17	345	9.48	524915	SW_4K33 6	230	9.13	525780	FLOYD_CNTY 3	115	6.13
523216	RB-HOGUE 3	115	4.13	525018	EMULESH&VLY3	115	4.84	525816	TUCO_INT2 2	69	4.73
523220	XIT_INTG 3	115	6.10	525019	EMU&VLY_TP 3	115	5.15	525826	TUCO_INT 2	69	8.07
523221	XIT_INTG 6	230	3.25	525028	BAILEYCO 3	115	5.03	525828	TUCO_INT 3	115	21.72
523256	ETTER 3	115	5.65	525050	BC-KELLEY +3	115	7.77	525830	TUCO_INT 6	230	32.78
523266	PRINGLE 3	115	10.64	525056	BC-EARTH 3	115	8.20	525832	TUCO_INT 7	345	26.37
523267	PRINGLE 6	230	4.28	525116	DS-#12 2	69	2.38	525840	ANTELOPE_1 6	230	32.38
523277	VALERO 3	115	10.71	525119	BC-SUNYSIDE2	69	1.32	525853	LH-WIL&ELN+2	69	2.60
523304	MOORE_W 3	115	11.86	525124	HART_INDUST3	115	7.84	525885	SP-NEWDEAL 2	69	3.34
523308	MOORE_E 3	115	11.86	525129	LC-HART 2	69	2.57	525926	CROSBY 3	115	4.54
523309	MOORE_CNTY 6	230	6.99	525132	LC-N_OLTON 2	69	3.09	525957	HALE_WNDCL16	230	10.20
523823	WALKEMEYER 7	345	8.30	525143	HAPPY_CTYTP2	69	4.04	526020	HOCKLEY 3	115	5.47
523869	CHAN+TASCOS6	230	4.37	525153	HAPPY_INT 2	69	4.47	526036	LC-OPDYKE 3	115	5.76
523959	POTTER_CO 6	230	22.66	525154	HAPPY_INT 3	115	5.52	526076	STANTON_W 3	115	9.31
523961	POTTER_CO 7	345	11.58	525179	TULIA_TP 3	115	6.57	526146	INDIANA 3	115	9.72
523977	HARRNG_WST 6	230	27.44	525191	KRESS_INT 2	69	4.54	526161	CARLISLE 6	230	11.90
523978	HARRNG_MID 6	230	27.44	525192	KRESS_INT 3	115	12.41	526268	LUBBCK_STH 3	115	19.76
523979	HARRNG_EST 6	230	27.44	525203	SW-KRESS 2	69	4.54	526269	LUBBCK_STH 6	230	18.78
524007	ROLLHILLS 3	115	19.67	525212	SWISHER 3	115	11.97	526297	LUBBCK_EST 2	69	8.13
524009	CHERRY 3	115	18.80	525213	SWISHER 6	230	11.27	526298	LUBBCK_EST 3	115	15.77
524010	ROLLHILLS 6	230	20.52	525224	KRESS_RURL 2	69	2.54	526299	LUBBCK_EST 6	230	13.65
524043	NICHOLS 3	115	31.16	525225	KRESS_RURAL3	115	6.53	526337	JONES 6	230	21.29
524044	NICHOLS 6	230	26.56	525249	LH-PLW&FNY+2	69	1.61	526424	PACIFIC 3	115	9.44
524106	NORTHWEST 3	115	11.34	525256	SW_9748 2	69	3.11	526434	SUNDOWN 3	115	11.08
524136	HASTINGS 3	115	13.88	525257	N_PLAINVEW 3	115	5.21	526435	SUNDOWN 6	230	11.27
524163	EAST_PLANT 6	230	14.03	525271	KISER 2	69	3.49	526445	AMOCO_TP 3	115	10.37
524266	BUSHLAND 3	115	9.43	525272	KISER 3	115	5.21	526460	AMOCO_SS 6	230	9.87
524267	BUSHLAND 6	230	9.88	525284	WESTRIDGE 2	69	4.28	526524	WOLFFORTH 3	115	11.71
524276	WILDOR_WND 6	230	5.01	525291	PLAINVW_TP 2	69	6.52	526525	WOLFFORTH 6	230	14.03
524290	WILDOR2_JUS6	230	6.71	525298	S_PLAINVEW 2	69	2.59	526935	YOAKUM 6	230	18.00
524296	SPNSPUR_WND7	345	5.57	525307	E_PLAINVEW 2	69	2.45	527656	CROSSROADS 7	345	16.70
524300	HILLSIDE 3	115	12.66	525316	LH-PROVDNCE2	69	3.38	560010	G14-037-TAP	345	15.71
524364	RANDALL 3	115	21.55	525325	COX 2	69	3.38	560021	CRAWFISH_DR2	230	29.24
524365	RANDALL 6	230	14.77	525326	COX 3	115	6.01	560022	CRAWFISH_DR	345	27.31
524414	AMA_SOUTH 3	115	16.86	525339	AIKEN_RURL 2	69	2.45	560035	GRAPEVINE	345	6.52
524415	AMA_SOUTH 6	230	13.84	525393	ROCKYFORD 3	115	8.88	560050	G15-031-TAP	230	9.52
524530	PALO_DURO 3	115	6.81	525397	OLTON 2	69	4.20	560051	G15-039-TAP	230	7.52
524556	LAPLATA 3	115	6.08	525404	LC-OLTON 2	69	4.51	560100	CRAWFISH765	765	11.46
524567	NE_HEREFORD3	115	9.60	525413	LAMTON 2	69	5.20	562004	G11-025-TAP	115	4.65
524573	NE_HEREFORD2	69	6.74	525414	LAMTON 3	115	7.72	562480	G13-027-TAP	230	9.59
524590	DAWN 3	115	6.27	525425	CORNER 2	69	3.64	576395	GEN-2010-014	345	11.65
524597	PANDAHFD 3	115	8.94	525432	SP-HALFWAY+2	69	5.90	583840	GEN-2013-027	230	9.08
524604	HEREFRD_SB 2	69	4.43	525440	LC-S_OLTON+3	115	7.22	584640	GEN-2015-022	115	11.97
524605	HEREFRD_NB 2	69	4.43	525446	RKYFORD_TP 3	115	9.92	584750	GEN-2015-031	230	8.04
524606	HEREFORD 3	115	10.77	525453	HALE_CNTY 2	69	6.95	584800	GEN-2015-039	230	6.37
524622	DEAFSMITH 3	115	12.02	525454	HALE_CNTY 3	115	10.30	587250	GEN-2016-039	115	11.97
524623	DEAFSMITH 6	230	7.78	525460	NEWHART 3	115	17.09	587570	ASGI1604	115	6.81
524629	DS-#6 3	115	6.18	525461	NEWHART 6	230	11.56	587964	G16-120-TAP	345	8.72
524681	DIMMIT_E&S 2	69	2.80	525480	PLANT_X 3	115	18.07	588440	GEN-2016-172	115	14.35
524688	DS-#3 2	69	2.96	525481	PLANT_X 6	230	24.43	599955	PNM-DC6	230	9.13
524694	DS-#22 3	115	4.61								

Table 4-15
Short Circuit Analysis for Study Project GEN-2016-177 (18SP)

Study Generator GEN-2016-177											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
526736	TERRY_CNTY 3	115	10.42	527130	DENVER_N 3	115	20.84	528638	LE-SAUNDRTP2	69	3.56
527021	CORTEZ 3	115	6.40	527136	DENVER_S 3	115	20.84	528667	LE-MHOON 2	69	4.37
527022	APACHE_ROB 3	115	7.23	527146	MUSTANG 3	115	22.41	528675	LE-FAMARISS2	69	3.32
527024	ALLRED_SUB 3	115	7.93	527149	MUSTANG 6	230	15.79	528679	LE-TATUM_SW2	69	4.88
527030	ALRDCRTZ_TP3	115	8.72	527183	JAYBEE 2	69	4.36	528699	LE-GRAY 2	69	4.13
527036	SHELL_C2 3	115	12.90	527202	SEAGRAVES 3	115	8.53	528703	LE-DENTN_TP2	69	3.89
527062	SHELL_CO2 3	115	15.86	527275	SEMINOLE 3	115	11.43	528709	LE-FTS_COND2	69	2.91
527068	SHELLC3_TP 3	115	10.67	527286	XTO_RUSSEL 3	115	9.96	528711	LE-TP89 2	69	1.92
527074	SHELLC3 3	115	9.59	527313	MIDAMERI_TP2	69	2.15	528714	LE-FORT_SW 2	69	3.10
527080	EL_PASO 3	115	15.62	527891	HOBBS_INT 3	115	30.30	528718	LE-NEWTEX 2	69	1.91
527099	DC_EAST 2	69	6.09	528325	LE-WAITS 3	115	6.70	528759	LE-TP51 2	69	2.19
527105	SAN_ANDS_TP3	115	16.47	528333	LE-WEST_SUB3	115	8.34	528780	LE-NITROTEC2	69	1.93
527106	SAN_ANDRES 3	115	11.72	528334	LE-NRTH_INT3	115	8.26	585150	GEN-2015-078	115	16.46
527111	WASSON 2	69	5.96	528617	LE-WAITS 2	69	3.28	588460	A16-008SUB	115	9.23
527125	DENVER_CTY 2	69	8.63	528618	LE-LOVINTON2	69	7.09	588462	A16-008TP	115	9.23

4.3 Short Circuit Results: 2026 Summer Peak

The maximum fault current for each bus is provided for the 2026 Summer Peak conditions. The following tables show the short circuit results for the study generators for the 2026 Summer Peak conditions:

- Table 4-16: Short Circuit Analysis for ASGI-2016-009 (26SP)
- Table 4-17: Short Circuit Analysis for GEN-2015-039 (26SP)
- Table 4-18: Short Circuit Analysis for GEN-2015-040 (26SP)
- Table 4-19: Short Circuit Analysis for GEN-2015-078 (26SP)
- Table 4-20: Short Circuit Analysis for GEN-2015-099 (26SP)
- Table 4-21: Short Circuit Analysis for GEN-2016-039 (26SP)
- Table 4-22: Short Circuit Analysis for GEN-2016-077 (26SP)
- Table 4-23: Short Circuit Analysis for GEN-2016-078 (26SP)
- Table 4-24: Short Circuit Analysis for GEN-2016-120 and GEN-2016-175 (26SP)
- Table 4-25: Short Circuit Analysis for GEN-2016-121 (26SP)
- Table 4-26: Short Circuit Analysis for GEN-2016-123, GEN-2016-124, and GEN-2016-125 (26SP)
- Table 4-27: Short Circuit Analysis for GEN-2016-169 (26SP)
- Table 4-28: Short Circuit Analysis for GEN-2016-171 (26SP)
- Table 4-29: Short Circuit Analysis for GEN-2016-172 (26SP)
- Table 4-30: Short Circuit Analysis for GEN-2016-177 (26SP)

Table 4-16
Short Circuit Analysis for Study Project ASGI-2016-009 (26SP)

Study Generator ASGI-2016-009											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
522823	LP-MILWAKEE6	230	14.13	526192	MURPHY 3	115	10.95	526736	TERRY_CNTY 3	115	10.42
522828	LP-MILWAKEE2	69	8.33	526199	SP-FRANKFRD3	115	9.89	526747	LG-BROWNFLD2	69	3.56
522861	LP-SOUTHEST6	230	18.00	526221	BATTON_N 2	69	1.78	526792	PRENTICE 3	115	5.90
525481	PLANT_X 6	230	23.72	526268	LUBBCK_STH 3	115	20.03	526934	YOAKUM 3	115	16.73
525524	TOLK_EAST 6	230	32.04	526269	LUBBCK_STH 6	230	20.08	527080	EL_PASO 3	115	15.57
525828	TUCO_INT 3	115	21.65	526337	JONES 6	230	22.23	527125	DENVER_CTY 2	69	8.62
525830	TUCO_INT 6	230	32.78	526434	SUNDOWN 3	115	11.10	527130	DENVER_N 3	115	20.74
525832	TUCO_INT 7	345	26.28	526435	SUNDOWN 6	230	11.26	527136	DENVER_S 3	115	20.74
525840	ANTELOPE_1 6	230	32.38	526460	AMOCO_SS 6	230	9.85	527146	MUSTANG 3	115	22.31
525957	HALE_WNDCL16	230	10.20	526469	SP-YUMA 2	69	3.06	527202	SEAGRAVES 3	115	8.52
526076	STANTON_W 3	115	9.36	526475	YUMA_INT 3	115	11.29	527212	DIAMONDBACK3	115	3.10
526109	SP-ERSKINE 3	115	11.67	526481	SP-WOLF_TP 3	115	11.49	527261	SULPHUR 2	69	3.36
526130	SP-CARLISLE2	69	2.12	526483	SP-WOLFORTH3	115	8.86	527262	SULPHUR 3	115	5.66
526146	INDIANA 3	115	9.78	526484	LG-LEVELAND3	115	9.31	527286	XTO_RUSSEL 3	115	9.92
526159	CARLISLE 2	69	2.58	526491	LG-CLAUENE 3	115	7.95	560021	CRAWFISH_DR2	230	29.19
526160	CARLISLE 3	115	13.74	526506	LG-DOCWEBR 2	69	4.94	583810	COMNIRE	115	0.37
526161	CARLISLE 6	230	14.65	526524	WOLFFORTH 3	115	11.79	584720	ASGI15021602	69	2.13
526162	LP-DOUD_TP 3	115	12.03	526525	WOLFFORTH 6	230	14.26	585120	GEN-2015-075	69	1.55
526176	LP-DOUD 3	115	9.28	526535	SP-MILWAKEE3	115	10.21	587370	GEN-2016-056	230	6.66
526184	SW_6878 2	69	2.17	526735	TERRY_CNTY 2	69	6.97				

Table 4-17
Short Circuit Analysis for Study Project GEN-2015-039 (26SP)

Study Generator GEN-2015-039											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
522823	LP-MILWAKEE6	230	14.13	524908	ROOSEVELT 3	115	10.46	525830	TUCO_INT 6	230	32.78
522861	LP-SOUTHEST6	230	18.00	524909	ROSEVELT_N 6	230	9.13	525832	TUCO_INT 7	345	26.28
522870	LP-HOLLY 6	230	17.67	524911	ROSEVELT_S 6	230	9.13	525840	ANTELOPE_1 6	230	32.38
523095	HITCHLAND 6	230	15.12	524915	SW_4K33 6	230	9.13	525850	ELK_CT1	345	25.73
523097	HITCHLAND 7	345	16.04	524924	PORTALES 3	115	7.31	525957	HALE_WNDCL16	230	10.20
523221	XIT_INTG 6	230	3.23	525018	EMULESH&VLY3	115	5.70	526020	HOCKLEY 3	115	5.54
523267	PRINGLE 6	230	4.25	525019	EMU&VLY_TP 3	115	6.13	526036	LC-OPDYKE 3	115	5.82
523308	MOORE_E 3	115	11.76	525027	BAILEYCO 2	69	5.44	526076	STANTON_W 3	115	9.36
523309	MOORE_CNTY 6	230	6.94	525028	BAILEYCO 3	115	6.13	526160	CARLISLE 3	115	13.74
523869	CHAN+TASCOS6	230	4.34	525040	BAILEY_PMP 3	115	4.74	526161	CARLISLE 6	230	14.65
523959	POTTER_CO 6	230	21.82	525050	BC-KELLEY +3	115	7.46	526268	LUBBCK_STH 3	115	20.03
523961	POTTER_CO 7	345	11.46	525056	BC-EARTH 3	115	7.76	526269	LUBBCK_STH 6	230	20.08
523977	HARRNG_WST 6	230	25.75	525124	HART_INDUST3	115	7.74	526298	LUBBCK_EST 3	115	15.85
523978	HARRNG_MID 6	230	25.75	525179	TULIA_TP 3	115	6.54	526299	LUBBCK_EST 6	230	13.96
523979	HARRNG_EST 6	230	25.75	525191	KRESS_INT 2	69	4.53	526337	JONES 6	230	22.23
524007	ROLLHILLS 3	115	18.45	525192	KRESS_INT 3	115	12.29	526361	COCHRAN 3	115	6.84
524010	ROLLHILLS 6	230	19.59	525212	SWISHER 3	115	11.86	526424	PACIFIC 3	115	9.45
524266	BUSHLAND 3	115	9.31	525213	SWISHER 6	230	11.15	526434	SUNDOWN 3	115	11.10
524267	BUSHLAND 6	230	9.73	525225	KRESS_RURAL3	115	6.49	526435	SUNDOWN 6	230	11.26
524276	WILDOR_WND 6	230	4.97	525272	KISER 3	115	5.19	526445	AMOCO_TP 3	115	10.38
524290	WILDOR2_JUS6	230	6.64	525291	PLAINVW_TP 2	69	6.48	526452	AMOCO_CRYO 3	115	6.44
524296	SPNSPUR_WND7	345	5.54	525298	S_PLAINVEW 2	69	2.58	526460	AMOCO_SS 6	230	9.85
524300	HILLSIDE 3	115	12.37	525325	COX 2	69	3.38	526475	YUMA_INT 3	115	11.29
524306	COULTER 3	115	14.94	525326	COX 3	115	5.97	526484	LG-LEVELAND3	115	9.31
524415	AMA_SOUTH 6	230	13.35	525393	ROCKYFORD 3	115	8.17	526524	WOLFFORTH 3	115	11.79
524516	CANYON_WEST3	115	5.66	525413	LAMTON 2	69	5.14	526525	WOLFFORTH 6	230	14.26
524554	CENTRE_ST 2	69	3.80	525414	LAMTON 3	115	7.50	526677	GRASSLAND 6	230	6.69
524556	LAPLATA 3	115	6.05	525432	SP-HALFWAY+2	69	5.86	526736	TERRY_CNTY 3	115	10.42
524561	DS-MTR 2	69	6.03	525440	LC-S_OLTON+3	115	6.93	526934	YOAKUM 3	115	16.73
524567	NE_HEREFORD3	115	9.53	525446	RKYFORD_TP 3	115	9.04	526935	YOAKUM 6	230	17.72
524573	NE_HEREFORD2	69	6.71	525453	HALE_CNTY 2	69	6.90	526936	YOAKUM_345	345	9.40
524590	DAWN 3	115	6.23	525454	HALE_CNTY 3	115	10.11	527009	BRU_SUB 6	230	14.01
524597	PANDAHFD 3	115	8.87	525460	NEWHART 3	115	16.84	527149	MUSTANG 6	230	15.65
524604	HEREFRD_SB 2	69	4.42	525461	NEWHART 6	230	11.40	527656	CROSSROADS 7	345	16.63
524605	HEREFRD_NB 2	69	4.42	525480	PLANT_X 3	115	14.77	560021	CRAWFISH_DR2	230	29.19
524606	HEREFORD 3	115	10.67	525481	PLANT_X 6	230	23.72	560022	CRAWFISH_DR	345	27.21
524608	HERFRD_STH 2	69	4.42	525524	TOLK_EAST 6	230	32.04	560035	GRAPEVINE	345	6.50
524622	DEAFSMITH 3	115	11.90	525531	TOLK_WEST 6	230	32.04	560050	G15-031-TAP	230	9.43
524623	DEAFSMITH 6	230	7.70	525543	TOLK_TAP 6	230	32.04	560051	G15-039-TAP	230	7.45
524629	DS-#6 3	115	6.16	525549	TOLK 7	345	18.06	560059	G1579&G1580T	230	8.93
524655	FRIONA 3	115	3.92	525608	NEW_AMHERST3	115	5.16	562480	G13-027-TAP	230	9.54
524694	DS-#22 3	115	4.56	525614	W_LITLFLDTP3	115	7.63	583840	GEN-2013-027	230	9.04
524734	DS-#21 3	115	9.18	525615	W_LITTLFLD 3	115	7.25	584640	GEN-2015-022	115	11.86
524745	CASTRO_CNTY2	69	8.73	525635	LAMB_CNTY 2	69	6.12	584750	GEN-2015-031	230	7.98
524746	CASTRO_CNTY3	115	9.68	525636	LAMB_CNTY 3	115	9.25	584800	GEN-2015-039	230	6.32
524757	BETHEL_COL13	115	8.09	525637	LAMB_CNTY 6	230	5.57	585060	GEN-2015-068	345	17.26
524768	PLSNT_HILL 3	115	10.19	525780	FLOYD_CNTY 3	115	6.11	587370	GEN-2016-056	230	6.66
524770	PLSNT_HILL 6	230	6.27	525816	TUCO_INT2 2	69	4.72	587700	GEN-2016-078	69	9.48
524822	CURRY 3	115	10.75	525826	TUCO_INT 2	69	8.06	588440	GEN-2016-172	115	14.18
524875	OASIS 6	230	7.54	525828	TUCO_INT 3	115	21.65	599955	PNM-DC6	230	9.13

Table 4-18
Short Circuit Analysis for Study Project GEN-2015-040 (26SP)

Study Generator GEN-2015-040											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
524909	ROSEVELT_N 6	230	9.13	527041	ARCO_TP 3	115	13.00	527275	SEMINOLE 3	115	11.39
525481	PLANT_X 6	230	23.72	527047	OXY_WILRD1 3	115	10.46	527276	SEMINOLE 6	230	7.25
525531	TOLK_WEST 6	230	32.04	527051	ODC_TP 3	115	13.11	527286	XTO_RUSSEL 3	115	9.92
525543	TOLK_TAP 6	230	32.04	527056	ODC 3	115	9.89	527313	MIDAMERI_TP2	69	2.15
525637	LAMB_CNTY 6	230	5.57	527062	SHELL_CO2 3	115	15.80	527321	GAINES 2	69	4.13
525830	TUCO_INT 6	230	32.78	527068	SHELLC3_TP 3	115	10.63	527322	GAINES 3	115	8.50
525832	TUCO_INT 7	345	26.28	527080	EL_PASO 3	115	15.57	527325	OXY_WSEM_TP3	115	8.41
525850	ELK_CT1	345	25.73	527099	DC_EAST 2	69	6.08	527339	DOSS 2	69	4.07
526434	SUNDOWN 3	115	11.10	527105	SAN_ANDS_TP3	115	16.40	527340	DOSS 3	115	7.13
526435	SUNDOWN 6	230	11.26	527106	SAN_ANDRES 3	115	11.69	527346	LEGACY 3	115	7.02
526460	AMOCO_SS 6	230	9.85	527111	WASSON 2	69	5.95	527363	HIGG 3	115	10.08
526491	LG-CLAUENE 3	115	7.95	527125	DENVER_CTY 2	69	8.62	527867	CUNNIGHM_S 6	230	14.33
526524	WOLFFORTH 3	115	11.79	527130	DENVER_N 3	115	20.74	527891	HOBBS_INT 3	115	29.35
526525	WOLFFORTH 6	230	14.26	527136	DENVER_S 3	115	20.74	527894	HOBBS_INT 6	230	16.22
526735	TERRY_CNTY 2	69	6.97	527146	MUSTANG 3	115	22.31	527896	HOBBS_INT 7	345	9.39
526736	TERRY_CNTY 3	115	10.42	527149	MUSTANG 6	230	15.65	527965	KIOWA 7	345	5.76
526784	AMOCOWASSON6	230	13.90	527151	GS-MUSTANG 6	230	15.65	528611	GAINESGENTP6	345	7.17
526792	PRENTICE 3	115	5.90	527183	JAYBEE 2	69	4.36	528626	LE-PLNSINT 2	69	4.39
526928	PLAINS_INT 3	115	9.80	527194	LG-PLSHILL 3	115	7.52	560022	CRAWFISH_DR	345	27.21
526934	YOAKUM 3	115	16.73	527201	SEAGRAVES 2	69	5.40	560059	G1579&G1580T	230	8.93
526935	YOAKUM 6	230	17.72	527202	SEAGRAVES 3	115	8.52	562480	G13-027-TAP	230	9.54
526936	YOAKUM_345	345	9.40	527212	DIAMONDBACK3	115	3.10	583840	GEN-2013-027	230	9.04
526944	LG-PLAINS 3	115	7.83	527217	MOSS 2	69	5.30	584810	GEN-2015-040	230	14.30
526993	LG-WELLMAN 2	69	3.06	527223	LG-MC&SMNL+2	69	2.58	585060	GEN-2015-068	345	17.26
527009	BRU_SUB 6	230	14.01	527238	ROZ 3	115	9.25	585150	GEN-2015-078	115	16.40
527010	OXYBRU 6	230	13.89	527242	AMERADA 3	115	9.35	585160	G1579&G1580	230	8.49
527018	BENNETT 3	115	13.10	527261	SULPHUR 2	69	3.36	588350	GEN-2016-171	230	8.71
527036	SHELL_C2 3	115	12.85	527262	SULPHUR 3	115	5.66	588430	GEN-2016-169	345	9.13

Table 4-19
Short Circuit Analysis for Study Project GEN-2015-078 (26SP)

Study Generator GEN-2015-078											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
524909	ROSEVELT_N 6	230	9.13	527018	BENNETT 3	115	13.10	527271	LG-FOSTER +2	69	2.71
525481	PLANT_X 6	230	23.72	527030	ALRDCRTZ_TP3	115	8.70	527275	SEMINOLE 3	115	11.39
525531	TOLK_WEST 6	230	32.04	527036	SHELL_C2 3	115	12.85	527276	SEMINOLE 6	230	7.25
525543	TOLK_TAP 6	230	32.04	527041	ARCO_TP 3	115	13.00	527284	RUSSELL 3	115	8.98
525637	LAMB_CNTY 6	230	5.57	527047	OXY_WILRD1 3	115	10.46	527286	XTO_RUSSEL 3	115	9.92
525830	TUCO_INT 6	230	32.78	527051	ODC_TP 3	115	13.11	527291	LE-KCM 2	69	2.91
525832	TUCO_INT 7	345	26.28	527056	ODC 3	115	9.89	527305	LG-SAWYERFL2	69	2.07
525850	ELK_CT1	345	25.73	527062	SHELL_CO2 3	115	15.80	527313	MIDAMERI_TP2	69	2.15
526161	CARLISLE 6	230	14.65	527068	SHELLC3_TP 3	115	10.63	527321	GAINES 2	69	4.13
526269	LUBBCK_STH 6	230	20.08	527074	SHELLC3 3	115	9.57	527322	GAINES 3	115	8.50
526434	SUNDOWN 3	115	11.10	527080	EL_PASO 3	115	15.57	527325	OXY_WSEM_TP3	115	8.41
526435	SUNDOWN 6	230	11.26	527093	SW_7848 2	69	4.22	527331	RILEY 2	69	3.84
526445	AMOCO_TP 3	115	10.38	527096	OXY_DC_WST 2	69	4.49	527339	DOSS 2	69	4.07
526460	AMOCO_SS 6	230	9.85	527099	DC_EAST 2	69	6.08	527340	DOSS 3	115	7.13
526469	SP-YUMA 2	69	3.06	527105	SAN_ANDS_TP3	115	16.40	527346	LEGACY 3	115	7.02
526475	YUMA_INT 3	115	11.29	527106	SAN_ANDRES 3	115	11.69	527360	MAPCO 3	115	10.18
526481	SP-WOLF_TP 3	115	11.49	527111	WASSON 2	69	5.95	527362	JOHNSON_DRW3	115	10.41
526484	LG-LEVELAND3	115	9.31	527117	SW_7814 2	69	3.13	527363	HIGG 3	115	10.08
526491	LG-CLAUENE 3	115	7.95	527125	DENVER_CTY 2	69	8.62	527867	CUNNIGHM_S 6	230	14.33
526499	LG-MEADOW 2	69	3.71	527130	DENVER_N 3	115	20.74	527891	HOBBS_INT 3	115	29.35
526506	LG-DOCWEBR 2	69	4.94	527136	DENVER_S 3	115	20.74	527894	HOBBS_INT 6	230	16.22
526524	WOLFFORTH 3	115	11.79	527146	MUSTANG 3	115	22.31	527896	HOBBS_INT 7	345	9.39
526525	WOLFFORTH 6	230	14.26	527149	MUSTANG 6	230	15.65	527965	KIOWA 7	345	5.76
526735	TERRY_CNTY 2	69	6.97	527151	GS-MUSTANG 6	230	15.65	528413	TAYLOR 3	115	14.02
526736	TERRY_CNTY 3	115	10.42	527183	JAYBEE 2	69	4.36	528433	BENSING 3	115	7.89
526747	LG-BROWNFLD2	69	3.56	527189	LG-SEAGRAVE2	69	3.73	528611	GAINESGENTP6	345	7.17
526754	BROWNFIELD 2	69	3.05	527194	LG-PLSHILL 3	115	7.52	528626	LE-PLNSINT 2	69	4.39
526784	AMOCOWASSON6	230	13.90	527201	SEAGRAVES 2	69	5.40	528775	LE-ERF 3	115	10.41
526792	PRENTICE 3	115	5.90	527202	SEAGRAVES 3	115	8.52	528778	LE-ROZ 2	69	3.40
526928	PLAINS_INT 3	115	9.80	527211	DIAMONDBACK2	69	2.76	560022	CRAWFISH_DR	345	27.21
526934	YOAKUM 3	115	16.73	527212	DIAMONDBACK3	115	3.10	560059	G1579&G1580T	230	8.93
526935	YOAKUM 6	230	17.72	527217	MOSS 2	69	5.30	562480	G13-027-TAP	230	9.54
526936	YOAKUM_345	345	9.40	527223	LG-MC&SMNL+2	69	2.58	583840	GEN-2013-027	230	9.04
526944	LG-PLAINS 3	115	7.83	527228	RILEY_TP 2	69	3.98	584810	GEN-2015-040	230	14.30
526965	KINNEY 2	69	2.41	527229	OZRK_MAH02 2	69	2.59	585060	GEN-2015-068	345	17.26
526971	TOKIO_TP 2	69	3.64	527235	LG-ASHMORE 2	69	2.18	585150	GEN-2015-078	115	16.40
526979	LG-JS_SMITH2	69	2.10	527238	ROZ 3	115	9.25	585160	G1579&G1580	230	8.49
526985	WELLMAN 2	69	2.85	527242	AMERADA 3	115	9.35	588350	GEN-2016-171	230	8.71
526993	LG-WELLMAN 2	69	3.06	527247	CEDARLAKE 2	69	2.45	588430	GEN-2016-169	345	9.13
526999	UNION_TX 2	69	2.38	527253	ADAIR 2	69	2.61	588460	A16-008SUB	115	9.20
527009	BRU_SUB 6	230	14.01	527261	SULPHUR 2	69	3.36	588462	A16-008TP	115	9.20
527010	OXYBRU 6	230	13.89	527262	SULPHUR 3	115	5.66				

Table 4-20
Short Circuit Analysis for Study Project GEN-2015-099 (26SP)

Study Generator GEN-2015-099											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
525832	TUCO_INT 7	345	26.28	527999	INTREPDW_TP3	115	12.23	528480	OXY_S_HOBBS3	115	10.42
526460	AMOCO_SS 6	230	9.85	528027	RDRUNNER 7	345	3.84	528484	SW_4J44 3	115	11.04
526934	YOAKUM 3	115	16.73	528095	7-RIVERS 6	230	6.17	528491	MONUMENT 3	115	14.91
526935	YOAKUM 6	230	17.72	528145	NATPOT_TP 2	69	8.68	528498	W_HOBBS 3	115	11.61
526936	YOAKUM_345	345	9.40	528151	FIESTA 3	115	9.63	528512	EUNICE 3	115	6.31
527009	BRU_SUB 6	230	14.01	528159	CARLSBAD 2	69	4.86	528533	DRINKARD_TP3	115	8.17
527030	ALRDCRTZ_TP3	115	8.70	528160	CARLSBAD 3	115	11.07	528552	OIL_CENTER 3	115	5.83
527130	DENVER_N 3	115	20.74	528178	PECOS 3	115	11.69	528554	COOPER_RNCH3	115	6.35
527149	MUSTANG 6	230	15.65	528179	PECOS 6	230	6.43	528568	MONUMNT_TP 3	115	9.90
527284	RUSSELL 3	115	8.98	528185	N_LOVING 7	345	4.54	528575	OXYPERMIAN 3	115	14.70
527286	XTO_RUSSEL 3	115	9.92	528317	ENRON_TP 3	115	6.70	528582	BYRD 3	115	7.72
527325	OXY_WSEM_TP3	115	8.41	528318	ENRON 3	115	5.84	528589	DRINKARD 3	115	8.44
527360	MAPCO 3	115	10.18	528325	LE-WAITS 3	115	6.68	528596	CARDINAL 3	115	8.34
527362	JOHNSON_DRW3	115	10.41	528333	LE-WEST_SUB3	115	8.30	528603	NA_ENRICH 3	115	11.88
527363	HIGG 3	115	10.08	528334	LE-NRTH_INT3	115	8.22	528604	ANDREWS 6	345	6.51
527483	CHAVES_CNTY6	230	4.42	528341	LE-SANANDRS3	115	6.29	528610	GAINES_GEN 6	230	9.14
527793	EDDY_STH 3	115	11.46	528348	BUCKEYE_TP 3	115	8.08	528611	GAINESGENTP6	345	7.17
527798	EDDY_NTH 3	115	11.46	528353	MADDOXG23 3	115	24.85	528617	LE-WAITS 2	69	3.28
527799	EDDY_NORTH 6	230	8.42	528355	MADDOX 3	115	24.85	528618	LE-LOVINTON2	69	7.07
527802	EDDY_CNTY 7	345	5.04	528385	BUCKEYE 3	115	7.28	528622	LE-SANANDRS2	69	5.21
527864	CUNNINHAM 3	115	25.90	528392	PEARLE 3	115	6.24	528627	LE-TXACO_TP3	115	6.97
527865	CUNNIGHM_N 6	230	14.33	528394	QUAHADA 3	115	7.97	528638	LE-SAUNDRTP2	69	3.55
527867	CUNNIGHM_S 6	230	14.33	528399	LEA_NATIONL3	115	6.74	528667	LE-MHOON 2	69	4.36
527891	HOBBS_INT 3	115	29.35	528406	MALJMAR1&2 3	115	3.20	528675	LE-FAMARISS2	69	3.31
527894	HOBBS_INT 6	230	16.22	528413	TAYLOR 3	115	14.02	528679	LE-TATUM_SW2	69	4.87
527896	HOBBS_INT 7	345	9.39	528420	ZIA 3	115	6.47	528699	LE-GRAY 2	69	4.13
527929	PCA 2	69	6.19	528422	DCP_ZIA TP 3	115	6.92	528775	LE-ERF 3	115	10.41
527930	PCA 3	115	10.94	528423	DCP_ZIA 3	115	6.57	528792	LE-TEXACO 3	115	6.32
527935	CV-SKELLY 3	115	3.20	528433	BENSING 3	115	7.89	560059	G1579&G1580T	230	8.93
527943	CV-LUSK 2	69	2.24	528435	MILLEN 3	115	11.26	562480	G13-027-TAP	230	9.54
527947	CV-LUSK 3	115	3.43	528442	NE_HOBBS 3	115	11.55	585160	G1579&G1580	230	8.49
527948	CV-LUSK_TP 3	115	4.14	528449	W_BENDER 3	115	14.23	587670	GEN-2015-099	115	16.24
527961	POTASH_JCT 2	69	8.72	528456	N_HOBBS 3	115	8.84	588350	GEN-2016-171	230	8.71
527962	POTASH_JCT 3	115	14.42	528463	SANGER_SW 3	115	15.29	588430	GEN-2016-169	345	9.13
527963	POTASH_JCT 6	230	7.04	528470	E_SANGER 3	115	12.31	599960	EPTNP-D6	230	8.42
527965	KIOWA 7	345	5.76	528477	S_HOBBS 3	115	10.26				

Table 4-21
Short Circuit Analysis for Study Project GEN-2016-039 (26SP)

Study Generator GEN-2016-039											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
511456	O.K.U.-7	345	5.59	525028	BAILEYCO 3	115	6.13	525779	FLOYD_CNTY 2	69	5.35
511468	L.E.S.-7	345	13.34	525050	BC-KELLEY +3	115	7.46	525780	FLOYD_CNTY 3	115	6.11
511553	CHISHOLM7	345	12.97	525056	BC-EARTH 3	115	7.76	525816	TUCO_INT2 2	69	4.72
511565	OKLAUN HVDC7	345	5.57	525124	HART_INDUST3	115	7.74	525826	TUCO_INT 2	69	8.06
515375	WWRDEHV7	345	20.00	525132	LC-N_OLTON 2	69	3.07	525828	TUCO_INT 3	115	21.65
515458	BORDER 7	345	12.63	525143	HAPPY_CTYTP2	69	4.03	525830	TUCO_INT 6	230	32.78
522800	MU-TULIA 3	115	5.25	525153	HAPPY_INT 2	69	4.46	525832	TUCO_INT 7	345	26.28
522823	LP-MILWAKEE6	230	14.13	525154	HAPPY_INT 3	115	5.49	525840	ANTELOPE_1 6	230	32.38
522870	LP-HOLLY 6	230	17.67	525179	TULIA_TP 3	115	6.54	525850	ELK_CT1	345	25.73
523095	HITCHLAND 6	230	15.12	525191	KRESS_INT 2	69	4.53	525853	LH-WIL&ELN+2	69	2.60
523097	HITCHLAND 7	345	16.04	525192	KRESS_INT 3	115	12.29	525885	SP-NEWDEAL 2	69	3.34
523221	XIT_INTG 6	230	3.23	525203	SW-KRESS 2	69	4.53	525926	CROSBY 3	115	4.54
523267	PRINGLE 6	230	4.25	525212	SWISHER 3	115	11.86	525957	HALE_WNDCL16	230	10.20
523308	MOORE_E 3	115	11.76	525213	SWISHER 6	230	11.15	526076	STANTON_W 3	115	9.36
523309	MOORE_CNTY 6	230	6.94	525224	KRESS_RURL 2	69	2.54	526146	INDIANA 3	115	9.78
523551	HUTCHISON 6	230	7.14	525225	KRESS_RURAL3	115	6.49	526160	CARLISLE 3	115	13.74
523771	GRAPEVINE 6	230	5.79	525249	LH-PLW&FNY+2	69	1.61	526161	CARLISLE 6	230	14.65
523869	CHAN+TASCOS6	230	4.34	525256	SW_9748 2	69	3.10	526268	LUBBCK_STH 3	115	20.03
523959	POTTER_CO 6	230	21.82	525257	N_PLAINVEW 3	115	5.19	526269	LUBBCK_STH 6	230	20.08
523961	POTTER_CO 7	345	11.46	525271	KISER 2	69	3.48	526297	LUBBCK_EST 2	69	8.14
523977	HARRNG_WST 6	230	25.75	525272	KISER 3	115	5.19	526298	LUBBCK_EST 3	115	15.85
523978	HARRNG_MID 6	230	25.75	525284	WESTRIDGE 2	69	4.26	526299	LUBBCK_EST 6	230	13.96
523979	HARRNG_EST 6	230	25.75	525291	PLAINVW_TP 2	69	6.48	526337	JONES 6	230	22.23
524007	ROLLHILLS 3	115	18.45	525298	S_PLAINVEW 2	69	2.58	526434	SUNDOWN 3	115	11.10
524010	ROLLHILLS 6	230	19.59	525307	E_PLAINVEW 2	69	2.45	526435	SUNDOWN 6	230	11.26
524043	NICHOLS 3	115	25.74	525316	LH-PROVDNCE2	69	3.38	526460	AMOCO_SS 6	230	9.85
524044	NICHOLS 6	230	24.89	525325	COX 2	69	3.38	526525	WOLFFORTH 6	230	14.26
524266	BUSHLAND 3	115	9.31	525326	COX 3	115	5.97	526677	GRASSLAND 6	230	6.69
524267	BUSHLAND 6	230	9.73	525339	AIKEN_RURL 2	69	2.45	526936	YOAKUM_345	345	9.40
524290	WILDOR2_JUS6	230	6.64	525393	ROCKYFORD 3	115	8.17	527656	CROSSROADS 7	345	16.63
524296	SPNSPUR_WND7	345	5.54	525404	LC-OLTON 2	69	4.46	560021	CRAWFISH_DR2	230	29.19
524364	RANDALL 3	115	20.74	525413	LAMTON 2	69	5.14	560022	CRAWFISH_DR	345	27.21
524365	RANDALL 6	230	14.19	525414	LAMTON 3	115	7.50	560035	GRAPEVINE	345	6.50
524377	FARMERS 3	115	14.88	525425	CORNER 2	69	3.63	560050	G15-031-TAP	230	9.43
524397	ARROWHEAD 3	115	13.28	525432	SP-HALFWAY+2	69	5.86	560051	G15-039-TAP	230	7.45
524404	OWENSCORN 3	115	14.58	525440	LC-S_OLTON+3	115	6.93	560100	CRAWFISH765	765	11.42
524414	AMA_SOUTH 3	115	16.32	525446	RKYFORD_TP 3	115	9.04	560102	CROSSRDS765	765	7.65
524415	AMA_SOUTH 6	230	13.35	525453	HALE_CNTY 2	69	6.90	560103	CRAW_TAP	765	9.32
524530	PALO_DURO 3	115	6.74	525454	HALE_CNTY 3	115	10.11	562004	G11-025-TAP	115	4.65
524544	SPRING_DRW 3	115	6.32	525460	NEWHART 3	115	16.84	562480	G13-027-TAP	230	9.54
524622	DEAFSMITH 3	115	11.90	525461	NEWHART 6	230	11.40	583090	G1149&G1504	345	9.90
524623	DEAFSMITH 6	230	7.70	525480	PLANT_X 3	115	14.77	584640	GEN-2015-022	115	11.86
524694	DS-#22 3	115	4.56	525481	PLANT_X 6	230	23.72	584750	GEN-2015-031	230	7.98
524714	CASTRO_TP 2	69	3.52	525524	TOLK_EAST 6	230	32.04	584800	GEN-2015-039	230	6.32
524721	DS-#15&#19+2	69	3.54	525531	TOLK_WEST 6	230	32.04	585060	GEN-2015-068	345	17.26
524728	DS-CASTRO 2	69	4.26	525543	TOLK_TAP 6	230	32.04	587250	GEN-2016-039	115	11.86
524734	DS-#21 3	115	9.18	525549	TOLK 7	345	18.06	587370	GEN-2016-056	230	6.66
524745	CASTRO_CNTY2	69	8.73	525614	W_LITLFLDTP3	115	7.63	587570	ASGI1604	115	6.74
524746	CASTRO_CNTY3	115	9.68	525615	W_LITTLFLD 3	115	7.25	587960	GEN-2016-120	345	6.46
524757	BETHEL_COL13	115	8.09	525636	LAMB_CNTY 3	115	9.25	587964	G16-120-TAP	345	8.71
524909	ROSEVELT_N 6	230	9.13	525637	LAMB_CNTY 6	230	5.57	587970	GEN-2016-175	345	5.18
524911	ROSEVELT_S 6	230	9.13	525731	SP-ABERNTHY2	69	3.04	588440	GEN-2016-172	115	14.18
525018	EMULESH&VLY3	115	5.70	525738	HALECENTER 2	69	2.48	599891	OKLAUN 7	345	4.04
525019	EMU&VLY_TP 3	115	6.13	525745	LH-HALECTR 2	69	2.45				

Table 4-22
Short Circuit Analysis for Study Project GEN-2016-077 (26SP)

Study Generator GEN-2016-077

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
522892	MU-BROWNFLD2	69	2.73	526655	LYNN_CNTY 2	69	3.78	526777	GOODPASTURE2	69	2.40
526491	LG-CLAUENE 3	115	7.95	526711	LG-DIXON 2	69	2.50	526792	PRENTICE 3	115	5.90
526499	LG-MEADOW 2	69	3.71	526735	TERRY_CNTY 2	69	6.97	526979	LG-JS_SMITH2	69	2.10
526506	LG-DOCWEBR 2	69	4.94	526736	TERRY_CNTY 3	115	10.42	526985	WELLMAN 2	69	2.85
526524	WOLFFORTH 3	115	11.79	526747	LG-BROWNFLD2	69	3.56	527130	DENVER_N 3	115	20.74
526631	LAKEVIEW 2	69	1.50	526754	BROWNFIELD 2	69	3.05	527262	SULPHUR 3	115	5.66
526638	LG-NEWMOORE2	69	1.71	526761	BROWNFLD_TP2	69	2.83	587690	GEN-2016-077	69	2.49
526645	LG-NH&WILN+2	69	2.81	526770	OZARK_MAHO 2	69	1.79				

Table 4-23
Short Circuit Analysis for Study Project GEN-2016-078 (26SP)

Study Generator GEN-2016-078

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
523959	POTTER_CO 6	230	21.82	524941	PORTALES#1 2	69	5.52	525453	HALE_CNTY 2	69	6.90
524486	CAPROCK 3	115	3.51	524963	S_PORTALES 3	115	5.63	525454	HALE_CNTY 3	115	10.11
524502	NORTON 3	115	3.87	524977	GREYHOUND 3	115	5.55	525460	NEWHART 3	115	16.84
524509	FE-TUCMCARI3	115	2.86	524987	LARIAT 2	69	2.20	525461	NEWHART 6	230	11.40
524623	DEAFSMITH 6	230	7.70	524994	BC-LARIAT 2	69	2.44	525480	PLANT_X 3	115	14.77
524648	CARGILL 3	115	3.90	524996	BC-PROGRSS+2	69	2.87	525481	PLANT_X 6	230	23.72
524662	PARMER_CO 3	115	4.10	525001	W_MULESHOE 2	69	4.17	525524	TOLK_EAST 6	230	32.04
524664	DS-#24 +3	115	4.05	525008	MULESH_CTY 2	69	4.35	525531	TOLK_WEST 6	230	32.04
524669	DS-#20 3	115	4.83	525017	EMULESH&VLY2	69	4.36	525543	TOLK_TAP 6	230	32.04
524746	CASTRO_CNTY3	115	9.68	525018	EMULESH&VLY3	115	5.70	525592	SUDANRURAL 2	69	2.29
524764	NORRIS_TP 3	115	10.72	525019	EMU&VLY_TP 3	115	6.13	525594	SUDANRURAL 3	115	4.64
524768	PLSNT_HILL 3	115	10.19	525023	BC-BAIL_MTR2	69	5.44	525599	LC-SANDHLL+2	69	2.77
524770	PLSNT_HILL 6	230	6.27	525027	BAILEYCO 2	69	5.44	525607	NEW_AMHERST2	69	3.19
524773	E_CLOVIS 3	115	8.63	525028	BAILEYCO 3	115	6.13	525608	NEW_AMHERST3	115	5.16
524776	N_CLOVIS_TP3	115	7.30	525038	BAILEY_PMP 2	69	2.87	525614	W_LITLFLDTP3	115	7.63
524777	N_CLOVIS 3	115	6.60	525040	BAILEY_PMP 3	115	4.74	525615	W_LITTLFLD 3	115	7.25
524783	W_CLOVIS 2	69	2.42	525045	LC-BECK +2	69	2.04	525635	LAMB_CNTY 2	69	6.12
524797	PERIMETER 3	115	6.40	525050	BC-KELLEY +3	115	7.46	525636	LAMB_CNTY 3	115	9.25
524801	NORRIS 3	115	9.83	525056	BC-EARTH 3	115	7.76	525637	LAMB_CNTY 6	230	5.57
524808	FE-CLVS_INT3	115	6.80	525124	HART_INDUST3	115	7.74	525780	FLOYD_CNTY 3	115	6.11
524821	CURRY 2	69	4.37	525179	TULIA_TP 3	115	6.54	525816	TUCO_INT2 2	69	4.72
524822	CURRY 3	115	10.75	525191	KRESS_INT 2	69	4.53	525826	TUCO_INT 2	69	8.06
524831	FE-HOLLAND 3	115	8.91	525192	KRESS_INT 3	115	12.29	525828	TUCO_INT 3	115	21.65
524838	FE-CLOVIS2+3	115	10.20	525212	SWISHER 3	115	11.86	525830	TUCO_INT 6	230	32.78
524846	FARWELL 2	69	2.12	525213	SWISHER 6	230	11.15	526020	HOCKLEY 3	115	5.54
524853	DS-#10 +2	69	1.77	525225	KRESS_RURAL3	115	6.49	526076	STANTON_W 3	115	9.36
524863	FE-CHZPLT 3	115	7.74	525272	KISER 3	115	5.19	526298	LUBBCK_EST 3	115	15.85
524874	OASIS 3	115	9.70	525291	PLAINVW_TP 2	69	6.48	526434	SUNDOWN 3	115	11.10
524875	OASIS 6	230	7.54	525298	S_PLAINVEW 2	69	2.58	526435	SUNDOWN 6	230	11.26
524908	ROOSEVELT 3	115	10.46	525325	COX 2	69	3.38	526460	AMOCO_SS 6	230	9.85
524909	ROSEVELT_N 6	230	9.13	525326	COX 3	115	5.97	526525	WOLFFORTH 6	230	14.26
524911	ROSEVELT_S 6	230	9.13	525393	ROCKYFORD 3	115	8.17	560051	G15-039-TAP	230	7.45
524915	SW_4K33 6	230	9.13	525413	LAMTON 2	69	5.14	562480	G13-027-TAP	230	9.54
524923	PORTALES 2	69	7.17	525414	LAMTON 3	115	7.50	584620	GEN-2015-020	115	9.45
524924	PORTALES 3	115	7.31	525432	SP-HALFWAY+2	69	5.86	584800	GEN-2015-039	230	6.32
524929	RO-PORT_MTR2	69	7.17	525440	LC-S_OLTON+3	115	6.93	587700	GEN-2016-078	69	9.48
524934	ZODIAC 2	69	5.33	525446	RKYFORD_TP 3	115	9.04	599955	PNM-DC6	230	9.13
524935	KILGORE 3	115	5.99								

Table 4-24
Short Circuit Analysis for Study Project GEN-2016-120 (26SP)

Study Generator GEN-2016-120 and GEN-2016-175											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
511423	FLE TAP4	138	8.89	523309	MOORE_CNTY 6	230	6.94	528611	GAINESGENTP6	345	7.17
511437	COMANC-4	138	18.15	523779	STLN-DEMARC6	230	7.63	532782	BUFFALO7	345	21.69
511439	LWSTAP 4	138	11.48	523823	WALKEMEYER 7	345	8.33	532783	KINGMAN7	345	6.87
511456	O.K.U.-7	345	5.59	523869	CHAN+TASCOS6	230	4.34	532796	WICHITA7	345	26.14
511458	ELKCTY-4	138	11.16	523959	POTTER_CO 6	230	21.82	539638	FLATRDG4	138	15.46
511466	L.E.S.-2	69	16.57	523961	POTTER_CO 7	345	11.46	539800	CLARKCOUNTY7	345	13.53
511467	L.E.S.-4	138	24.72	523979	HARRNG_EST 6	230	25.75	539801	THISTLE7	345	16.31
511468	L.E.S.-7	345	13.34	524010	ROLLHILLS 6	230	19.59	539804	THISTLE4	138	17.43
511474	SHERID4	138	12.27	524267	BUSHLAND 6	230	9.73	560010	G14-037-TAP	345	15.70
511486	ELGINJT4	138	10.03	524296	SPNSPUR_WND7	345	5.54	560021	CRAWFISH_DR2	230	29.19
511490	ELKCITY6	230	7.18	524415	AMA_SOUTH 6	230	13.35	560022	CRAWFISH_DR	345	27.21
511494	COMMTAP4	138	21.59	524909	ROSEVELT_N 6	230	9.13	560035	GRAPEVINE	345	6.50
511541	SWEETWT6	230	8.71	524911	ROSEVELT_S 6	230	9.13	560050	G15-031-TAP	230	9.43
511542	BUFFCK6	230	6.20	525192	KRESS_INT 3	115	12.29	560059	G1579&G1580T	230	8.93
511544	DEMPSEY6	230	5.25	525212	SWISHER 3	115	11.86	560071	G16-003-TAP	345	15.13
511547	ROARK6	230	4.74	525213	SWISHER 6	230	11.15	560072	G16-005-TAP	345	12.80
511553	CHISHOLM7	345	12.97	525454	HALE_CNTY 3	115	10.11	560078	G16-037-TAP	345	9.83
511557	CHISHOLM6	230	11.85	525460	NEWHART 3	115	16.84	560100	CRAWFISH765	765	11.42
511565	OKLAUN HVDC7	345	5.57	525461	NEWHART 6	230	11.40	560101	SEMINOLE765	765	11.67
511568	TERRYRD7	345	9.98	525481	PLANT_X 6	230	23.72	560102	CROSSRDS765	765	7.65
511571	RUSHSPR7	345	6.38	525524	TOLK_EAST 6	230	32.04	560103	CRAW_TAP	765	9.32
514782	WODWRD 2	69	10.86	525531	TOLK_WEST 6	230	32.04	562480	G13-027-TAP	230	9.54
514785	WOODWRD4	138	12.99	525543	TOLK_TAP 6	230	32.04	576395	GEN-2010-014	345	11.64
514787	DEWEY 4	138	7.46	525549	TOLK 7	345	18.06	583090	G1149&G1504	345	9.90
514796	IODINE-4	138	7.26	525637	LAMB_CNTY 6	230	5.57	584640	GEN-2015-022	115	11.86
514801	MINCO 7	345	17.61	525780	FLOYD_CNTY 3	115	6.11	584700	GEN-2015-029	345	9.64
514880	NORTWST7	345	32.42	525816	TUCO_INT2 2	69	4.72	584750	GEN-2015-031	230	7.98
514901	CIMARON7	345	33.12	525826	TUCO_INT 2	69	8.06	584940	GEN-2015-056	345	11.70
515045	SEMINOL7	345	32.78	525828	TUCO_INT 3	115	21.65	585060	GEN-2015-068	345	17.26
515136	SUNNYSD7	345	10.83	525830	TUCO_INT 6	230	32.78	585080	GEN-2015-071	345	10.72
515363	CENT 4	138	3.08	525832	TUCO_INT 7	345	26.28	585190	GEN-2015-082	345	7.02
515375	WWRDEHV7	345	20.00	525840	ANTELOPE_1 6	230	32.38	585270	GEN-2015-093	345	10.00
515376	WWRDEHV4	138	23.10	525850	ELK_CT1	345	25.73	585410	GREAT_WESTRN	345	9.98
515394	KEENAN 4	138	8.03	525957	HALE_WNDCL16	230	10.20	585420	COWBOY_RIDGE	345	7.69
515398	OUSPRT 4	138	8.83	526076	STANTON_W 3	115	9.36	585430	PRSIMN_CRK1	345	11.67
515407	TATONGA7	345	16.02	526160	CARLISLE 3	115	13.74	585440	PRSIMN_CRK2	345	10.65
515425	WWDPST 4	138	17.10	526161	CARLISLE 6	230	14.65	587020	GEN-2016-003	345	15.13
515448	CRSRDSW7	345	11.15	526269	LUBBCK_STH 6	230	20.08	587040	GEN-2016-005	345	10.55
515458	BORDER 7	345	12.63	526298	LUBBCK_EST 3	115	15.85	587230	GEN-2016-037	345	8.61
515497	MATHWSN7	345	31.98	526299	LUBBCK_EST 6	230	13.96	587300	G16-045-SUB1	345	1.56
515554	BVRCNTY7	345	14.54	526337	JONES 6	230	22.23	587304	G16-045-SUB2	345	1.52
515582	SLNGWND7	345	7.25	526460	AMOCO_SS 6	230	9.85	587370	GEN-2016-056	230	6.66
515585	MAMTHPW7	345	12.64	526525	WOLFFORTH 6	230	14.26	587380	G16-057-SUB1	345	1.53
515599	G07621119-20	345	13.27	526677	GRASSLAND 6	230	6.69	587384	G16-057-SUB2	345	1.47
515677	BADGER 7	345	13.64	526934	YOAKUM 3	115	16.73	587500	GEN-2016-073	345	15.71
515686	GEN-2011-014	345	12.20	526935	YOAKUM 6	230	17.72	587740	GEN-2016-091	345	13.34
515785	WINDFRM4	138	19.85	526936	YOAKUM_345	345	9.40	587744	G16-091-TAP	345	15.06
515800	GRACMNT7	345	17.65	527009	BRU_SUB 6	230	14.01	587770	GEN-2016-095	345	11.02
515802	GRACMNT4	138	28.58	527149	MUSTANG 6	230	15.65	587960	GEN-2016-120	345	6.46
515875	REDNGTN7	345	18.08	527654	RSVLT_CC_W 7	345	10.77	587964	G16-120-TAP	345	8.71
522823	LP-MILWAKEE6	230	14.13	527655	RSVLT_CC_E 7	345	13.21	587970	GEN-2016-175	345	5.18
522870	LP-HOLLY 6	230	17.67	527656	CROSSROADS 7	345	16.63	588000	GEN-2016-123	345	16.00
523095	HITCHLAND 6	230	15.12	527799	EDDY_NORTH 6	230	8.42	588430	GEN-2016-169	345	9.13
523097	HITCHLAND 7	345	16.04	527802	EDDY_CNTY 7	345	5.04	590001	OKLEHV24	138	4.79
523101	NOBLE_WND 7	345	15.97	527894	HOBBS_INT 6	230	16.22	590003	OKLEHV14	138	4.80
523112	NOVUS1 7	345	15.74	527896	HOBBS_INT 7	345	9.39	599891	OKLAUN 7	345	4.04
523215	FREWHELCOL17	345	9.47	527965	KIOWA 7	345	5.76				

Table 4-25
Short Circuit Analysis for Study Project GEN-2016-121 (26SP)

Study Generator GEN-2016-121											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
525832	TUCO_INT 7	345	26.28	528000	INTREPIDWST3	115	10.50	528223	CHINA_DRAW 7	345	3.69
526935	YOAKUM 6	230	17.72	528009	WIPP 3	115	6.54	528226	HOPI_SUB 3	115	6.65
526936	YOAKUM_345	345	9.40	528016	SAND_DUNES 3	115	6.09	528228	WOOD_DRAW 3	115	4.69
527865	CUNNIGHM_N 6	230	14.33	528018	RED_BLUFF 3	115	6.64	528230	AGAVE_RHILL3	115	8.33
527867	CUNNIGHM_S 6	230	14.33	528020	BOPCO_PKRLK3	115	5.02	528232	OCHOA 3	115	8.21
527891	HOBBS_INT 3	115	29.35	528022	MISSCHEM#2 2	69	6.69	528235	WOLFCAMP_TP3	115	5.15
527894	HOBBS_INT 6	230	16.22	528025	RDRUNNER 3	115	8.60	528236	WOLFCAMP 3	115	4.98
527896	HOBBS_INT 7	345	9.39	528027	RDRUNNER 7	345	3.84	528239	PNDEROSATP 3	115	6.61
527929	PCA 2	69	6.19	528035	IMC_#1_TP 3	115	8.99	528240	PONDEROSA 3	115	4.50
527930	PCA 3	115	10.94	528040	BATTLE_AXE 3	115	2.82	528394	QUAHADA 3	115	7.97
527948	CV-LUSK_TP 3	115	4.14	528145	NATPOT_TP 2	69	8.68	528519	WARD 3	115	5.44
527953	LIVSTNRIDGE3	115	7.11	528151	FIESTA 3	115	9.63	528540	WHITTEN 3	115	6.81
527955	SAGE_BRUSH 3	115	5.07	528159	CARLSBAD 2	69	4.86	528547	S_JAL 3	115	6.21
527961	POTASH_JCT 2	69	8.72	528160	CARLSBAD 3	115	11.07	528604	ANDREWS 6	345	6.51
527962	POTASH_JCT 3	115	14.42	528178	PECOS 3	115	11.69	528610	GAINES_GEN 6	230	9.14
527963	POTASH_JCT 6	230	7.04	528179	PECOS 6	230	6.43	528611	GAINESGENTP6	345	7.17
527965	KIOWA 7	345	5.76	528182	NORTH_LOVNG3	115	8.48	560059	G1579&G1580T	230	8.93
527980	DUVAL_#1 2	69	5.74	528185	N_LOVING 7	345	4.54	587990	GEN-2016-121	115	8.18
527996	KERMAC 2	69	2.95	528192	SOUTH_LOVNG3	115	6.53	588430	GEN-2016-169	345	9.13
527999	INTREPDW_TP3	115	12.23	528222	CHINA_DRAW 3	115	7.42				

Table 4-26
Short Circuit Analysis for Study Project GEN-2016-123, GEN-2016-124, and GEN-2016-125 (26SP)

Study Generator GEN-2016-123, GEN-2016-124, GEN-2016-125											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
511456	O.K.U.-7	345	5.59	525212	SWISHER 3	115	11.86	527867	CUNNIGHM_S 6	230	14.33
511467	L.E.S.-4	138	24.72	525213	SWISHER 6	230	11.15	527894	HOBBS_INT 6	230	16.22
511468	L.E.S.-7	345	13.34	525460	NEWHART 3	115	16.84	527896	HOBBS_INT 7	345	9.39
511553	CHISHOLM7	345	12.97	525461	NEWHART 6	230	11.40	527962	POTASH_JCT 3	115	14.42
511557	CHISHOLM6	230	11.85	525480	PLANT_X 3	115	14.77	527963	POTASH_JCT 6	230	7.04
511565	OKLAUN HVDC7	345	5.57	525481	PLANT_X 6	230	23.72	528070	CV-AZMESA 3	115	7.42
511568	TERRYRD7	345	9.98	525524	TOLK_EAST 6	230	32.04	528093	7-RIVERS 2	69	2.40
515045	SEMINOL7	345	32.78	525531	TOLK_WEST 6	230	32.04	528094	7-RIVERS 3	115	8.29
515375	WWRDEHV7	345	20.00	525543	TOLK_TAP 6	230	32.04	528095	7-RIVERS 6	230	6.17
515376	WWRDEHV4	138	23.10	525549	TOLK 7	345	18.06	528109	CV-LAKEWOOD3	115	6.43
515407	TATONGA7	345	16.02	525636	LAMB_CNTY 3	115	9.25	528132	OCOTILLO 3	115	6.13
515458	BORDER 7	345	12.63	525637	LAMB_CNTY 6	230	5.57	528137	N_CANAL 3	115	8.59
515554	BVRCNTY7	345	14.54	525828	TUCO_INT 3	115	21.65	528160	CARLSBAD 3	115	11.07
515599	G07621119-20	345	13.27	525830	TUCO_INT 6	230	32.78	528178	PECOS 3	115	11.69
523093	HITCHLAND 3	115	17.94	525832	TUCO_INT 7	345	26.28	528179	PECOS 6	230	6.43
523095	HITCHLAND 6	230	15.12	525840	ANTELOPE_1 6	230	32.38	528226	HOPI_SUB 3	115	6.65
523097	HITCHLAND 7	345	16.04	525850	ELK_CT1	345	25.73	539801	THISTLE7	345	16.31
523101	NOBLE_WND 7	345	15.97	525957	HALE_WNDCL16	230	10.20	560010	G14-037-TAP	345	15.70
523103	NOBLE_WND 3	115	10.78	526161	CARLISLE 6	230	14.65	560021	CRAWFISH_DR2	230	29.19
523111	NOVUS1 3	115	19.72	526337	JONES 6	230	22.23	560022	CRAWFISH_DR	345	27.21
523112	NOVUS1 7	345	15.74	526435	SUNDOWN 6	230	11.26	560035	GRAPEVINE	345	6.50
523155	OCHILTREE 6	230	4.23	526935	YOAKUM 6	230	17.72	560050	G15-031-TAP	230	9.43
523215	FREWHELCOL17	345	9.47	526936	YOAKUM_345	345	9.40	560051	G15-039-TAP	230	7.45
523221	XIT_INTG 6	230	3.23	527455	RSWL_SLRCOL3	115	6.93	560071	G16-003-TAP	345	15.13
523267	PRINGLE 6	230	4.25	527470	CHVS_SLRCOL3	115	6.63	560078	G16-037-TAP	345	9.83
523308	MOORE_E 3	115	11.76	527482	CHAVES_CNTY3	115	7.00	560100	CRAWFISH765	765	11.42
523309	MOORE_CNTY 6	230	6.94	527483	CHAVES_CNTY6	230	4.42	560101	SEMINOLE765	765	11.67
523821	WALKEMEYER 3	115	10.41	527501	URTON 3	115	5.81	560102	CROSSRDS765	765	7.65
523823	WALKEMEYER 7	345	8.33	527509	PRICE_TAP 3	115	5.36	560103	CRAW_TAP	765	9.32
523853	FINNEY 7	345	10.36	527546	SAMSON 3	115	5.47	562480	G13-027-TAP	230	9.54
523869	CHAN+TASCOS6	230	4.34	527564	ROSWLL_INT 3	115	5.73	576395	GEN-2010-014	345	11.64
523959	POTTER_CO 6	230	21.82	527597	TWEEDY 3	115	5.27	576396	G10-014-XFMR	115	13.46
523961	POTTER_CO 7	345	11.46	527654	RSVLT_CC_W 7	345	10.77	583090	G1149&G1504	345	9.90
523977	HARRNG_WST 6	230	25.75	527655	RSVLT_CC_E 7	345	13.21	583840	GEN-2013-027	230	9.04
523978	HARRNG_MID 6	230	25.75	527656	CROSSROADS 7	345	16.63	583960	G14034G14035	115	6.59
523979	HARRNG_EST 6	230	25.75	527707	ARTESIA 3	115	6.82	584210	GEN-2014-037	345	11.19
524007	ROLLHILLS 3	115	18.45	527710	EAGLE_CREEK2	69	2.32	584940	GEN-2015-056	345	11.70
524010	ROLLHILLS 6	230	19.59	527711	EAGLE_CREEK3	115	7.42	585060	GEN-2015-068	345	17.26
524266	BUSHLAND 3	115	9.31	527715	NAVAJO_2TP 3	115	7.07	585080	GEN-2015-071	345	10.72
524267	BUSHLAND 6	230	9.73	527736	NAVAJO_5TP 3	115	7.03	587470	GEN-2016-069	115	6.76
524290	WILDOR2_JUS6	230	6.64	527786	ATOKA 3	115	7.13	587744	G16-091-TAP	345	15.06
524296	SPNSPUR_WND7	345	5.54	527793	EDDY_STH 3	115	11.46	587960	GEN-2016-120	345	6.46
524623	DEAFSMITH 6	230	7.70	527798	EDDY_NTH 3	115	11.46	587964	G16-120-TAP	345	8.71
524770	PLSNT_HILL 6	230	6.27	527799	EDDY_NORTH 6	230	8.42	587970	GEN-2016-175	345	5.18
524875	OASIS 6	230	7.54	527802	EDDY_CNTY 7	345	5.04	588000	GEN-2016-123	345	16.00
524885	SN_JUAN_TAP6	230	4.81	527809	CV-8_MILE 3	115	5.37	590001	OKLEHV24	138	4.79
524889	SN_JUAN_WND6	230	4.60	527821	CV-DAYTON +3	115	7.04	590003	OKLEHV14	138	4.80
524908	ROOSEVELT 3	115	10.46	527822	CV-TURKYTRK3	115	3.43	599891	OKLAUN 7	345	4.04
524909	ROSEVELT_N 6	230	9.13	527864	CUNNINHAM 3	115	25.90	599955	PNM-DC6	230	9.13
524911	ROSEVELT_S 6	230	9.13	527865	CUNNIGHM_N 6	230	14.33	599960	EPTNP-D6	230	8.42
524915	SW_4K33 6	230	9.13								

Table 4-27
Short Circuit Analysis for Study Project GEN-2016-169 (26SP)

Study Generator GEN-2016-169											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
511456	O.K.U.-7	345	5.59	527276	SEMINOLE 6	230	7.25	528232	OCHOA 3	115	8.21
511468	L.E.S.-7	345	13.34	527284	RUSSELL 3	115	8.98	528235	WOLFCAMP_TP3	115	5.15
511553	CHISHOLM7	345	12.97	527286	XTO_RUSSEL 3	115	9.92	528246	YESO_HILLS 3	115	2.70
511565	OKLAUN HVDC7	345	5.57	527362	JOHNSON_DRW3	115	10.41	528317	ENRON_TP 3	115	6.70
515375	WWRDEHV7	345	20.00	527363	HIGG 3	115	10.08	528325	LE-WAITS 3	115	6.68
515458	BORDER 7	345	12.63	527483	CHAVES_CNTY6	230	4.42	528333	LE-WEST_SUB3	115	8.30
522823	LP-MILWAKEE6	230	14.13	527656	CROSSROADS 7	345	16.63	528334	LE-NRTH_INT3	115	8.22
522870	LP-HOLLY 6	230	17.67	527793	EDDY_STH 3	115	11.46	528348	BUCKEYE_TP 3	115	8.08
523961	POTTER_CO 7	345	11.46	527798	EDDY_NTH 3	115	11.46	528353	MADDOXG23 3	115	24.85
524909	ROSEVELT_N 6	230	9.13	527799	EDDY_NORTH 6	230	8.42	528355	MADDOX 3	115	24.85
524911	ROSEVELT_S 6	230	9.13	527802	EDDY_CNTY 7	345	5.04	528385	BUCKEYE 3	115	7.28
525213	SWISHER 6	230	11.15	527864	CUNNINHAM 3	115	25.90	528392	PEARLE 3	115	6.24
525454	HALE_CNTY 3	115	10.11	527865	CUNNIGHM_N 6	230	14.33	528394	QUAHADA 3	115	7.97
525481	PLANT_X 6	230	23.72	527867	CUNNIGHM_S 6	230	14.33	528399	LEA_NATIONL3	115	6.74
525524	TOLK_EAST 6	230	32.04	527891	HOBBS_INT 3	115	29.35	528413	TAYLOR 3	115	14.02
525531	TOLK_WEST 6	230	32.04	527894	HOBBS_INT 6	230	16.22	528422	DCP_ZIA TP 3	115	6.92
525543	TOLK_TAP 6	230	32.04	527896	HOBBS_INT 7	345	9.39	528433	BENSING 3	115	7.89
525549	TOLK 7	345	18.06	527929	PCA 2	69	6.19	528435	MILLEN 3	115	11.26
525637	LAMB_CNTY 6	230	5.57	527930	PCA 3	115	10.94	528442	NE_HOBBS 3	115	11.55
525780	FLOYD_CNTY 3	115	6.11	527935	CV-SKELLY 3	115	3.20	528463	SANGER_SW 3	115	15.29
525816	TUCO_INT2 2	69	4.72	527943	CV-LUSK 2	69	2.24	528484	SW_4J44 3	115	11.04
525826	TUCO_INT 2	69	8.06	527947	CV-LUSK 3	115	3.43	528491	MONUMENT 3	115	14.91
525828	TUCO_INT 3	115	21.65	527948	CV-LUSK_TP 3	115	4.14	528498	W_HOBBS 3	115	11.61
525830	TUCO_INT 6	230	32.78	527953	LIVSTNRIDGE3	115	7.11	528568	MONUMNT_TP 3	115	9.90
525832	TUCO_INT 7	345	26.28	527961	POTASH_JCT 2	69	8.72	528575	OXYPERMIAN 3	115	14.70
525840	ANTELOPE_1 6	230	32.38	527962	POTASH_JCT 3	115	14.42	528582	BYRD 3	115	7.72
525850	ELK_CT1	345	25.73	527963	POTASH_JCT 6	230	7.04	528589	DRINKARD 3	115	8.44
525957	HALE_WNDCL16	230	10.20	527965	KIOWA 7	345	5.76	528602	ANDREWS 3	115	12.59
526076	STANTON_W 3	115	9.36	527980	DUVAL_#1 2	69	5.74	528603	NA_ENRICH 3	115	11.88
526160	CARLISLE 3	115	13.74	527989	NMPOTASH 2	69	2.54	528604	ANDREWS 6	345	6.51
526161	CARLISLE 6	230	14.65	527996	KERMAC 2	69	2.95	528605	TARGA 3	115	9.17
526269	LUBBCK_STH 6	230	20.08	527999	INTREPDW_TP3	115	12.23	528610	GAINES_GEN 6	230	9.14
526298	LUBBCK_EST 3	115	15.85	528000	INTREPIDWST3	115	10.50	528611	GAINESGENTP6	345	7.17
526299	LUBBCK_EST 6	230	13.96	528016	SAND_DUNES 3	115	6.09	528618	LE-LOVINTON2	69	7.07
526337	JONES 6	230	22.23	528018	RED_BLUFF 3	115	6.64	528626	LE-PLNSINT 2	69	4.39
526434	SUNDOWN 3	115	11.10	528022	MISSCHEM#2 2	69	6.69	528627	LE-TXACO_TP3	115	6.97
526435	SUNDOWN 6	230	11.26	528025	RDRUNNER 3	115	8.60	560021	CRAWFISH_DR2	230	29.19
526460	AMOCO_SS 6	230	9.85	528027	RDRUNNER 7	345	3.84	560022	CRAWFISH_DR	345	27.21
526525	WOLFFORTH 6	230	14.26	528029	IMC_#2 2	69	4.24	560059	G1579&G1580T	230	8.93
526677	GRASSLAND 6	230	6.69	528035	IMC_#1_TP 3	115	8.99	560100	CRAWFISH765	765	11.42
526736	TERRY_CNTY 3	115	10.42	528037	IMC_#1 3	115	8.08	560102	CROSSRDS765	765	7.65
526784	AMOCOWASSON6	230	13.90	528040	BATTLE_AXE 3	115	2.82	560103	CRAW_TAP	765	9.32
526792	PRENTICE 3	115	5.90	528070	CV-AZMESA 3	115	7.42	562480	G13-027-TAP	230	9.54
526928	PLAINS_INT 3	115	9.80	528095	7-RIVERS 6	230	6.17	583090	G1149&G1504	345	9.90
526934	YOAKUM 3	115	16.73	528132	OCOTILLO 3	115	6.13	583840	GEN-2013-027	230	9.04
526935	YOAKUM 6	230	17.72	528137	N_CANAL 3	115	8.59	584810	GEN-2015-040	230	14.30
526936	YOAKUM_345	345	9.40	528145	NATPOT_TP 2	69	8.68	585060	GEN-2015-068	345	17.26
526944	LG-PLAINS 3	115	7.83	528151	FIESTA 3	115	9.63	585150	GEN-2015-078	115	16.40
527009	BRU_SUB 6	230	14.01	528159	CARLSBAD 2	69	4.86	585160	G1579&G1580	230	8.49
527010	OXYBRU 6	230	13.89	528160	CARLSBAD 3	115	11.07	587110	GEN-2016-015	345	6.22
527018	BENNETT 3	115	13.10	528178	PECOS 3	115	11.69	587370	GEN-2016-056	230	6.66
527041	ARCO_TP 3	115	13.00	528179	PECOS 6	230	6.43	587420	GEN-2016-062	345	5.09
527047	OXY_WILRD1 3	115	10.46	528182	NORTH_LOVNG3	115	8.48	587670	GEN-2015-099	115	16.24
527062	SHELL_CO2 3	115	15.80	528185	N_LOVING 7	345	4.54	587960	GEN-2016-120	345	6.46
527130	DENVER_N 3	115	20.74	528190	S_LOVING_TP2	69	2.99	587964	G16-120-TAP	345	8.71
527136	DENVER_S 3	115	20.74	528192	SOUTH_LOVNG3	115	6.53	587970	GEN-2016-175	345	5.18
527146	MUSTANG 3	115	22.31	528222	CHINA_DRAW 3	115	7.42	587990	GEN-2016-121	115	8.18
527149	MUSTANG 6	230	15.65	528223	CHINA_DRAW 7	345	3.69	588350	GEN-2016-171	230	8.71
527151	GS-MUSTANG 6	230	15.65	528226	HOPI_SUB 3	115	6.65	588430	GEN-2016-169	345	9.13
527194	LG-PLSHILL 3	115	7.52	528228	WOOD_DRAW 3	115	4.69	599891	OKLAUN 7	345	4.04
527202	SEAGRAVES 3	115	8.52	528230	AGAVE_RHILL3	115	8.33	599960	EPTNP-D6	230	8.42
527275	SEMINOLE 3	115	11.39								

Table 4-28
Short Circuit Analysis for Study Project GEN-2016-171 (26SP)

Study Generator GEN-2016-171											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
511456	O.K.U.-7	345	5.59	527051	ODC_TP 3	115	13.11	528317	ENRON_TP 3	115	6.70
515458	BORDER 7	345	12.63	527062	SHELL_CO2 3	115	15.80	528325	LE-WAITS 3	115	6.68
524908	ROOSEVELT 3	115	10.46	527080	EL_PASO 3	115	15.57	528333	LE-WEST_SUB3	115	8.30
524909	ROSEVELT_N 6	230	9.13	527105	SAN_ANDS_TP3	115	16.40	528334	LE-NRTH_INT3	115	8.22
524911	ROSEVELT_S 6	230	9.13	527125	DENVER_CTY 2	69	8.62	528348	BUCKEYE_TP 3	115	8.08
524915	SW_4K33 6	230	9.13	527130	DENVER_N 3	115	20.74	528353	MADDOXG23 3	115	24.85
525461	NEWHART 6	230	11.40	527136	DENVER_S 3	115	20.74	528355	MADDOX 3	115	24.85
525480	PLANT_X 3	115	14.77	527146	MUSTANG 3	115	22.31	528385	BUCKEYE 3	115	7.28
525481	PLANT_X 6	230	23.72	527149	MUSTANG 6	230	15.65	528392	PEARLE 3	115	6.24
525524	TOLK_EAST 6	230	32.04	527151	GS-MUSTANG 6	230	15.65	528394	QUAHADA 3	115	7.97
525531	TOLK_WEST 6	230	32.04	527194	LG-PLSHILL 3	115	7.52	528399	LEA_NATIONL3	115	6.74
525543	TOLK_TAP 6	230	32.04	527201	SEAGRAVES 2	69	5.40	528413	TAYLOR 3	115	14.02
525549	TOLK 7	345	18.06	527202	SEAGRAVES 3	115	8.52	528422	DCP_ZIA TP 3	115	6.92
525636	LAMB_CNTY 3	115	9.25	527238	ROZ 3	115	9.25	528433	BENSING 3	115	7.89
525637	LAMB_CNTY 6	230	5.57	527242	AMERADA 3	115	9.35	528435	MILLEN 3	115	11.26
525828	TUCO_INT 3	115	21.65	527262	SULPHUR 3	115	5.66	528442	NE_HOBBS 3	115	11.55
525830	TUCO_INT 6	230	32.78	527275	SEMINOLE 3	115	11.39	528463	SANGER_SW 3	115	15.29
525832	TUCO_INT 7	345	26.28	527276	SEMINOLE 6	230	7.25	528484	SW_4J44 3	115	11.04
525840	ANTELOPE_1 6	230	32.38	527284	RUSSELL 3	115	8.98	528491	MONUMENT 3	115	14.91
525850	ELK_CT1	345	25.73	527286	XTO_RUSSEL 3	115	9.92	528498	W_HOBBS 3	115	11.61
525957	HALE_WNDCL16	230	10.20	527322	GAINES 3	115	8.50	528568	MONUMNT_TP 3	115	9.90
526036	LC-OPDYKE 3	115	5.82	527340	DOSS 3	115	7.13	528575	OXYPERMIAN 3	115	14.70
526161	CARLISLE 6	230	14.65	527362	JOHNSON_DRW3	115	10.41	528582	BYRD 3	115	7.72
526269	LUBBCK_STH 6	230	20.08	527363	HIGG 3	115	10.08	528602	ANDREWS 3	115	12.59
526337	JONES 6	230	22.23	527483	CHAVES_CNTY6	230	4.42	528604	ANDREWS 6	345	6.51
526350	LEHMAN_TP 3	115	5.86	527793	EDDY_STH 3	115	11.46	528610	GAINES_GEN 6	230	9.14
526424	PACIFIC 3	115	9.45	527798	EDDY_NTH 3	115	11.46	528611	GAINESGENTP6	345	7.17
526434	SUNDOWN 3	115	11.10	527799	EDDY_NORTH 6	230	8.42	528618	LE-LOVINTON2	69	7.07
526435	SUNDOWN 6	230	11.26	527802	EDDY_CNTY 7	345	5.04	528626	LE-PLNSINT 2	69	4.39
526445	AMOCO_TP 3	115	10.38	527864	CUNNINHAM 3	115	25.90	528627	LE-TXACO_TP3	115	6.97
526460	AMOCO_SS 6	230	9.85	527865	CUNNIGHM_N 6	230	14.33	528740	LE-PLANS_TP2	69	3.65
526491	LG-CLAUENE 3	115	7.95	527867	CUNNIGHM_S 6	230	14.33	560021	CRAWFISH_DR2	230	29.19
526524	WOLFFORTH 3	115	11.79	527891	HOBBS_INT 3	115	29.35	560022	CRAWFISH_DR	345	27.21
526525	WOLFFORTH 6	230	14.26	527894	HOBBS_INT 6	230	16.22	560051	G15-039-TAP	230	7.45
526735	TERRY_CNTY 2	69	6.97	527896	HOBBS_INT 7	345	9.39	560059	G1579&G1580T	230	8.93
526736	TERRY_CNTY 3	115	10.42	527930	PCA 3	115	10.94	560100	CRAWFISH765	765	11.42
526784	AMOCOWASSON6	230	13.90	527961	POTASH_JCT 2	69	8.72	562480	G13-027-TAP	230	9.54
526792	PRENTICE 3	115	5.90	527962	POTASH_JCT 3	115	14.42	583840	GEN-2013-027	230	9.04
526928	PLAINS_INT 3	115	9.80	527963	POTASH_JCT 6	230	7.04	584810	GEN-2015-040	230	14.30
526934	YOAKUM 3	115	16.73	527965	KIOWA 7	345	5.76	585060	GEN-2015-068	345	17.26
526935	YOAKUM 6	230	17.72	527999	INTREPDW_TP3	115	12.23	585150	GEN-2015-078	115	16.40
526936	YOAKUM_345	345	9.40	528025	RDRUNNER 3	115	8.60	585160	G1579&G1580	230	8.49
526944	LG-PLAINS 3	115	7.83	528027	RDRUNNER 7	345	3.84	587110	GEN-2016-015	345	6.22
527009	BRU_SUB 6	230	14.01	528095	7-RIVERS 6	230	6.17	587420	GEN-2016-062	345	5.09
527010	OXYBRU 6	230	13.89	528160	CARLSBAD 3	115	11.07	587670	GEN-2015-099	115	16.24
527018	BENNETT 3	115	13.10	528179	PECOS 6	230	6.43	587964	G16-120-TAP	345	8.71
527036	SHELL_C2 3	115	12.85	528182	NORTH_LOVNG3	115	8.48	588350	GEN-2016-171	230	8.71
527041	ARCO_TP 3	115	13.00	528185	N_LOVING 7	345	4.54	588430	GEN-2016-169	345	9.13
527047	OXY_WILRD1 3	115	10.46	528223	CHINA_DRAW 7	345	3.69	599960	EPTNP-D6	230	8.42

Table 4-29
Short Circuit Analysis for Study Project GEN-2016-172 (26SP)

Study Generator GEN-2016-172											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
511456	O.K.U.-7	345	5.59	524714	CASTRO_TP 2	69	3.52	525524	TOLK_EAST 6	230	32.04
511553	CHISHOLM7	345	12.97	524721	DS-#15&#19+2	69	3.54	525531	TOLK_WEST 6	230	32.04
515458	BORDER 7	345	12.63	524728	DS-CASTRO 2	69	4.26	525543	TOLK_TAP 6	230	32.04
522800	MU-TULIA 3	115	5.25	524734	DS-#21 3	115	9.18	525549	TOLK 7	345	18.06
523093	HITCHLAND 3	115	17.94	524745	CASTRO_CNTY2	69	8.73	525614	W_LITLFLDTP3	115	7.63
523095	HITCHLAND 6	230	15.12	524746	CASTRO_CNTY3	115	9.68	525615	W_LITTLFLD 3	115	7.25
523097	HITCHLAND 7	345	16.04	524757	BETHEL_COL13	115	8.09	525636	LAMB_CNTY 3	115	9.25
523101	NOBLE_WND 7	345	15.97	524770	PLSNT_HILL 6	230	6.27	525637	LAMB_CNTY 6	230	5.57
523112	NOVUS1 7	345	15.74	524908	ROOSEVELT 3	115	10.46	525731	SP-ABERNTHY2	69	3.04
523155	OCHILTREE 6	230	4.23	524909	ROSEVELT_N 6	230	9.13	525738	HALECENTER 2	69	2.48
523177	RB-SPURLCK+3	115	5.86	524911	ROSEVELT_S 6	230	9.13	525745	LH-HALECTR 2	69	2.45
523215	FREWHELCOL17	345	9.47	524915	SW_4K33 6	230	9.13	525779	FLOYD_CNTY 2	69	5.35
523216	RB-HOGUE 3	115	4.12	525018	EMULESH&VLY3	115	5.70	525780	FLOYD_CNTY 3	115	6.11
523220	XIT_INTG 3	115	6.08	525019	EMU&VLY_TP 3	115	6.13	525816	TUCO_INT2 2	69	4.72
523221	XIT_INTG 6	230	3.23	525028	BAILEYCO 3	115	6.13	525826	TUCO_INT 2	69	8.06
523256	ETTER 3	115	5.63	525050	BC-KELLEY +3	115	7.46	525828	TUCO_INT 3	115	21.65
523266	PRINGLE 3	115	10.57	525056	BC-EARTH 3	115	7.76	525830	TUCO_INT 6	230	32.78
523267	PRINGLE 6	230	4.25	525116	DS-#12 2	69	2.37	525832	TUCO_INT 7	345	26.28
523277	VALERO 3	115	10.63	525119	BC-SUNYSIDE2	69	1.32	525840	ANTELOPE_1 6	230	32.38
523304	MOORE_W 3	115	11.76	525124	HART_INDUST3	115	7.74	525853	LH-WIL&ELN+2	69	2.60
523308	MOORE_E 3	115	11.76	525129	LC-HART 2	69	2.56	525885	SP-NEWDEAL 2	69	3.34
523309	MOORE_CNTY 6	230	6.94	525132	LC-N_OLTON 2	69	3.07	525926	CROSBY 3	115	4.54
523823	WALKEMEYER 7	345	8.33	525143	HAPPY_CTYTP2	69	4.03	525957	HALE_WNDCL16	230	10.20
523869	CHAN+TASCOS6	230	4.34	525153	HAPPY_INT 2	69	4.46	526036	LC-OPDYKE 3	115	5.82
523959	POTTER_CO 6	230	21.82	525154	HAPPY_INT 3	115	5.49	526076	STANTON_W 3	115	9.36
523961	POTTER_CO 7	345	11.46	525179	TULIA_TP 3	115	6.54	526146	INDIANA 3	115	9.78
523977	HARRNG_WST 6	230	25.75	525191	KRESS_INT 2	69	4.53	526161	CARLISLE 6	230	14.65
523978	HARRNG_MID 6	230	25.75	525192	KRESS_INT 3	115	12.29	526268	LUBBCK_STH 3	115	20.03
523979	HARRNG_EST 6	230	25.75	525203	SW-KRESS 2	69	4.53	526269	LUBBCK_STH 6	230	20.08
524007	ROLLHILLS 3	115	18.45	525212	SWISHER 3	115	11.86	526297	LUBBCK_EST 2	69	8.14
524009	CHERRY 3	115	17.68	525213	SWISHER 6	230	11.15	526298	LUBBCK_EST 3	115	15.85
524010	ROLLHILLS 6	230	19.59	525224	KRESS_RURL 2	69	2.54	526299	LUBBCK_EST 6	230	13.96
524043	NICHOLS 3	115	25.74	525225	KRESS_RURAL3	115	6.49	526337	JONES 6	230	22.23
524044	NICHOLS 6	230	24.89	525249	LH-PLW&FNY+2	69	1.61	526424	PACIFIC 3	115	9.45
524106	NORTHWEST 3	115	11.02	525256	SW_9748 2	69	3.10	526434	SUNDOWN 3	115	11.10
524136	HASTINGS 3	115	13.29	525257	N_PLAINVEW 3	115	5.19	526435	SUNDOWN 6	230	11.26
524163	EAST_PLANT 6	230	13.49	525271	KISER 2	69	3.48	526445	AMOCO_TP 3	115	10.38
524266	BUSHLAND 3	115	9.31	525272	KISER 3	115	5.19	526460	AMOCO_SS 6	230	9.85
524267	BUSHLAND 6	230	9.73	525284	WESTRIDGE 2	69	4.26	526524	WOLFFORTH 3	115	11.79
524276	WILDOR_WND 6	230	4.97	525291	PLAINVW_TP 2	69	6.48	526525	WOLFFORTH 6	230	14.26
524290	WILDOR2_JUS6	230	6.64	525298	S_PLAINVEW 2	69	2.58	526935	YOAKUM 6	230	17.72
524296	SPNSPUR_WND7	345	5.54	525307	E_PLAINVEW 2	69	2.45	527656	CROSSROADS 7	345	16.63
524300	HILLSIDE 3	115	12.37	525316	LH-PROVDNCE2	69	3.38	560010	G14-037-TAP	345	15.70
524364	RANDALL 3	115	20.74	525325	COX 2	69	3.38	560021	CRAWFISH_DR2	230	29.19
524365	RANDALL 6	230	14.19	525326	COX 3	115	5.97	560022	CRAWFISH_DR	345	27.21
524414	AMA_SOUTH 3	115	16.32	525339	AIKEN_RURL 2	69	2.45	560035	GRAPEVINE	345	6.50
524415	AMA_SOUTH 6	230	13.35	525393	ROCKYFORD 3	115	8.17	560050	G15-031-TAP	230	9.43
524530	PALO_DURO 3	115	6.74	525397	OLTON 2	69	4.16	560051	G15-039-TAP	230	7.45
524556	LAPLATA 3	115	6.05	525404	LC-OLTON 2	69	4.46	560100	CRAWFISH765	765	11.42
524567	NE_HEREFORD3	115	9.53	525413	LAMTON 2	69	5.14	562004	G11-025-TAP	115	4.65
524573	NE_HEREFORD2	69	6.71	525414	LAMTON 3	115	7.50	562480	G13-027-TAP	230	9.54
524590	DAWN 3	115	6.23	525425	CORNER 2	69	3.63	576395	GEN-2010-014	345	11.64
524597	PANDAHFD 3	115	8.87	525432	SP-HALFWAY+2	69	5.86	583840	GEN-2013-027	230	9.04
524604	HEREFRD_SB 2	69	4.42	525440	LC-S_OLTON+3	115	6.93	584640	GEN-2015-022	115	11.86
524605	HEREFRD_NB 2	69	4.42	525446	RKYFORD_TP 3	115	9.04	584750	GEN-2015-031	230	7.98
524606	HEREFORD 3	115	10.67	525453	HALE_CNTY 2	69	6.90	584800	GEN-2015-039	230	6.32
524622	DEAFSMITH 3	115	11.90	525454	HALE_CNTY 3	115	10.11	587250	GEN-2016-039	115	11.86
524623	DEAFSMITH 6	230	7.70	525460	NEWHART 3	115	16.84	587570	ASGI1604	115	6.74
524629	DS-#6 3	115	6.16	525461	NEWHART 6	230	11.40	587964	G16-120-TAP	345	8.71
524681	DIMMIT_E&S 2	69	2.79	525480	PLANT_X 3	115	14.77	588440	GEN-2016-172	115	14.18
524688	DS-#3 2	69	2.95	525481	PLANT_X 6	230	23.72	599955	PNM-DC6	230	9.13
524694	DS-#22 3	115	4.56								

Table 4-30
Short Circuit Analysis for Study Project GEN-2016-177 (26SP)

Study Generator GEN-2016-177											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
526736	TERRY_CNTY 3	115	10.42	527130	DENVER_N 3	115	20.74	528638	LE-SAUNDRTP2	69	3.55
527021	CORTEZ 3	115	6.39	527136	DENVER_S 3	115	20.74	528667	LE-MHOON 2	69	4.36
527022	APACHE_ROB 3	115	7.21	527146	MUSTANG 3	115	22.31	528675	LE-FAMARISS2	69	3.31
527024	ALLRED_SUB 3	115	7.91	527149	MUSTANG 6	230	15.65	528679	LE-TATUM_SW2	69	4.87
527030	ALRDCRTZ_TP3	115	8.70	527183	JAYBEE 2	69	4.36	528699	LE-GRAY 2	69	4.13
527036	SHELL_C2 3	115	12.85	527202	SEAGRAVES 3	115	8.52	528703	LE-DENTN_TP2	69	3.89
527062	SHELL_CO2 3	115	15.80	527275	SEMINOLE 3	115	11.39	528709	LE-FTS_COND2	69	2.91
527068	SHELLC3_TP 3	115	10.63	527286	XTO_RUSSEL 3	115	9.92	528711	LE-TP89 2	69	1.91
527074	SHELLC3 3	115	9.57	527313	MIDAMERI_TP2	69	2.15	528714	LE-FORT_SW 2	69	3.10
527080	EL_PASO 3	115	15.57	527891	HOBBS_INT 3	115	29.35	528718	LE-NEWTEX 2	69	1.91
527099	DC_EAST 2	69	6.08	528325	LE-WAITS 3	115	6.68	528759	LE-TP51 2	69	2.19
527105	SAN_ANDS_TP3	115	16.40	528333	LE-WEST_SUB3	115	8.30	528780	LE-NITROTEC2	69	1.93
527106	SAN_ANDRES 3	115	11.69	528334	LE-NRTH_INT3	115	8.22	585150	GEN-2015-078	115	16.40
527111	WASSON 2	69	5.95	528617	LE-WAITS 2	69	3.28	588460	A16-008SUB	115	9.20
527125	DENVER_CTY 2	69	8.62	528618	LE-LOVINTON2	69	7.07	588462	A16-008TP	115	9.20

SECTION 5: CONCLUSIONS

Summary of Stability Analysis

The Stability Analysis determined that there were multiple contingencies across all seasons that resulted in system/voltage instability, generation tripping offline, and poor post-fault voltage recovery when all generation interconnection requests were at 100% output.

To mitigate the system/voltage instability, voltage violations, generation tripping offline, and poor post-fault steady-state voltages, the following upgrades were provided by SPP and implemented (upgrades provided here are required for 17W season and thus, implemented in remaining years):

- Crawfish Draw SVC +600 MVAR
    - For this study, the SVC size was determined at the POI. Actual SVC size may differ at the 13.8 kV bus.
- Crawfish Draw 345/230 kV transformer #2
- Crawfish Draw to Crossroads 765 kV circuit #1
- Crawfish Draw to midpoint station to Seminole 765 kV circuit #1 and #2
- Crossroads 765/345 kV transformer #1 and #2
- Crawfish Draw 765/345 kV transformer #1 and #2
- Seminole 765/345 kV transformer #1 and #2
- Hobbs to Yoakum to Tuco 345 kV circuit #1 (advancement in 17W and 18S)
- Yoakum 345/230 kV transformer #1 (advancement in 17W and 18S)
- Tolk 345/230 kV transformer #3

FLT252-PO, a prior outage of Crossroads to Tolk 345 kV line followed by a three-phase fault resulting in the loss of Crossroads to Crawfish Draw 765 kV line (line identified as mitigation), was observed to have system instability after implemented the mitigation identified above. For this prior outage, the following generation curtailment was required:

- 17W: curtail study generation by 950 MW
- 18S: curtail study generation by 750 MW
- 26S: curtail study generation by 550 MW

In all three seasons, under normal system dispatch, system instability exists for three-phase faults at Crawfish Draw (345 kV and 765 kV) following a prior outage of the Crawfish Draw to Crawfish Draw Tap (new bus) 765 kV line. For this reason, it is necessary to curtail generation and limit line flow along the parallel circuit of the Crawfish Draw to Crawfish Draw Tap 765 kV circuits following the outage of one circuit from Crawfish Draw to Crawfish Draw Tap 765 kV. It was necessary to curtail generation and limit the line flow on the parallel circuit to the following:

- 17W: Reduce from 3090 MW to 1950 MW (curtail all study generation)
- 18S: Reduce from 2645 MW to 1730 MW (curtail study generation by 2200 MW)
- 26S: Reduce from 2140 MW to 1720 MW (curtail study generation by 1000 MW)

FLT341-PO, a prior outage of the Crawfish Draw 765/345 kV transformer circuit #1 followed by a three-phase fault resulting in the loss of the second Crawfish Draw 765/345 kV transformer, was observed to have system instability after implemented the mitigation identified in this study and under normal dispatch. For this prior outage, the following generation curtailment was required:

- 17W: curtail study generation by 700 MW
- 18S: curtail study generation by 400 MW
- 26S: No curtailment

In addition to the above generation curtailment for the prior outage of one of the Crawfish Draw 765/345 kV transformers, line reactors on the Crawfish Draw to Crawfish Draw Tap to Seminole 765 kV double circuit were required to mitigate high overvoltages. The following line reactors were required to be switched in service for each season for this prior outage:

- Crawfish Draw 765 kV line end
  - 17W: 200 Mvar line reactor
  - 18S: 300 Mvar line reactor (increase of 190 Mvar)
  - 26S: 400 Mvar line reactor (increase of 150 Mvar)
- Seminole 765 kV line end
  - 17W: 150 Mvar line reactor
  - 18S: 200 Mvar line reactor (increase of 90 Mvar)
  - 26S: 350 Mvar line reactor (increase of 100 Mvar)

The frequency transient spike that was observed is a known artifact of the PSS/E software because the positive-sequence model does not estimate the actual frequency variations during and immediately following the fault fairly and thus cannot be trusted as a good indication of frequency. For these simulations, the instantaneous frequency protection was changed to incur 1 second of time delay for each of projects listed above. In addition, it is recommended the manufacturer investigates the frequency calculation of the TMEIC inverter.

After implementing the above upgrades, the contingency analysis was re-simulated for all contingencies. With the upgrades, the Stability Analysis determined that there was no wind turbine tripping or system instability observed as a result of interconnecting all study projects at 100% output.

Summary of the Short Circuit Analysis

The short circuit analysis was performed on the 2018 Summer Peak and 2026 Summer Peak power flows for all study projects. Refer to Table 5-1 and Table 5-2 for a list of maximum fault currents observed for each study project for the 18S and 26S cases, respectively.

Table 5-1
2018S: List of Maximum Fault Currents Observed for Each Study Project

Study Project	Fault Current at POI (kA)	Maximum Fault Current (kA)	Fault Location
ASGI-2016-009	11.38	32.78	Tuco 230 kV
GEN-2015-039	7.52	32.78	Tuco 230 kV
GEN-2015-040	15.79	32.78	Tuco 230 kV
GEN-2015-078	22.41	32.78	Tuco 230 kV
GEN-2015-099	25.30	30.30	Hobbs 115 kV
GEN-2016-039	11.97	32.78	Tuco 230 kV
GEN-2016-077	2.50	20.84	Denver N 115 kV
GEN-2016-078	5.03	32.78	Tuco 230 kV
GEN-2016-120	8.72	33.20	Cimaron 345 kV
GEN-2016-121	8.67	30.30	Hobbs 115 kV
GEN-2016-123	16.70	32.83	Seminole 345 kV
GEN-2016-124	16.70	32.83	Seminole 345 kV
GEN-2016-125	16.70	32.83	Seminole 345 kV
GEN-2016-169	9.81	32.78	Tuco 230 kV
GEN-2016-171	9.21	32.78	Tuco 230 kV
GEN-2016-172	17.09	32.78	Tuco 230 kV
GEN-2016-175	8.72	33.20	Cimaron 345 kV
GEN-2016-177	9.23	30.30	Hobbs 115 kV

Table 5-2
2026S: List of Maximum Fault Currents Observed for Each Study Project

Study Project	Fault Current at POI (kA)	Maximum Fault Current (kA)	Fault Location
ASGI-2016-009	11.49	32.78	Tuco 230 kV
GEN-2015-039	7.45	32.78	Tuco 230 kV
GEN-2015-040	15.65	32.78	Tuco 230 kV
GEN-2015-078	22.31	32.78	Tuco 230 kV
GEN-2015-099	24.85	29.35	Hobbs 115 kV
GEN-2016-039	11.86	32.78	Tuco 230 kV
GEN-2016-077	2.50	20.74	Denver N 115 kV
GEN-2016-078	6.13	32.78	Tuco 230 kV
GEN-2016-120	8.71	33.12	Cimaron 345 kV
GEN-2016-121	8.60	29.35	Hobbs 115 kV
GEN-2016-123	16.63	32.78	Seminole 345 kV
GEN-2016-124	16.63	32.78	Seminole 345 kV
GEN-2016-125	16.63	32.78	Seminole 345 kV
GEN-2016-169	9.39	32.78	Tuco 230 kV
GEN-2016-171	8.93	32.78	Tuco 230 kV
GEN-2016-172	16.84	32.78	Tuco 230 kV
GEN-2016-175	8.71	33.12	Cimaron 345 kV
GEN-2016-177	9.20	29.35	Hobbs 115 kV

J7: GROUP 7 DYNAMIC STABILITY ANALYSIS REPORT

S&C ELECTRIC COMPANY
Excellence Through Innovation

DISIS-2016-002 (GROUP 07)

LITTLE ROCK, AR

SOUTHWEST POWER POOL

DEFINITIVE INTERCONNECTION SYSTEM IMPACT STUDY

S&C PROJECT NUMBER: 12651

DOCUMENT NUMBER: E-857

REVISION: 0

FINAL REPORT

CONFIDENTIAL

JUNE 28, 2018

REPORT REVISION HISTORY:

REV	DATE	PREPARED BY	REVIEWED BY	APPROVED BY	DESCRIPTION
A	04/9/2018	RY	ME	SK	Preliminary report issued.
0	06/28/2018	RY	ME	SK	Final Report

AUTHORS:

Prepared By:

Reza Yousefian, Ph.D.
Project Engineer
S&C Electric Company

Reviewed By:

Mohamed Elkhatib, Ph.D.
Project Engineer
S&C Electric Company

Approved By:

Saeed Kamalinia, Ph.D.
Manager – Consulting and Analytical Services
S&C Electric Company

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1. Executive Summary

S&C Electric Company (S&C) has performed a Definitive Interconnection System Impact Study, DISIS-2016-002 (Group 7), in response to a request through Southwest Power Pool (SPP) Tariff. Group 7 consists of four (4) new interconnection requests (GEN-2016-091, GEN-2016-095, GEN-2016-097, and GEN-2016-132).

S&C has performed dynamic stability analysis for Group 7 under Cluster scenarios. The cluster studies were performed using three (3) cluster base cases (2017 Winter Peak (WP), 2018 Summer Peak (SP), and 2026 SP) provided by SPP. In the cluster studies, all four new interconnection requests and prior-queued projects were studied at 100% of nameplate MW capacity.

The initial dynamic stability analysis demonstrated that several studied contingencies led to abnormal oscillations in the monitored system variables in the area close to WASHITA4 substation. In discussions with SPP, the source of the oscillation was traced back to a prior-queued wind generator model at bus 599003. Further investigations and discussions with SPP concluded that this was potentially a simulation numerical issue and, therefore, the GNET command was used for the referenced generating unit. The dynamic stability studies were repeated for the all cluster base cases (2017 WP, 2018 SP, and 2026 SP) after implementing that change and the results demonstrate that the system remains stable, with one exception, under each studied contingency and all studied interconnection projects stay online during and after the contingency. Only for contingency FLT-28, although no tripping occurred, abnormal oscillations could still be observed in the area close to the WASHITA4 138 kV substation. It is worth noting that contingency FLT-28 is a prior outage fault, i.e. TPL-001 P6 event, which causes the generating units near the WASHITA4 substation to become connected through a longer radial electrical path to the S.W.S.-4 substation. S&C performed additional investigation on this matter to confirm that the issues were not caused by the addition of the new interconnection requests. The dynamic stability study was repeated with the new interconnection requests disconnected and the same issues could still be observed, i.e. pre-project and post-project cases demonstrate similar operating performance.

S&C has performed a short-circuit analysis for the 2018 Summer Peak and 2026 Summer Peak under Group 7 Cluster and reported short-circuit results at all buses up to five (5) levels away from the Point of Interconnection (POI) of the study projects.

2. INTRODUCTION

S&C has performed a Definitive Interconnection System Impact Study, DISIS-2016-002 (Group 7), in response to a request through the SPP Tariff. Group 7 consist of four (4) new interconnection requests listed in Table 1 and twenty-nine (29) previously queued projects listed in Table 2.

Table 1: Group 7 Generation Interconnection Requests

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2016-091	303.6	Siemens 2.3MW VS	New tap on PSE&G (AEP) 345 kV Gracemont-Lawton (587744)
GEN-2016-095	200	Vestas V110 VCSS 2.0MW	Tap Gracemont - Lawton 345 kV (587744)
GEN-2016-097	100	Vestas V110 VCSS 2.0MW	Tap Southwestern-Fletcher Tap 138 kV (587794)
GEN-2016-132	(6.12MW uprate of GEN-2006-002)	GE 1.62MW	Sweetwater 230 kV (511541)

Table 2: Prior Queued Projects

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2001-026	74.25	NEG Micon 1.65MW	Washita 138 kV (521089)
GEN-2002-005	118.5	Acciona 1.5MW	Red Hills Tap 138 kV (521116)
GEN-2003-004/ GEN-2004-023/GEN-2005-003	151.2	Vestas V80 1.8MW	Washita 138 kV (521089)
GEN-2003-005/GEN-2011-037	105.6	G.E. 1.6MW	Anadarko - Paradise (Blue Canyon) 138 kV (521129)
GEN-2003-022/GEN-2004-020/GEN-2016-051	156.8	GE 1.6MW	Weatherford 138 kV (511506)
GEN-2006-002	100.8	GE 1.5/1.6MW	Sweetwater 230 kV (511541)
GEN-2006-035	224	Gamesa G87 2.0MW	Sweetwater 230 kV (511541)
GEN-2006-043	98.9	Siemens 93m 2.3MW	Sweetwater 230 kV (511541)
GEN-2007-052	150	GE LM6000 CT 50MW	Anadarko 138 kV (520814)
GEN-2008-023	148.8	GE 1.6MW	Hobart Junction 138 kV (511463)
GEN-2008-037	99.825	Vestas V90 VCUS 1.8 MW	Slick Hills 138 kV (521089)
GEN-2011-049/GEN-2015-004	303.6	Siemens 101m 2.3MW, Siemens VS 6.6MW	Border 345 kV (515458)
GEN-2012-028	74	Vestas V110 VCSS 2.0 MW	Gotebo 69kV (520925)
GEN-2015-013	119.952	Eaton Power Xpert Solar Inverters 1.666MW	Snyder 138 kV (521052)

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2015-055	40	Advanced Energy AE 500NX 0.5MW solar inverters	Erick 138 kV (520903)
GEN-2015-071	200	Vestas V110 VCSS 2.0MW	Chisholm 345 kV (511533)
GEN-2015-084	51.3	GE LV5 1.9MW solar inverter	Hollis 138 kV (511507)
GEN-2015-085	122.4	GE LV5 3.6MW solar inverter	Altus (511440) to Snyder (511435) 138 kV
GEN-2016-037	300	Vestas V110 VCSS 2.0MW	Tap Chisholm (511553) – Gracemont (515800) 345 kV, (G16-037-TAP, 560078)

3. Transmission System and Study Area

Group 7 will be connected to the Southwestern Oklahoma Area. For the dynamic stability studies, the following areas were monitored in the analysis:

- American Electric Power West (AEPW, Area #520)
- Oklahoma Gas & Electric (OKGE, Area #524)
- Southwestern Public Service (SPS, Area #526)
- Midwest Energy (MIDW, Area #531)
- Sunflower Electric Power Corporation (SUNC, Area #534)
- Westar Energy, Inc. (WERE, Area #536)

4. Power Flow Base Cases

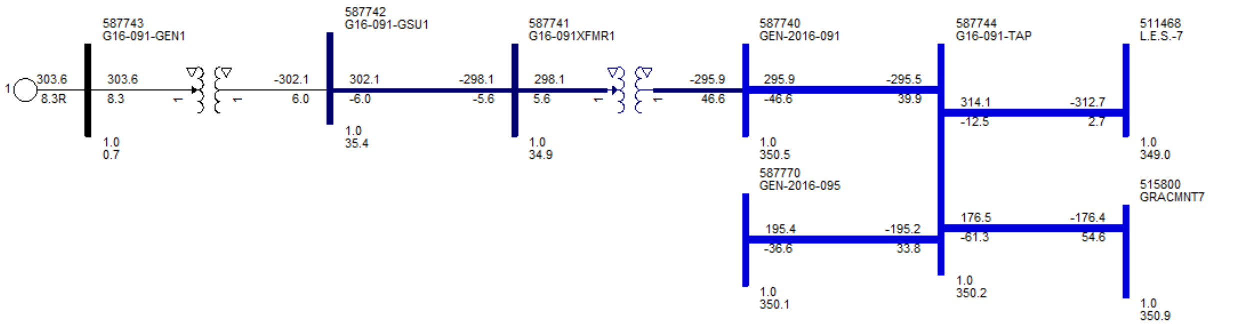
DISIS-2016-002 (Group 7) and prior-queued projects were modeled as aggregated generating units in the base cases from SPP.

Cluster Scenario Base Cases

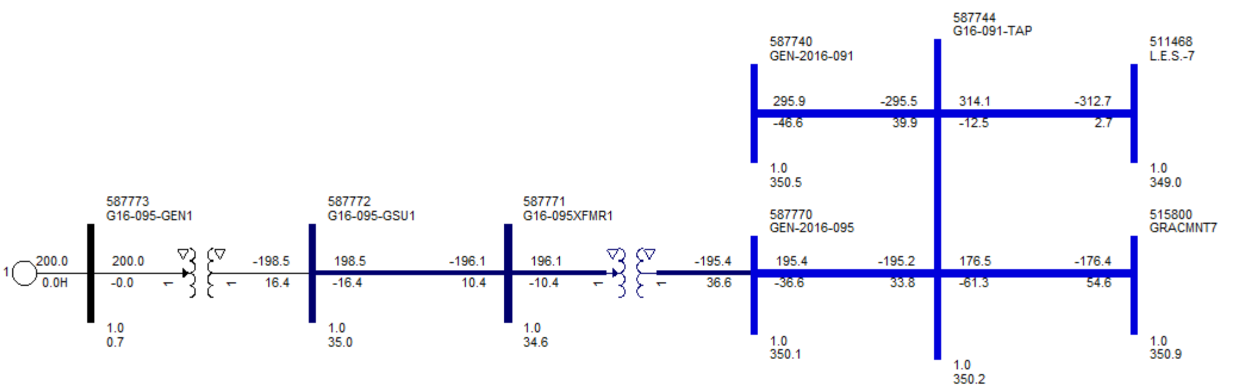
- **MDWG16-17WP_DIS1602_G07_Base.sav** – 2017 Winter Peak Cluster Base Case for Group 7. New interconnection requests and prior queued projects at 100% output power.
- **MDWG16-18SP_DIS1602_G07.sav** – 2018 Summer Peak Cluster Base Case for Group 7. New interconnection requests and prior queued projects at 100% output power.
- **MDWG16-26SP_DIS1602_G07.sav** – 2026 Summer Peak Cluster Base Case for Group 7. New interconnection requests and prior queued projects at 100% output power.

5. Power Flow Model

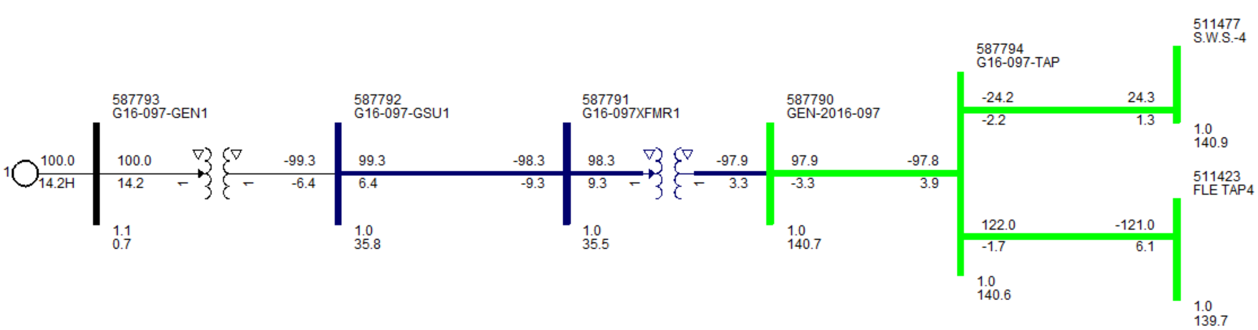
SPP's base case power flow models were built in PSS/E 33.0.7. S&C created one-line diagrams depicted in Figure 1 for each interconnection request.



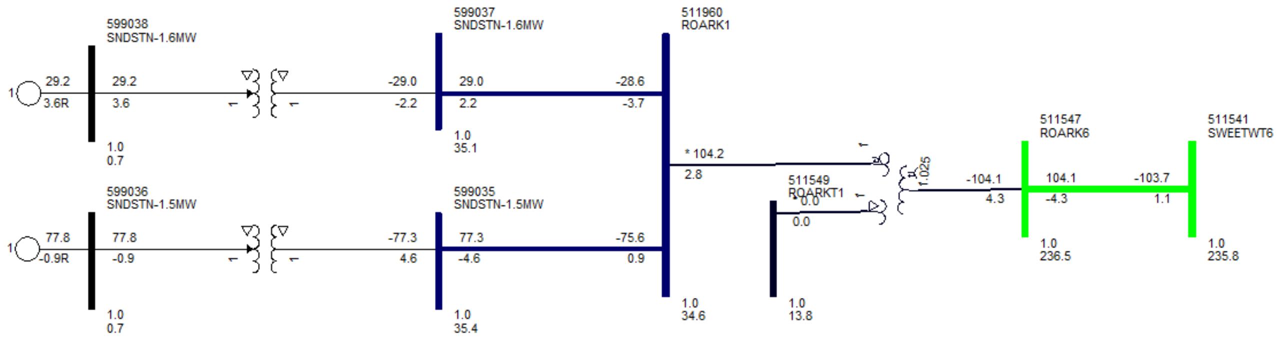
(a) Interconnection request GEN-2016-091



(b) Interconnection request GEN-2016-095



(c) Interconnection request GEN-2016-097



(d) Interconnection request GEN-2016-132

Figure 1: One-line Diagrams of the Interconnection Request Projects

6. Dynamic Stability Analysis

6.1. Assumptions

Dynamic stability analysis was performed for all the SPP contingencies listed in Appendix A. Three phase faults were simulated as bolted faults, while single line-to-ground faults were simulated under the assumption that a single line-to-ground fault will cause a 40% drop in the positive-sequence voltage at the fault location.

6.2. Stability Criteria

Dynamic stability studies were performed to ensure system stability following critical faults on the system. The system is considered stable if the following conditions are met:

(1) Disturbances including three-phase and single-phase to ground faults, should not cause synchronous and asynchronous plants to disconnect from the transmission grid.

(2) The angular positions of synchronous machine rotor become constant following an aperiodic system disturbance.

(3) Voltage magnitudes and frequencies at terminals of asynchronous generators should not exceed magnitudes and durations that will cause protection elements to operate. Furthermore, the response after the disturbance needs to be studied at the terminals of the machine to ensure that there are no sustained oscillations in power output, speed, frequency, etc.

(4) Voltage magnitudes and angles after the disturbance should settle to a constant and acceptable operating level. Frequencies should settle to the acceptable range within nominal 60 Hz power frequency.

In addition, performance of the transmission system is measured against the SPP Disturbance Criteria Requirements on Angular oscillations and Transient Voltage Recovery, detailed in Appendix B. Dynamic stability plots for all the Cluster scenarios are provided in Appendix C. Dynamic data for all study interconnection requests for Group 7 is provided in Appendix D.

6.3. DYNAMIC STABILITY RESULTS

The dynamic stability study was performed for the three base case scenarios; 2017 WP, 2018 SP, and 2026 SP for all the SPP contingencies listed in Appendix A. Initially, the base case dynamic data was analyzed and stable initial runs were obtained. Then, the study was performed for all the SPP contingencies listed in Appendix A. Time-domain simulations were performed to evaluate the dynamic performance of the system under identified contingencies. System dynamic voltage recovery and post-disturbance steady state performance under identified contingencies were also checked against SPP voltage recovery criteria. Additionally, simulation logs were scanned to identify any tripped generators during simulations.

The initial dynamic stability analysis demonstrated that several studied contingencies led to abnormal oscillations in the monitored system variables in the area close to WASHITA4 substation. In discussions with SPP, the source of the oscillation was traced back to the wind generator model at bus (599003). This unit is a Type 2 wind generator modelled using PSS/E generic dynamic models: WT2G1, WT2E1, WT12T1, and WT12A.

Further investigations and discussions with SPP concluded that this was potentially a simulation numerical issue and, therefore, the GNET command was used for the generating unit at bus (599003). Figure 2 shows an example of the improved system response after using the GNET command for the generating unit at bus (599003).

The dynamic stability studies for the 3 study cases were repeated after implementing that change and the results demonstrate that the system remains stable under each studied contingency and all studied interconnection projects stay online during and after the contingency. However, for contingency FLT-28, although no tripping occurred, abnormal oscillations could still be observed in the area close to WASHITA4 138 substation. It is worth noting that contingency FLT-28 is a prior outage fault, i.e. a TPL-001-4 P6 event, which is implemented as follows: in pre-contingency, the three-winding transformer between buses GRACMNT4 138 kV, GRACMNT7 345 kV and GRCMNT11 13.8 kV is taken out of service and then a 3-phase fault is applied on the line connecting S.W.S.-4 and WASHITA4 138 kV buses. In the post-fault system, the generating units near the WASHITA4 substation become connected through a longer radial electrical path to the S.W.S.-4 substation.

Additionally, to confirm that the oscillations issue was not caused by the addition of the new interconnection requests, the dynamic stability study was repeated with the new interconnection requests disconnected[1] and the same issues could still be observed.

Detailed plots of the dynamic stability results for each contingency and each peak season before and after the GNET command was used for the generating unit at bus 599003 are given in Appendices C-1 to C-3 and C-4 to C-6, respectively. Additionally, Table 3 below summarizes the dynamic stability results.

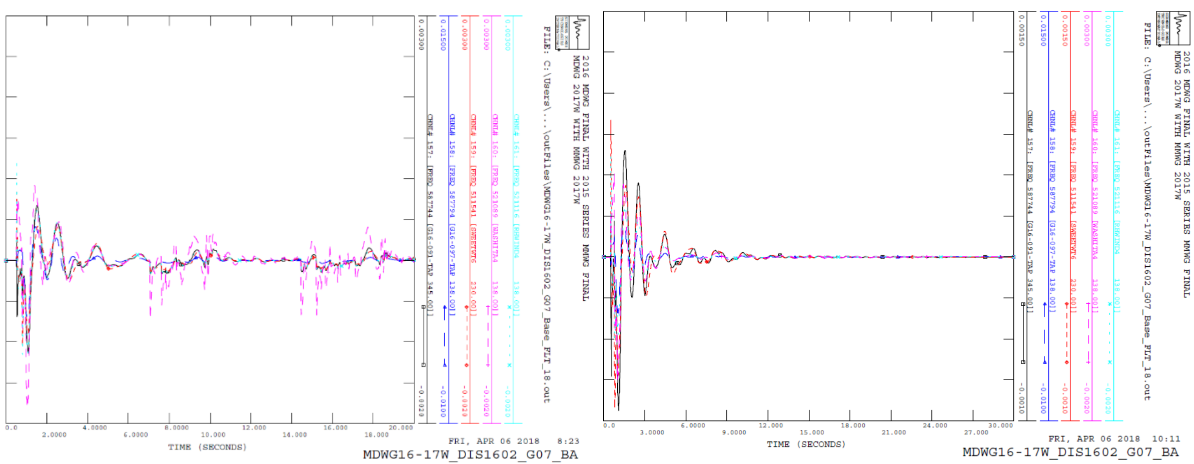


Figure 2: Example of Improved Result with GEN-2003-004/ GEN-2004-023/GEN-2005-003 (unit 599003) GNET

Left = FLT18 from 2017WP Cluster Case – unit at 599003 modeled with WT2G1, WT2E1, WT12T1, WT12A1
Right = FLT18 from 2017WP Cluster Case – unit at 599003 GNET

[1] The pre-projects cases have been developed by switching off the study projects. In order to balance the power, several loads in the TVA area (area #347) have been scaled down.

Table 3: Group 7 Dynamic Stability Results
(YES = STABLE, NO = UNSTABLE)

Cont. No.	Cont. Name	17WP Case	18SP Case	26SP Case	Cont. No.	Cont. Name	17WP Case	18SP Case	26SP Case
1	FLT_01-3PH	YES	YES	YES	37	FLT_37-PO	YES	YES	YES
2	FLT_02-3PH	YES	YES	YES	38	FLT_38-PO	YES	YES	YES
3	FLT_03-3PH	YES	YES	YES	39	FLT_39-PO	YES	YES	YES
4	FLT_04-3PH	YES	YES	YES	40	FLT_40-PO	YES	YES	YES
5	FLT_05-3PH	YES	YES	YES	41	FLT_41-PO	YES	YES	YES
6	FLT_06-3PH	YES	YES	YES	42	FLT_42-3PH	YES	YES	YES
7	FLT_07-3PH	YES	YES	YES	43	FLT_43-3PH	YES	YES	YES
8	FLT_08-3PH	YES	YES	YES	44	FLT_44-3PH	YES	YES	YES
9	FLT_09-3PH	YES	YES	YES	45	FLT_45-3PH	YES	YES	YES
10	FLT_10-3PH	YES	YES	YES	46	FLT_46-3PH	YES	YES	YES
11	FLT_11-3PH	YES	YES	YES	47	FLT_47-3PH	YES	YES	YES
12	FLT_12-3PH	YES	YES	YES	48	FLT_48-3PH	YES	YES	YES
13	FLT_13-SB	YES	YES	YES	49	FLT_49-3PH	YES	YES	YES
14	FLT_14-SB	YES	YES	YES	50	FLT_50-3PH	YES	YES	YES
15	FLT_15-SB	YES	YES	YES	51	FLT_51-3PH	YES	YES	YES
16	FLT_16-SB	YES	YES	YES	52	FLT_52-SB	YES	YES	YES
17	FLT_17-SB	YES	YES	YES	53	FLT_53-SB	YES	YES	YES
18	FLT_18-SB	YES	YES	YES	54	FLT_54-SB	YES	YES	YES
19	FLT_19-SB	YES	YES	YES	55	FLT_55-SB	YES	YES	YES
20	FLT_20-PO	YES	YES	YES	56	FLT_56-PO	YES	YES	YES
21	FLT_21-PO	YES	YES	YES	57	FLT_57-PO	YES	YES	YES
22	FLT_22-PO	YES	YES	YES	58	FLT_58-PO	YES	YES	YES
23	FLT_23-PO	YES	YES	YES	59	FLT_59-PO	YES	YES	YES
24	FLT_24-PO	YES	YES	YES	60	FLT_60-PO	YES	YES	YES
25	FLT_25-PO	YES	YES	YES	61	FLT_61-PO	YES	YES	YES
26	FLT_26-PO	YES	YES	YES	62	FLT_62-PO	YES	YES	YES
27	FLT_27-PO	YES	YES	YES	63	FLT_63-PO	YES	YES	YES
28	FLT_28-PO	YES	YES	YES	64	FLT_64-PO	YES	YES	YES
29	FLT_29-3PH	YES	YES	YES	65	FLT_65-3PH	YES	YES	YES
30	FLT_30-3PH	YES	YES	YES	66	FLT_66-3PH	YES	YES	YES
31	FLT_31-3PH	YES	YES	YES	67	FLT_67-3PH	YES	YES	YES
32	FLT_32-3PH	YES	YES	YES	68	FLT_68-SB	YES	YES	YES
33	FLT_33-3PH	YES	YES	YES	69	FLT_69-SB	YES	YES	YES
34	FLT_34-3PH	YES	YES	YES	70	FLT_70-PO	YES	YES	YES
35	FLT_35-SB	YES	YES	YES	71	FLT_71-PO	YES	YES	YES
36	FLT_36-SB	YES	YES	YES					

7. Short-Circuit Study

A short-circuit study has been performed on the power flow models for the 2017 WP, 2018 SP, and 2026 SP seasons for each generator using the Cluster Scenario model. The short-circuit analysis includes applying a 3-phase fault on buses up to 5 levels away from the POI of each interconnection request project. PSS/E "Automatic Sequence Fault Calculation (ASCC)" fault analysis module was used for short-circuit analysis. The results of the short-circuit analysis have been recorded for all the buses up to five levels away from the point of interconnection of each interconnection request project. Summary tables for the results of the short-circuit study are provided in Appendix E.

8. Conclusions and Recommendations

The initial dynamic stability analysis demonstrated that several studied contingencies led to abnormal oscillations in the monitored system variables in the area close to the WASHITA4 substation. In discussions with SPP, the source of the oscillation was traced back to the wind generator model at bus 599003. Further investigations and discussions with SPP concluded that this was potentially a simulation numerical issue and, therefore, the GNET command was used for the referenced generating unit. The dynamic stability studies for the 3 study cases were repeated after implementing that change and the results demonstrate that the system remains stable under each studied contingency and all studied interconnection projects stay online during and after the contingency. Only for contingency FLT-28, although no tripping occurred, abnormal oscillations could still be observed in the area close to WASHITA4 138 substation. It is worth noting that contingency FLT-28 is a prior outage fault, i.e. a TPL-001-4 P6 event, which causes the generating units near the WASHITA4 substation to become connected through a longer radial electrical path to the S.W.S.-4 substation.

S&C performed additional investigation on this matter to confirm that the issues were not caused by the addition of the new interconnection requests, the dynamic stability study was repeated with the new interconnection requests disconnected and the same issues could still be observed, i.e. pre-project and post-project cases demonstrate similar operating performance.

A short-circuit study has been performed on the power flow models for the 2017 Winter Peak, 2018 Summer Peak Season and 2026 Summer Peak Season for each generator using the Cluster Scenario model. A 3-phase fault is applied on buses up to 5 levels away from the POI of each interconnection request project and the results of the study have been presented.

APPENDIX A

SPP GROUP 7 FAULT DEFINITIONS

Table 4: Group 14 Fault Definitions

	Cont. Name	Description
1	FLT1-3PH	3 phase fault on G16-097-TAP 138 kV (587794) to FLE TAP4 138 kV (511423) line CKT 1, near G16-097-TAP. a. Apply fault at the G16-097-TAP 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT2-3PH	3 phase fault on G16-097-TAP 138 kV (587794) to S.W.S.-4 138 kV (511477) line CKT 1, near G16-097-TAP. a. Apply fault at the G16-097-TAP 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
3	FLT3-3PH	3 phase fault on S.W.S.-4 138 kV (511477) to ELSWORTH 138 kV (511563) line CKT 1, near S.W.S.-4. a. Apply fault at the S.W.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT4-3PH	3 phase fault on L.E.S.-4 138 kV (511467) to ELGINJT4 138 kV (511486) line CKT 1, near L.E.S.-4. a. Apply fault at the L.E.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
5	FLT5-3PH	3 phase fault on L.E.S.-4 138 kV (511467) to SHERID4 138 kV (511474) line CKT 1, near L.E.S.-4. a. Apply fault at the L.E.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT6-3PH	3 phase fault on L.E.S.-4 138 kV (511467) to LWSTAP 4 138 kV (511439) line CKT 1, near L.E.S.-4. a. Apply fault at the L.E.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

7	FLT7-3PH	3 phase fault on S.W.S.-4 138 kV (511477) to VERDEN 4 138 kV (511421) line CKT 1, near S.W.S.-4. a. Apply fault at the S.W.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
8	FLT8-3PH	3 phase fault on S.W.S.-4 138 kV (511477) to CARNEG-4 138 kV (511445) line CKT 1, near S.W.S.-4. a. Apply fault at the S.W.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
9	FLT9-3PH	3 phase fault on S.W.S.-4 138 kV (511477) to ANADARK4 138 kV (520814) line CKT 1, near S.W.S.-4. a. Apply fault at the S.W.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT10-3PH	3 phase fault on S.W.S.-4 138 kV (511477) to WASHITA4 138 kV (521089) line CKT 1, near S.W.S.-4. a. Apply fault at the S.W.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
11	FLT11-3PH	3 phase fault on GRACMNT4 138 kV (515802) to GRACMNT7 345 kV (515800) to GRCMNT11 13.8 kV (515801) transformer CKT 1, near GRACMNT4. a. Apply fault at the GRACMNT4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
12	FLT12-3PH	3 phase fault on L.E.S.-4 138 kV (511467) to COMMTAP4 138 kV (511494) line CKT 1, near L.E.S.-4. a. Apply fault at the L.E.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
13	FLT13-SB	**Stuck Breaker at L.E.S.-4 (511467)** a. Apply single phase fault at the L.E.S.-4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - L.E.S.-4 138 kV (511467) to FLE TAP4 138 kV (511423) line CKT 1 - L.E.S.-4 138 kV (511467) to ELGINJT4 138 kV (511486) line CKT 1

14	FLT14-SB	**Stuck Breaker at L.E.S.-4 (511467)** a. Apply single phase fault at the L.E.S.-4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - L.E.S.-4 138 kV (511467) to SHERID4 138 kV (511474) line CKT 1 - L.E.S.-4 138 kV (511467) to LWSTAP 4 138 kV (511439) line CKT 1
15	FLT15-SB	**Stuck Breaker at L.E.S.-4 (511467)** a. Apply single phase fault at the L.E.S.-4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - L.E.S.-4 138 kV (511467) to L.E.S.-7 345 kV (511468) to LES#4-1 13.8 kV (511414) transformer CKT 1 - L.E.S.-4 138 kV (511467) to L.E.S.-7 345 kV (511468) to LES#5-1 13.8 kV (511411) transformer CKT 2
16	FLT16-SB	**Stuck Breaker at S.W.S.-4 (511477)** a. Apply single phase fault at the S.W.S.-4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - G16-097-TAP 138 kV (587794) to S.W.S.-4 138 kV (511477) line CKT 1 - S.W.S.-4 138 kV (511477) to ELSWORTH 138 kV (511563) line CKT 1
17	FLT17-SB	**Stuck Breaker at S.W.S.-4 (511477)** a. Apply single phase fault at the S.W.S.-4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - S.W.S.-4 138 kV (511477) to VERDEN 4 138 kV (511421) line CKT 1 - S.W.S.-4 138 kV (511477) to NORGE--4 138 kV (511483) line CKT 1
18	FLT18-SB	**Stuck Breaker at S.W.S.-4 (511477)** a. Apply single phase fault at the S.W.S.-4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - S.W.S.-4 138 kV (511477) to ANADARK4 138 kV (520814) line CKT 1 - S.W.S.-4 138 kV (511477) to WASHITA4 138 kV (521089) line CKT 1
19	FLT19-SB	**Stuck Breaker at ANADARK4 (520814)** a. Apply single phase fault at the ANADARK4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - S.W.S.-4 138 kV (511477) to ANADARK4 138 kV (520814) line CKT 1 - GRACMNT4 138 kV (515802) to ANADARK4 138 kV (520814) line CKT 1
20	FLT20-PO	**Prior Outage of G16-097-TAP 138 kV (587794) to FLE TAP4 138 kV (511423) line CKT 1;** 3 phase fault on L.E.S.-4 138 kV (511467) to ELGINJT4 138 kV (511486) line CKT 1, near L.E.S.-4. a. Apply fault at the L.E.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

21	FLT21-PO	**Prior Outage of L.E.S.-4 138 kV (511467) to SHERID4 138 kV (511474) line CKT 1;** 3 phase fault on L.E.S.-4 138 kV (511467) to LWSTAP 4 138 kV (511439) line CKT 1, near L.E.S.-4. a. Apply fault at the L.E.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
22	FLT22-PO	**Prior Outage of L.E.S.-4 138 kV (511467) to L.E.S.-7 345 kV (511468) to LES#4-1 13.8 kV (511414) transformer CKT 1;** 3 phase fault on L.E.S.-4 138 kV (511467) to L.E.S.-7 345 kV (511468) to LES#5-1 13.8 kV (511411) transformer CKT 2, near L.E.S.-4. a. Apply fault at the L.E.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
23	FLT23-PO	**Prior Outage of G16-097-TAP 138 kV (587794) to S.W.S.-4 138 kV (511477) line CKT 1;** 3 phase fault on S.W.S.-4 138 kV (511477) to ELSWORTH 138 kV (511563) line CKT 1, near ELSWORTH. a. Apply fault at the ELSWORTH 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
24	FLT24-PO	**Prior Outage of S.W.S.-4 138 kV (511477) to VERDEN 4 138 kV (511421) line CKT 0;** 3 phase fault on S.W.S.-4 138 kV (511477) to NORGE--4 138 kV (511483) line CKT 1, near S.W.S.-4. a. Apply fault at the S.W.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
25	FLT25-PO	**Prior Outage of S.W.S.-4 138 kV (511477) to ANADARK4 138 kV (520814) line CKT 0;** 3 phase fault on S.W.S.-4 138 kV (511477) to WASHITA4 138 kV (521089) line CKT 1, near S.W.S.-4. a. Apply fault at the S.W.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
26	FLT26-PO	**Prior Outage of ANADARK4 138 kV (520814) to GRACMNT4 138 kV (515802) line CKT 1;** 3 phase fault on S.W.S.-4 138 kV (511477) to ANADARK4 138 kV (520814) line CKT 1, near S.W.S.-4. a. Apply fault at the S.W.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

27	FLT27-PO	**Prior Outage of S.W.S.-4 138 kV (511477) to WASHITA4 138 kV (521089) line CKT 0;** 3 phase fault on S.W.S.-4 138 kV (511477) to ANADARK4 138 kV (520814) line CKT 1, near S.W.S.-4. a. Apply fault at the S.W.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
28	FLT28-PO	**Prior Outage of GRACMNT4 138 kV (515802) to GRACMNT7 345 kV (515800) to GRCMNT11 13.8 kV (515801) transformer CKT 1;** 3 phase fault on S.W.S.-4 138 kV (511477) to WASHITA4 138 kV (521089) line CKT 1, near S.W.S.-4. a. Apply fault at the S.W.S.-4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
29	FLT29-3PH	3 phase fault on SWEETWT6 230.0 kV (511541) to CHISHOLM6 230.0 kV (511557) line CKT 1, near SWEETWT6. a. Apply fault at the SWEETWT6 230.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
30	FLT30-3PH	3 phase fault on SWEETWT6 230.0 kV (511541) to STLN-DEMARC6 230.0 kV (523779) line CKT 1, near SWEETWT6. a. Apply fault at the SWEETWT6 230.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
31	FLT31-3PH	3 phase fault on WHEELER 230.0 kV (523777) to GRAPEVINE 230.0 kV (523771) line CKT 1, near WHEELER. a. Apply fault at the WHEELER 230.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
32	FLT32-3PH	3 phase fault on WHEELER 230.0 kV (523777) to WHEELER 115.0 kV (523776) to WHEELER_TR11 13.19 kV (523774) transformer CKT 1, near WHEELER. a. Apply fault at the WHEELER 230.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
33	FLT33-3PH	3 phase fault on CHISHOLM6 230.0 kV (511557) to CHISHOLM7 345 kV (511553) to CHISHOLM1 13.19 kV (511558) transformer CKT 1, near CHISHOLM6. a. Apply fault at the CHISHOLM6 230.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line.

34	FLT34-3PH	3 phase fault on CHISHOLM6 230.0 kV (511557) to ELKCITY6 230.0 kV (511490) line CKT 1, near CHISHOLM6. a. Apply fault at the CHISHOLM6 230.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
35	FLT35-SB	**Stuck Breaker at WHEELER (523777)** a. Apply single phase fault at the WHEELER 230.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - WHEELER 230.0 kV (523777) to GRAPEVINE 230.0 kV (523771) line CKT 1 - WHEELER 230.0 kV (523777) to WHEELER 115.0 kV (523776) to WHEELER_TR11 13.19 kV (523774) transformer CKT 1
36	FLT36-SB	**Stuck Breaker at CHISHOLM6 (511557)** a. Apply single phase fault at the CHISHOLM6 230.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - CHISHOLM6 230.0 kV (511557) to CHISHOLM7 345 kV (511553) to CHISHOLM1 13.19 kV (511558) transformer CKT 1 - CHISHOLM6 230.0 kV (511557) to ELKCITY6 230.0 kV (511490) line CKT 1
37	FLT37-PO	**Prior Outage of WHEELER 230.0 kV (523777) to GRAPEVINE 230.0 kV (523771) line CKT 1;** 3 phase fault on WHEELER 230.0 kV (523777) to WHEELER 115.0 kV (523776) to WHEELER_TR11 13.19 kV (523774) transformer CKT 1, near WHEELER. a. Apply fault at the WHEELER 230.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
38	FLT38-PO	**Prior Outage of SWEETWT6 230.0 kV (511541) to CHISHOLM6 230.0 kV (511557) line CKT 1;** 3 phase fault on WHEELER 230.0 kV (523777) to WHEELER 115.0 kV (523776) to WHEELER_TR11 13.19 kV (523774) transformer CKT 1, near WHEELER. a. Apply fault at the WHEELER 230.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
39	FLT39-PO	**Prior Outage of CHISHOLM6 230.0 kV (511557) to CHISHOLM7 345 kV (511553) to CHISHOLM1 13.19 kV (511558) transformer CKT 1;** 3 phase fault on CHISHOLM6 230.0 kV (511557) to ELKCITY6 230.0 kV (511490) line CKT 1, near CHISHOLM6. a. Apply fault at the CHISHOLM6 230.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

40	FLT40-PO	**Prior Outage of SWEETWT6 230.0 kV (511541) to STLN-DEMARC6 230.0 kV (523779) line CKT 1;** 3 phase fault on CHISHOLM6 230.0 kV (511557) to CHISHOLM7 345 kV (511553) to CHISHOLM1 13.19 kV (511558) transformer CKT 1, near CHISHOLM6. a. Apply fault at the CHISHOLM6 230.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
41	FLT41-PO	**Prior Outage of CHISHOLM6 230.0 kV (511557) to ELKCITY6 230.0 kV (511490) line CKT 1;** 3 phase fault on WHEELER 230.0 kV (523777) to GRAPEVINE 230.0 kV (523771) line CKT 1, near WHEELER. a. Apply fault at the WHEELER 230.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
42	FLT42-3PH	3 phase fault on G16-091-TAP 345 kV (587744) to GRACMNT7 345 kV (515800) line CKT 1, near G16-091-TAP. a. Apply fault at the G16-091-TAP 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
43	FLT43-3PH	3 phase fault on G16-091-TAP 345 kV (587744) to L.E.S.-7 345 kV (511468) line CKT 1, near G16-091-TAP. a. Apply fault at the G16-091-TAP 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT44-3PH	3 phase fault on GRACMNT7 345 kV (515800) to G16-037-TAP 345 kV (560078) line CKT 1, near GRACMNT7. a. Apply fault at the GRACMNT7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
45	FLT45-3PH	3 phase fault on GRACMNT7 345 kV (515800) to MINCO 345 kV (514801) line CKT 1, near GRACMNT7. a. Apply fault at the GRACMNT7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

46	FLT46-3PH	3 phase fault on MINCO 345 kV (514801) to CIMARON7 345 kV (514901) line CKT 1, near MINCO. a. Apply fault at the MINCO 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
47	FLT47-3PH	3 phase fault on L.E.S.-7 345 kV (511468) to TERRYRD7 345 kV (511568) line CKT 1, near L.E.S.-7. a. Apply fault at the L.E.S.-7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
48	FLT48-3PH	3 phase fault on TERRYRD7 345 kV (511568) to SUNNYSD7 345 kV (515136) line CKT 1, near TERRYRD7. a. Apply fault at the TERRYRD7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
49	FLT49-3PH	3 phase fault on L.E.S.-7 345 kV (511468) to O.K.U.-7 345 kV (511456) line CKT 1, near L.E.S.-7. a. Apply fault at the L.E.S.-7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
50	FLT50-3PH	3 phase fault on O.K.U.-7 345 kV (511456) to TUCO_INT 345 kV (525832) line CKT 1, near O.K.U.-7. a. Apply fault at the O.K.U.-7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
51	FLT51-3PH	3 phase fault on L.E.S.-7 345 kV (511468) to L.E.S.-4 138 kV (511467) to LES#5-1 13.8 kV (511411) transformer CKT 2, near L.E.S.-7. a. Apply fault at the L.E.S.-7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
52	FLT52-SB	**Stuck Breaker at GRACMNT7 (515800)** a. Apply single phase fault at the GRACMNT7 345 kV bus. b. Clear fault after 16 cycles and trip the following elements. - GRACMNT7 345 kV (515800) to G16-037-TAP 345 kV (560078) line CKT 1 - GRACMNT7 345 kV (515800) to GRACMNT4 138 kV (515802) to GRCMNT11 13.8 kV (515801) transformer CKT 1

53	FLT53-SB	**Stuck Breaker at GRACMNT7 (515800)** a. Apply single phase fault at the GRACMNT7 345 kV bus. b. Clear fault after 16 cycles and trip the following elements. - GRACMNT7 345 kV (515800) to MINCO 345 kV (514801) line CKT 1 - GRACMNT7 345 kV (515800) to GRACMNT4 138 kV (515802) to GRCMNT11 13.8 kV (515801) transformer CKT 1
54	FLT54-SB	**Stuck Breaker at L.E.S.-7 (511468)** a. Apply single phase fault at the L.E.S.-7 345 kV bus. b. Clear fault after 16 cycles and trip the following elements. - L.E.S.-7 345 kV (511468) to TERRYRD7 345 kV (511568) line CKT 1 - L.E.S.-7 345 kV (511468) to O.K.U.-7 345 kV (511456) line CKT 1
55	FLT55-SB	**Stuck Breaker at L.E.S.-7 (511468)** a. Apply single phase fault at the L.E.S.-7 345 kV bus. b. Clear fault after 16 cycles and trip the following elements. - L.E.S.-7 345 kV (511468) to TERRYRD7 345 kV (511568) line CKT 1 - L.E.S.-7 345 kV (511468) to L.E.S.-4 138 kV (511467) to LES#5-1 13.8 kV (511411) transformer CKT 2
56	FLT56-PO	**Prior Outage of G16-091-TAP 345 kV (587744) to GRACMNT7 345 kV (515800) line CKT 1;** 3 phase fault on L.E.S.-7 345 kV (511468) to TERRYRD7 345 kV (511568) line CKT 1, near L.E.S.-7. a. Apply fault at the L.E.S.-7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
57	FLT57-PO	**Prior Outage of G16-091-TAP 345 kV (587744) to GRACMNT7 345 kV (515800) line CKT 1;** 3 phase fault on O.K.U.-7 345 kV (511456) to L.E.S.-7 345 kV (511468) line CKT 1, near L.E.S.-7. a. Apply fault at the L.E.S.-7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
58	FLT58-PO	**Prior Outage of G16-091-TAP 345 kV (587744) to GRACMNT7 345 kV (515800) line CKT 1;** 3 phase fault on TERRYRD7 345 kV (511568) to L.E.S.-7 345 kV (511468) line CKT 1, near L.E.S.-7. a. Apply fault at the L.E.S.-7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

59	FLT59-PO	**Prior Outage of G16-091-TAP 345 kV (587744) to GRACMNT7 345 kV (515800) line CKT 1;** 3 phase fault on L.E.S.-4 138 kV (511467) to L.E.S.-7 345 kV (511468) transformer CKT 511411, near L.E.S.-7. a. Apply fault at the L.E.S.-7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
60	FLT60-PO	**Prior Outage of G16-091-TAP 345 kV (587744) to L.E.S.-7 345 kV (511468) line CKT 1;** 3 phase fault on GRACMNT7 345 kV (515800) to GRACMNT4 138 kV (515802) to GRCMNT11 13.8 kV (515801) transformer CKT 1, near GRACMNT7. a. Apply fault at the GRACMNT7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
61	FLT61-PO	**Prior Outage of G16-091-TAP 345 kV (587744) to L.E.S.-7 345 kV (511468) line CKT 1;** 3 phase fault on GRACMNT7 345 kV (515800) to G16-037-TAP 345 kV (560078) line CKT 1, near GRACMNT7. a. Apply fault at the GRACMNT7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
62	FLT62-PO	**Prior Outage of G16-091-TAP 345 kV (587744) to L.E.S.-7 345 kV (511468) line CKT 1;** 3 phase fault on GRACMNT7 345 kV (515800) to MINCO 345 kV (514801) line CKT 1, near GRACMNT7. a. Apply fault at the GRACMNT7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
63	FLT63-PO	**Prior Outage of L.E.S.-7 345 kV (511468) to TERRYRD7 345 kV (511568) line CKT 1;** 3 phase fault on L.E.S.-7 345 kV (511468) to O.K.U.-7 345 kV (511456) line CKT 1, near L.E.S.-7. a. Apply fault at the L.E.S.-7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

64	FLT64-PO	**Prior Outage of GRACMNT7 345 kV (515800) to G16-037-TAP 345 kV (560078) line CKT 1;** 3 phase fault on GRACMNT7 345 kV (515800) to MINCO 345 kV (514801) line CKT 1, near GRACMNT7. a. Apply fault at the GRACMNT7 345 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
65	FLT_65-3PH	3 phase fault on CHISHOLM7 345.0 kV (511553) to BORDER 345.0 kV (515458) line CKT 1, near CHISHOLM7. a. Apply fault at the CHISHOLM7 345.0 kV bus. b. Clear fault after 6 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 6 cycles, then trip the line in (b) and remove fault.
66	FLT_66-3PH	3 phase fault on BORDER 345.0 kV (515458) to G16-120-TAP 345.0 kV (587964) line CKT 1, near BORDER. a. Apply fault at the BORDER 345.0 kV bus. b. Clear fault after 6 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 6 cycles, then trip the line in (b) and remove fault.
67	FLT_67-3PH	3 phase fault on G16-120-TAP 345.0 kV (587964) to TUCO_INT 345.0 kV (525832) line CKT 1, near TUCO_INT. a. Apply fault at the TUCO_INT 345.0 kV bus. b. Clear fault after 6 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 6 cycles, then trip the line in (b) and remove fault.
68	FLT_68-SB	**Stuck Breaker at CHISHOLM7 (511553)** a. Apply single phase fault at the CHISHOLM7 345.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - CHISHOLM7 345.0 kV (511553) to BORDER 345.0 kV (515458) line CKT 1 - CHISHOLM7 345.0 kV (511553) to BORDER 345.0 kV (515458) line CKT 2
69	FLT_69-SB	**Stuck Breaker at BORDER (515458)** a. Apply single phase fault at the BORDER 345.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - BORDER 345.0 kV (515458) to G16-120-TAP 345.0 kV (587964) line CKT 1 - BORDER 345.0 kV (515458) to WWRDEHV7 345.0 kV (515375) line CKT 1

70	FLT_70-PO	**Prior Outage of CHISHOLM7 345.0 kV (511553) to BORDER 345.0 kV (515458) line CKT 1;** 3 phase fault on CHISHOLM7 345.0 kV (511553) to BORDER 345.0 kV (515458) line CKT 2, near CHISHOLM7. a. Apply fault at the CHISHOLM7 345.0 kV bus. b. Clear fault after 6 cycles and trip the faulted line.
71	FLT_71-PO	**Prior Outage of BORDER 345.0 kV (515458) to G16-120-TAP 345.0 kV (587964) line CKT 1;** 3 phase fault on BORDER 345.0 kV (515458) to WWRDEHV7 345.0 kV (515375) line CKT 1, near BORDER. a. Apply fault at the BORDER 345.0 kV bus. b. Clear fault after 6 cycles and trip the faulted line.

APPENDIX B

SOUTHWEST POWER POOL DISTURBANCE PERFORMANCE REQUIREMENTS (SUBMITTED IN A SEPARATE FILE)

Appendix C

Dynamic Stability Plots For Cluster Scenario (Submitted in Separate Files from Appendix C-1 to C-6 which will be available upon request from SPP)

The original dynamic data-set:

C-1 Group 7 Cluster Dynamic Stability Plots for 2017 Winter Peak Case

C-2 Group 7 Cluster Dynamic Stability Plots for 2018 Summer Peak Case

C-3 Group 7 Cluster Dynamic Stability Plots for 2026 Summer Peak Case

The dynamic data-set with GNET command for GEN-2003-004/ GEN-2004-023/GEN-2005-003:

C-4 Group 7 Cluster Dynamic Stability Plots for 2017 Winter Peak Case

C-5 Group 7 Cluster Dynamic Stability Plots for 2018 Summer Peak Case

C-6 Group 7 Cluster Dynamic Stability Plots for 2026 Summer Peak Case

Each contingency consists of (47) subplots:

- Subplot #1 is the system phase angle channels in the snapshot file provided by SPP.
- Subplot #2 to Subplot #31 are results for (30) generators in the scope of study.
- Subplots #32 to Subplot #39 are voltages at the POI buses in the scope of study.
- Subplots #40 to Subplot #47 are frequencies at the POI buses in the scope of study.

APPENDIX D

DYNAMIC DATA OF INTERCONNECTION GENERATORS (SUBMITTED IN A SEPARATE FILE WHICH WILL BE AVAILABLE UPON REQUEST FROM SPP)

APPENDIX E

SHORT-CIRCUIT STUDY RESULTS

Table 5: GROUP 7 18SP Short-Circuit Study Results

Bus No	Bus Name	Short Circuit Current (A)	Bus No	Bus Name	Short Circuit Current (A)
MDWG16-18S_DIS1602_G07					
GEN-2016-091					
510907	PITTSB-7 345.00	13158.2	584072	G14-057-GSU134.500	24668.8
511456	O.K.U.-7 345.00	5100.9	584780	GEN-2015-036345.00	7616.3
511468	L.E.S.-7 345.00	13068.1	584951	G15-057XFMR134.500	15475.1
511553	CHISHOLM7 345.00	10482.7	585060	GEN-2015-068345.00	9170.0
511565	OKLAUN HVDC7345.00	5086.9	585061	G15-068-XF-134.500	33286.1
511568	TERRYRD7 345.00	9890.1	585080	GEN-2015-071345.00	9076.6
511571	RUSHSPR7 345.00	6374.3	585081	G15-071XFMR134.500	31015.9
511965	RUSHSPRW1-1 34.500	26517.9	585270	GEN-2015-093345.00	10062.0
514801	MINCO 7 345.00	17543.5	585271	G15-093XFMR134.500	30154.7
514809	JOHNCO 7 345.00	9690.6	585272	G15-093-GSU134.500	29374.2
514880	NORTWST7 345.00	31848.0	585273	G15-093-GEN10.6900	997576.0
514881	SPRNGCK7 345.00	22751.6	585274	G15-093-GEN20.6900	898755.4
514901	CIMARON7 345.00	32521.6	585280	GEN-2015-092345.00	6182.9
514908	ARCADIA7 345.00	25270.8	585281	G15-092XFMR134.500	26390.0
514934	DRAPER 7 345.00	20624.8	587230	GEN-2016-037345.00	8400.1
515045	SEMINOL7 345.00	25668.9	587231	G16-037XFMR134.500	46303.2
515136	SUNNYSD7 345.00	10697.4	587232	G16-037-GSU134.500	45119.9
515375	WWRDEHV7 345.00	19902.3	587300	G16-045-SUB1345.00	1584.1
515407	TATONGA7 345.00	15970.4	587304	G16-045-SUB2345.00	1542.0

515444	MCNOWND7 345.00	17490.9	587380	G16-057-SUB1345.00	1560.7
515458	BORDER 7345.00	10111.8	587384	G16-057-SUB2345.00	1482.3
515497	MATHWSN7 345.00	31253.4	587430	GEN-2016-063345.00	7342.3
515549	MNCWND37 345.00	11937.8	587740	GEN-2016-091345.00	13340.4
515600	KNGFSHR7 345.00	11300.6	587741	G16-091XFMR134.500	31171.6
515605	CANADN7 345.00	11681.9	587742	G16-091-GSU134.500	29739.3
515610	FSHRTAP7 345.00	16590.5	587743	G16-091-GEN10.6900	1340366.5
515800	GRACMNT7 345.00	17538.1	587744	G16-091-TAP 345.00	15000.2
515875	REDNGTN7 345.00	17944.3	587770	GEN-2016-095345.00	11064.6
515939	MNCWND47 345.00	6497.2	587771	G16-095XFMR134.500	31684.5
521157	HUGO 7 345.00	10994.4	587772	G16-095-GSU134.500	30880.0
525832	TUCO_INT 7345.00	11097.2	587773	G16-095-GEN10.6900	1503044.0
525844	ELK_1 118.000	45440.9	587960	GEN-2016-120345.00	5870.1
525845	ELK_2 1 18.000	41424.1	587964	G16-120-TAP 345.00	7433.4
525850	ELK_CT1 345.00	10998.3	587970	GEN-2016-175345.00	4782.5
560078	G16-037-TAP 345.00	9454.6	590001	OKLEHV24 138.00	5172.5
560088	G16-063-TAP 345.00	7429.8	590002	OKLAUN1G 24.000	87674.5
583090	G1149&G1504 345.00	8410.4	590003	OKLEHV14 138.00	5290.1
584060	GEN-2015-057345.00	8165.1	599891	OKLAUN 7 345.00	4367.2
GEN-2016-095					
510907	PITTSB-7 345.00	13158.2	584072	G14-057-GSU134.500	24668.8
511456	O.K.U.-7 345.00	5100.9	584780	GEN-2015-036345.00	7616.3
511468	L.E.S.-7 345.00	13068.1	584951	G15-057XFMR134.500	15475.1
511553	CHISHOLM7 345.00	10482.7	585060	GEN-2015-068345.00	9170.0
511565	OKLAUN HVDC7345.00	5086.9	585061	G15-068-XF-134.500	33286.1
511568	TERRYRD7 345.00	9890.1	585080	GEN-2015-071345.00	9076.6
511571	RUSHSPR7 345.00	6374.3	585081	G15-071XFMR134.500	31015.9
511965	RUSHSPRW1-1 34.500	26517.9	585270	GEN-2015-093345.00	10062.0

514801	MINCO 7 345.00	17543.5	585271	G15-093XFMR134.500	30154.7
514809	JOHNCO 7 345.00	9690.6	585272	G15-093-GSU134.500	29374.2
514880	NORTWST7 345.00	31848.0	585273	G15-093-GEN10.6900	997576.0
514881	SPRNGCK7 345.00	22751.6	585274	G15-093-GEN20.6900	898755.4
514901	CIMARON7 345.00	32521.6	585280	GEN-2015-092345.00	6182.9
514908	ARCADIA7 345.00	25270.8	585281	G15-092XFMR134.500	26390.0
514934	DRAPER 7 345.00	20624.8	587230	GEN-2016-037345.00	8400.1
515045	SEMINOL7 345.00	25668.9	587231	G16-037XFMR134.500	46303.2
515136	SUNNYSD7 345.00	10697.4	587232	G16-037-GSU134.500	45119.9
515375	WWRDEHV7 345.00	19902.3	587300	G16-045-SUB1345.00	1584.1
515407	TATONGA7 345.00	15970.4	587304	G16-045-SUB2345.00	1542.0
515444	MCNOWND7 345.00	17490.9	587380	G16-057-SUB1345.00	1560.7
515458	BORDER 7345.00	10111.8	587384	G16-057-SUB2345.00	1482.3
515497	MATHWSN7 345.00	31253.4	587430	GEN-2016-063345.00	7342.3
515549	MNCWND37 345.00	11937.8	587740	GEN-2016-091345.00	13340.4
515600	KNGFSHR7 345.00	11300.6	587741	G16-091XFMR134.500	31171.6
515605	CANADN7 345.00	11681.9	587742	G16-091-GSU134.500	29739.3
515610	FSHRTAP7 345.00	16590.5	587743	G16-091-GEN10.6900	1340366.5
515800	GRACMNT7 345.00	17538.1	587744	G16-091-TAP 345.00	15000.2
515875	REDNGTN7 345.00	17944.3	587770	GEN-2016-095345.00	11064.6
515939	MNCWND47 345.00	6497.2	587771	G16-095XFMR134.500	31684.5
521157	HUGO 7 345.00	10994.4	587772	G16-095-GSU134.500	30880.0
525832	TUCO_INT 7345.00	11097.2	587773	G16-095-GEN10.6900	1503044.0
525844	ELK_1 118.000	45440.9	587960	GEN-2016-120345.00	5870.1
525845	ELK_2 1 18.000	41424.1	587964	G16-120-TAP 345.00	7433.4
525850	ELK_CT1 345.00	10998.3	587970	GEN-2016-175345.00	4782.5
560078	G16-037-TAP 345.00	9454.6	590001	OKLEHV24 138.00	5172.5
560088	G16-063-TAP 345.00	7429.8	590002	OKLAUN1G 24.000	87674.5

583090	G1149&G1504 345.00	8410.4	590003	OKLEHV14 138.00	5290.1
584060	GEN-2015-057345.00	8165.1	599891	OKLAUN 7 345.00	4367.2
GEN-2016-097					
511421	VERDEN 4 138.00	9864.9	520211	HARPER2 138.00	30047.6
511422	FLETCHR4 138.00	8107.0	520404	MDCPRK4 138.00	5382.1
511423	FLE TAP4 138.00	8890.0	520422	SEQUOYAHJ4 138.00	30530.8
511425	TUTCONT4 138.00	10631.2	520501	BRIDGECR 138.00	6818.8
511428	LG-YEAR4 138.00	11916.3	520510	NAPLESTP 138.00	9087.4
511431	LWS S4 138.00	11060.8	520512	BC SW 4 138.00	6998.4
511437	COMANC-4 138.00	18000.9	520811	ANADRK4 13.800	55710.9
511439	LWSTAP 4 138.00	11537.6	520812	ANADRK5 13.800	55772.4
511445	CARNEG-4 138.00	7911.2	520813	ANADRK6 13.800	55704.8
511446	CL-AFTP4 138.00	6684.6	520814	ANADARK4 138.00	32686.4
511449	CORNVIL4 138.00	16580.7	520827	BINGERJ4 138.00	7553.1
511453	DUNCAN-4 138.00	6394.8	520867	CORN TP4 138.00	14146.3
511458	ELKCTY-4 138.00	11430.6	520870	CYRIL 2 138.00	7835.7
511463	HOB-JCT4 138.00	7016.9	520900	EMPIRE 4 138.00	4590.2
511467	L.E.S.-4 138.00	24656.2	520911	FLETCHR2 138.00	6222.3
511471	LWS-NTP4 138.00	11652.1	520912	FLETCH-4 138.00	6124.5
511474	SHERID4 138.00	12313.7	520923	GEORGIA4 138.00	17296.4
511477	S.W.S.-4 138.00	34476.7	521010	NIJECT 4 138.00	5391.8
511483	NORGE--4 138.00	11366.8	521017	ONEY 4 138.00	10757.3
511486	ELGINJT4 138.00	10002.6	521024	PARADSE4 138.00	5686.3
511488	112GORE4 138.00	12713.6	521031	POCASET4 138.00	7654.2
511491	RUSHSPT4 138.00	8084.9	521050	SICKLES4 138.00	6307.0
511492	SANTAFE4 138.00	8439.5	521072	TUTTLE 4 138.00	6521.8
511494	COMMTAP4 138.00	21503.6	521089	WASHITA4 138.00	28398.4
511501	TUTTLE4 138.00	10513.2	521101	GENCO1 4 13.800	33179.4

511502	N29CHIK4 138.00	10391.7	521102	GENCO2 4 13.800	33243.2
511508	BLANCHD4 138.00	5742.0	521103	SLKHILLS 4 138.00	7919.4
511509	53CACHE4 138.00	11690.2	521110	ORME1 13.800	51199.5
511510	LAIRGST4 138.00	12307.1	521111	ORME2 13.800	51199.5
511512	RPPAPER4 138.00	11966.9	521112	ORME3 13.800	51199.5
511515	TEXAS 4 138.00	5726.7	521129	BLUCAN5 4 138.00	5961.5
511516	ALEX BR4 138.00	6267.4	529302	OMALTUS4 138.00	4575.5
511535	CLIN-AF4 138.00	5068.4	529304	OMDUNCN4 138.00	6597.7
511537	ARTVLTP4 138.00	11710.0	583100	GEN-2011-050138.00	6836.9
511538	ARTVILL4 138.00	8464.8	583900	GEN-2014-020138.00	10513.2
511554	RKY_RDG4 138.00	5430.5	587790	GEN-2016-097138.00	9617.9
511562	ROUNDCK4 138.00	6615.2	587791	G16-097XFMR134.500	14971.8
511563	ELSWORTH 4138.00	9930.1	587792	G16-097-GSU134.500	14769.3
511564	MARTHA 4 138.00	4442.5	587793	G16-097-GEN10.6900	740542.6
511846	SWS1-1 14.400	58410.6	587794	G16-097-TAP 138.00	11743.1
511847	SWS2-1 14.400	58693.5	599004	BLUCAN2-CB1 34.500	17871.3
511848	SWS3-1 24.000	90829.9	599007	BLUCAN-CB1 34.500	13458.7
511851	COM1-1 13.800	72592.4	599021	BLUCAN5-LVB134.500	10788.2
511852	COM2-1 13.800	45736.7	599022	BLUCAN5-CB1 34.500	10249.7
515055	MAUD 4 138.00	19263.4	599095	BCVI_HVB 138.00	7895.3
515802	GRACMNT4 138.00	29285.3	599096	BCVI_LVB 34.500	15530.8
GEN-2016-132					
511490	ELKCITY6 230.00	7336.3	523779	STLN-DEMARC6230.00	7736.6
511541	SWEETWT6 230.00	8732.2	523977	HARRNG_WST 6230.00	26021.6
511542	BUFFCK6 230.00	6374.9	523978	HARRNG_MID 6230.00	26021.6
511544	DEMPSEY6 230.00	5473.4	524023	NICHOLS_3 122.000	94227.7
511547	ROARK6 230.00	4925.2	524044	NICHOLS 6230.00	25261.7
511557	CHISHOLM6 230.00	11290.7	524415	AMA_SOUTH 6230.00	13342.5

511961	DEMPSEY1 34.500	20312.7	599047	DEMPSEY_GSU134.500	18790.9
523551	HUTCHISON 6230.00	7084.2	599048	DEMPSEY_GSU234.500	18038.3
523771	GRAPEVINE 6230.00	5904.7	599049	DEMPSEY_WTG10.6900	649404.6
523777	WHEELER 6230.00	6307.9	599050	DEMPSEY_WTG20.6900	532317.9

Table 6: GROUP 7 26SP Short-Circuit Study Results

Bus No	Bus Name	Short Circuit Current (A)	Bus No	Bus Name	Short Circuit Current (A)
MDWG16-26S_DIS1602_G07					
GEN-2016-091					
510907	PITTSB-7 345.00	13067.8	584072	G14-057-GSU134.500	24482.2
511456	O.K.U.-7 345.00	5132.6	584780	GEN-2015-036345.00	7560.1
511468	L.E.S.-7 345.00	13052.2	584951	G15-057XFMR134.500	15389.1
511553	CHISHOLM7 345.00	10481.2	585060	GEN-2015-068345.00	10528.6
511565	OKLAUN HVDC7345.00	5118.4	585061	G15-068-XF-134.500	34551.1
511568	TERRYRD7 345.00	9845.6	585080	GEN-2015-071345.00	9070.8
511571	RUSHSPR7 345.00	6337.5	585081	G15-071XFMR134.500	30952.5
511965	RUSHSPRW1-1 34.500	26320.4	585270	GEN-2015-093345.00	10018.9
514801	MINCO 7 345.00	17447.9	585271	G15-093XFMR134.500	29992.0
514809	JOHNCO 7 345.00	9622.6	585272	G15-093-GSU134.500	29216.0
514880	NORTWST7 345.00	31576.9	585273	G15-093-GEN10.6900	992011.4
514881	SPRNGCK7 345.00	22593.0	585274	G15-093-GEN20.6900	893730.6
514901	CIMARON7 345.00	32239.2	585280	GEN-2015-092345.00	6146.9
514908	ARCADIA7 345.00	25228.3	585281	G15-092XFMR134.500	26187.8
514934	DRAPER 7 345.00	20407.9	587230	GEN-2016-037345.00	8379.3
515045	SEMINOL7 345.00	25464.8	587231	G16-037XFMR134.500	46188.0
515136	SUNNYSD7 345.00	10633.9	587232	G16-037-GSU134.500	45017.4
515375	WWRDEHV7 345.00	19864.8	587300	G16-045-SUB1345.00	1578.3
515407	TATONGA7 345.00	15909.5	587304	G16-045-SUB2345.00	1536.2
515444	MCNOWND7 345.00	17395.7	587380	G16-057-SUB1345.00	1555.0

515458	BORDER 7345.00	10121.5	587384	G16-057-SUB2345.00	1476.8
515497	MATHWSN7 345.00	31029.3	587430	GEN-2016-063345.00	7302.8
515549	MNCWND37 345.00	11872.6	587740	GEN-2016-091345.00	13294.7
515600	KNGFSHR7 345.00	11233.3	587741	G16-091XFMR134.500	31004.9
515605	CANADN7 345.00	11608.7	587742	G16-091-GSU134.500	29583.1
515610	FSHRTAP7 345.00	16478.8	587743	G16-091-GEN10.6900	1333305.9
515800	GRACMNT7 345.00	17477.9	587744	G16-091-TAP 345.00	14953.1
515875	REDNGTN7 345.00	17864.8	587770	GEN-2016-095345.00	11023.7
515939	MNCWND47 345.00	6461.9	587771	G16-095XFMR134.500	31570.7
521157	HUGO 7 345.00	10860.2	587772	G16-095-GSU134.500	30777.2
525832	TUCO_INT 7345.00	13206.0	587773	G16-095-GEN10.6900	1499476.0
525844	ELK_1 118.000	47023.3	587960	GEN-2016-120345.00	6018.8
525845	ELK_2 1 18.000	42709.8	587964	G16-120-TAP 345.00	7732.1
525850	ELK_CT1 345.00	13065.4	587970	GEN-2016-175345.00	4886.8
560078	G16-037-TAP 345.00	9432.6	590001	OKLEHV24 138.00	5171.0
560088	G16-063-TAP 345.00	7389.6	590002	OKLAUN1G 24.000	87657.0
583090	G1149&G1504 345.00	8411.4	590003	OKLEHV14 138.00	5289.4
584060	GEN-2015-057345.00	8120.7	599891	OKLAUN 7 345.00	4366.3
GEN-2016-095					
510907	PITTSB-7 345.00	13067.8	584072	G14-057-GSU134.500	24482.2
511456	O.K.U.-7 345.00	5132.6	584780	GEN-2015-036345.00	7560.1
511468	L.E.S.-7 345.00	13052.2	584951	G15-057XFMR134.500	15389.1
511553	CHISHOLM7 345.00	10481.2	585060	GEN-2015-068345.00	10528.6
511565	OKLAUN HVDC7345.00	5118.4	585061	G15-068-XF-134.500	34551.1
511568	TERRYRD7 345.00	9845.6	585080	GEN-2015-071345.00	9070.8
511571	RUSHSPR7 345.00	6337.5	585081	G15-071XFMR134.500	30952.5
511965	RUSHSPRW1-1 34.500	26320.4	585270	GEN-2015-093345.00	10018.9
514801	MINCO 7 345.00	17447.9	585271	G15-093XFMR134.500	29992.0

514809	JOHNCO 7 345.00	9622.6	585272	G15-093-GSU134.500	29216.0
514880	NORTWST7 345.00	31576.9	585273	G15-093-GEN10.6900	992011.4
514881	SPRNGCK7 345.00	22593.0	585274	G15-093-GEN20.6900	893730.6
514901	CIMARON7 345.00	32239.2	585280	GEN-2015-092345.00	6146.9
514908	ARCADIA7 345.00	25228.3	585281	G15-092XFMR134.500	26187.8
514934	DRAPER 7 345.00	20407.9	587230	GEN-2016-037345.00	8379.3
515045	SEMINOL7 345.00	25464.8	587231	G16-037XFMR134.500	46188.0
515136	SUNNYSD7 345.00	10633.9	587232	G16-037-GSU134.500	45017.4
515375	WWRDEHV7 345.00	19864.8	587300	G16-045-SUB1345.00	1578.3
515407	TATONGA7 345.00	15909.5	587304	G16-045-SUB2345.00	1536.2
515444	MCNOWND7 345.00	17395.7	587380	G16-057-SUB1345.00	1555.0
515458	BORDER 7345.00	10121.5	587384	G16-057-SUB2345.00	1476.8
515497	MATHWSN7 345.00	31029.3	587430	GEN-2016-063345.00	7302.8
515549	MNCWND37 345.00	11872.6	587740	GEN-2016-091345.00	13294.7
515600	KNGFSHR7 345.00	11233.3	587741	G16-091XFMR134.500	31004.9
515605	CANADN7 345.00	11608.7	587742	G16-091-GSU134.500	29583.1
515610	FSHRTAP7 345.00	16478.8	587743	G16-091-GEN10.6900	1333305.9
515800	GRACMNT7 345.00	17477.9	587744	G16-091-TAP 345.00	14953.1
515875	REDNGTN7 345.00	17864.8	587770	GEN-2016-095345.00	11023.7
515939	MNCWND47 345.00	6461.9	587771	G16-095XFMR134.500	31570.7
521157	HUGO 7 345.00	10860.2	587772	G16-095-GSU134.500	30777.2
525832	TUCO_INT 7345.00	13206.0	587773	G16-095-GEN10.6900	1499476.0
525844	ELK_1 118.000	47023.3	587960	GEN-2016-120345.00	6018.8
525845	ELK_2 1 18.000	42709.8	587964	G16-120-TAP 345.00	7732.1
525850	ELK_CT1 345.00	13065.4	587970	GEN-2016-175345.00	4886.8
560078	G16-037-TAP 345.00	9432.6	590001	OKLEHV24 138.00	5171.0
560088	G16-063-TAP 345.00	7389.6	590002	OKLAUN1G 24.000	87657.0
583090	G1149&G1504 345.00	8411.4	590003	OKLEHV14 138.00	5289.4

584060	GEN-2015-057345.00	8120.7	599891	OKLAUN 7 345.00	4366.3
GEN-2016-097					
511421	VERDEN 4 138.00	9821.9	520211	HARPER2 138.00	29951.5
511422	FLETCHR4 138.00	8068.5	520404	MDCPRK4 138.00	5361.1
511423	FLE TAP4 138.00	8848.7	520422	SEQUOYAHJ4 138.00	30433.6
511425	TUTCONT4 138.00	10572.1	520501	BRIDGECR 138.00	6761.6
511428	LG-YEAR4 138.00	11873.6	520510	NAPLESTP 138.00	9027.7
511431	LWS S4 138.00	11015.8	520512	BC SW 4 138.00	6980.5
511437	COMANC-4 138.00	17970.8	520811	ANADRK4 13.800	55555.8
511439	LWSTAP 4 138.00	11492.5	520812	ANADRK5 13.800	55617.0
511445	CARNEG-4 138.00	7884.2	520813	ANADRK6 13.800	55549.9
511446	CL-AFTP4 138.00	6666.6	520814	ANADARK4 138.00	32586.0
511449	CORNVIL4 138.00	16501.3	520827	BINGERJ4 138.00	7521.5
511453	DUNCAN-4 138.00	6354.1	520867	CORN TP4 138.00	14073.0
511458	ELKCTY-4 138.00	11431.8	520870	CYRIL 2 138.00	7795.6
511463	HOB-JCT4 138.00	7002.9	520900	EMPIRE 4 138.00	4570.1
511467	L.E.S.-4 138.00	24653.8	520911	FLETCHR2 138.00	6186.3
511471	LWS-NTP4 138.00	11608.1	520912	FLETCH-4 138.00	6102.8
511474	SHERID4 138.00	12268.7	520923	GEORGIA4 138.00	17233.6
511477	S.W.S.-4 138.00	34392.7	521010	NIJECT 4 138.00	5367.1
511483	NORGE--4 138.00	11311.3	521017	ONEY 4 138.00	10715.9
511486	ELGINJT4 138.00	9955.6	521024	PARADSE4 138.00	5664.1
511488	112GORE4 138.00	12671.7	521031	POCASET4 138.00	7605.8
511491	RUSHSPT4 138.00	8042.6	521050	SICKLES4 138.00	6279.3
511492	SANTAFE4 138.00	8396.2	521072	TUTTLE 4 138.00	6471.8
511494	COMMTAP4 138.00	21479.1	521089	WASHITA4 138.00	28316.7
511501	TUTTLE4 138.00	10455.9	521101	GENCO1 4 13.800	33026.0
511502	N29CHIK4 138.00	10342.6	521102	GENCO2 4 13.800	33089.5

511508	BLANCHD4 138.00	5709.0	521103	SLKHILLS 4 138.00	7897.7
511509	53CACHE4 138.00	11645.8	521110	ORME1 13.800	51050.4
511510	LAIRGST4 138.00	12265.4	521111	ORME2 13.800	51050.4
511512	RPPAPER4 138.00	11923.1	521112	ORME3 13.800	51050.4
511515	TEXAS 4 138.00	5696.6	521129	BLUCAN5 4 138.00	5938.2
511516	ALEX BR4 138.00	6235.0	529302	OMALTUS4 138.00	4581.2
511535	CLIN-AF4 138.00	5050.2	529304	OMDUNCN4 138.00	6555.7
511537	ARTVLTP4 138.00	11665.4	583100	GEN-2011-050138.00	6802.1
511538	ARTVILL4 138.00	8422.3	583900	GEN-2014-020138.00	10455.9
511554	RKY_RDG4 138.00	5414.2	587790	GEN-2016-097138.00	9579.6
511562	ROUNDCK4 138.00	6580.6	587791	G16-097XFMR134.500	14922.4
511563	ELSWORTH 4138.00	9883.5	587792	G16-097-GSU134.500	14723.9
511564	MARTHA 4 138.00	4440.4	587793	G16-097-GEN10.6900	738917.3
511846	SWS1-1 14.400	58352.7	587794	G16-097-TAP 138.00	11697.5
511847	SWS2-1 14.400	58631.0	599004	BLUCAN2-CB1 34.500	17835.7
511848	SWS3-1 24.000	90623.4	599007	BLUCAN-CB1 34.500	13434.4
511851	COM1-1 13.800	72688.6	599021	BLUCAN5-LVB134.500	10738.7
511852	COM2-1 13.800	45864.3	599022	BLUCAN5-CB1 34.500	10204.0
515055	MAUD 4 138.00	19112.1	599095	BCVI_HVB 138.00	7873.7
515802	GRACMNT4 138.00	29189.0	599096	BCVI_LVB 34.500	15500.1
GEN-2016-132					
511490	ELKCITY6 230.00	7326.7	523779	STLN-DEMARC6230.00	7719.8
511541	SWEETWT6 230.00	8717.0	523977	HARRNG_WST 6230.00	25980.0
511542	BUFFCK6 230.00	6360.4	523978	HARRNG_MID 6230.00	25980.0
511544	DEMPSEY6 230.00	5459.9	524023	NICHOLS_3 122.000	94172.2
511547	ROARK6 230.00	4912.6	524044	NICHOLS 6230.00	25230.6
511557	CHISHOLM6 230.00	11279.5	524415	AMA_SOUTH 6230.00	13326.4
511961	DEMPSEY1 34.500	20264.3	599047	DEMPSEY_GSU134.500	18748.7

523551	HUTCHISON 6230.00	7060.6	599048	DEMPSEY_GSU234.500	17996.8
523771	GRAPEVINE 6230.00	5882.3	599049	DEMPSEY_WTG10.6900	648261.1
523777	WHEELER 6230.00	6289.6	599050	DEMPSEY_WTG20.6900	531353.9

J8: GROUP 8 DYNAMIC STABILITY ANALYSIS REPORT

MITSUBISHI ELECTRIC POWER PRODUCTS, INC.
POWER SYSTEMS ENGINEERING DIVISION
530 KEYSTONE DRIVE
WARRENDALE, PA 15086, U.S.A.

Phone: (724) 778-5111 Fax: (724) 778-5149
Home Page: www.meppi.com

Southwest Power Pool, Inc. (SPP)

DISIS-2016-002 (Group 08) Definitive Impact Study

Final Report

REP-0250
Revision #00

May 2018

Submitted By:
Mitsubishi Electric Power Products, Inc. (MEPPI)
Power Systems Engineering Division
Warrendale, PA

Title: **DISIS-2016-002 (Group 08) Definitive Impact Study: Final Report REP-0250**
Date: May 2018

Author: Marcus Young; Principal Engineer, Power Systems Engineering Division *Marcus Young*
Reviewed: Nicholas Tenza; Senior Engineer, Power Systems Engineering Division *Nicholas Tenza*
Approved: Donald Shoup; General Manager, Power Systems Engineering Division *Donald Shoup*

EXECUTIVE SUMMARY

SPP requested a Definitive Interconnection System Impact Study (DISIS). The DISIS required a Stability Analysis and a Short Circuit Analysis detailing the impacts of the interconnecting projects as shown in Table ES-1.

Table ES-1
Interconnection Projects Evaluated

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2016-024	55.86	Solar	Midian 138kV (532990)
GEN-2016-072	300	Wind	Tap Hunter-Renfrow 345kV (560086)
GEN-2016-100	100	Wind	Tap Sooner-Spring Creek 345kV (587804)
GEN-2016-101	195	Wind	Tap Sooner-Spring Creek 345kV (587804)
GEN-2016-119	600	Wind	Tap Spring Creek-Sooner 345 kV (587804)
GEN-2016-127	200	Wind	Shidler 138kV Substation (520214)
GEN-2016-128	252	Wind	Woodring 345kV Substation (514715)
GEN-2016-133	187.5	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-134	187.5	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-135	100	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-136	75	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-137	187.5	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-138	187.5	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-139	100	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-140	75	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-141	350	Wind	Tulsa North 345kV Substation (509852)

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2016-142	350	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-143	175	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-144	175	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-145	175	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-146	175	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-148	150	Wind	Hardy 138kV Substation (520213)
GEN-2016-153	134	Wind	Viola 345kV (532798)
GEN-2016-162	252	Wind	Benton 345kV (532791)
GEN-2016-163	252	Wind	Benton 345kV (532791)
GEN-2016-173	42	Solar	Creswell 69kV Substation (533543)

SUMMARY OF STABILITY ANALYSIS

The Stability Analysis determined that there were multiple contingencies across all seasons that resulted in voltage instability, generation tripping offline, and poor post-fault voltage recovery when all generation interconnection requests were at 100% output. To mitigate the voltage instability, voltage violations, generation tripping offline, and poor post-fault steady-state voltages, the following upgrades were provided by SPP and implemented in each season:

- Redington to Woodring 345 kV circuit #2
- Hunter to Woodring 345 kV circuit #2
- Redington to Spring Creek 345 kV circuit #1
- Tulsa North 345/138 kV transformer #2
- Benton 138 kV capacitor bank initialized at 153.6 Mvar (an existing capacitor bank)
- GEN-2016-045 34.5 kV reactor: 175 Mvar (an existing reactor)
- GEN-2016-057 34.5 kV reactor #1 and #2: 175 Mvar each (existing reactors)
- Static Var Compensators (SVC)
    - +300 Mvar SVC at Tulsa North 345 kV bus (wind plant side of 765 kV line)
    - +300 Mvar SVC at Tulsa North 345 kV bus (transmission side of 765 kV line)

It was observed that the SVC solutions at Tulsa North mitigated a portion of the contingencies around the Tulsa North 345 kV substation. For various contingencies, a reasonable solution was not identified due to 2,500 MW of generation being interconnected to the Tulsa North 345 kV line through a 360 mile 765 kV transmission line which results in the project's turbines tripping offline due to overvoltage protection. It is recommended that the interconnection customer(s) for GEN-2016-133 through GEN-2016-146 re-examine the design of the interconnection request(s).

For FLT29-PO, which is a prior outage of G16-072-Tap to Hunters 345 kV line, followed by a three phase fault on the Renfrow to Viola 345 kV line, voltage and generator instability of GEN-2016-072 exists. In order to mitigate this violation, it is recommended GEN-2016-072 be curtailed to 210 MW (reduction of 90 MW) following the prior outage condition for the 17 Winter Peak, 18 Summer Peak, and 26 Summer Peak condition.

Similarly, FLT33-PO is a prior outage of the Renfrow to Viola 345 kV line followed by a three phase fault on the G16-072-Tap to Hunters 345 kV line which also requires GEN-2016-072 be curtailed to 210 MW (reduction of 90 MW) following the prior outage condition for the 17 Winter Peak, 18 Summer Peak, and 26 Summer Peak condition.

Note for GEN-2016-173, for a three-phase fault at the point of interconnection (Creswell 69 kV), the Power Electronics HEC-US V1500 inverter model tripped offline due to over frequency protection. For this study, the over frequency protection was set to 80 Hz to avoid instantaneous tripping. It is recommended the supplier of the Power Electronic inverter model examine this model for three-phase faults that cause the model to trip on over frequency protection.

For FLT186, which is a three phase fault on the Waverly to LaCygne 345 kV line near Waverly, it was determined the system response of area generators and voltage did not meet SPP disturbance requirements following the fault until the power output at Waverly Wind Farm and Wolf Creek Generating Station were reduced.

After implementing the above upgrades, the contingency analysis was re-simulated for all contingencies. With the upgrades, the Stability Analysis determined that there was no generation tripping or system instability observed as a result of interconnecting all study projects at 100% output except for several contingencies near Tulsa North. It is recommended that the interconnection customer(s) for GEN-2016-133 through GEN-2016-146 re-examine the design of the interconnection request(s).

SUMMARY OF THE SHORT CIRCUIT ANALYSIS

The Short Circuit Analysis was performed on the 2018 Summer Peak (18SP) and 2026 Summer Peak (26SP) power flows for all study projects. Refer to Table ES-2 and Table ES-3 for a list of maximum fault currents observed for each study project for the 18SP and 26SP cases, respectively.

Table ES-2
2018SP: List of Maximum Fault Currents Observed for Each Study Project

Study Project	Fault Current at POI (kA)	Maximum Fault Current (kA)	Fault Location	Bus Voltage (kV)
GEN-2016-024	10.16	40.84	EVANS N4	138
GEN-2016-072	13.08	44.84	EVANS N4	138
GEN-2016-100 GEN-2016-101 GEN-2016-119	16.29	44.32	NORTHWEST 7	138
GEN-2016-127	7.41	31.56	SOONER 4	138
GEN-2016-128	18.96	44.32	NORTHWEST 4	138
GEN-2016-133 to GEN-2016-146	25.91	59	RSS T2 4	138
GEN-2016-148	5.56	20.41	SNRPMPT4	138
GEN-2016-153	7.77	44.84	EVANS N4	138
GEN-2016-162 GEN-2016-163	20.46	44.84	EVANS N4	138
GEN-2016-173	10.63	16.07	FARBER 4	138

Table ES-3
2026SP: List of Maximum Fault Currents Observed for Each Study Project

Study Project	Fault Current at POI (kA)	Maximum Fault Current (kA)	Fault Location	Bus Voltage (kV)
GEN-2016-024	10.18	41.05	EVANS N4	138
GEN-2016-072	15.00	44.05	EVANS N4	138
GEN-2016-100 GEN-2016-101 GEN-2016-119	16.49	44.55	NORTHWEST 7	138
GEN-2016-127	7.43	31.97	SOONER 4	138
GEN-2016-128	22.99	44.55	NORTHWEST 4	138
GEN-2016-133 to GEN-2016-146	25.73	61.25	RSS T2 4	138
GEN-2016-148	5.57	20.60	SNRPMPT4	138
GEN-2016-153	7.77	41.05	EVANS N4	138
GEN-2016-162 GEN-2016-163	20.55	41.05	EVANS N4	138
GEN-2016-173	11.15	26.22	GILL 4	138

Table of Contents

SECTION 1: OBJECTIVES

The objective of this report is to provide Southwest Power Pool, Inc. (SPP) with the deliverables for the "DISIS-2016-002 (Group 08) Definitive Impact Study." SPP requested an Interconnection System Impact Study for twenty-six (26) generation interconnections for 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak, which requires a Stability Analysis and Short Circuit Analysis.

SECTION 2: BACKGROUND

The Siemens Power Technologies International PSS/E power system simulation program Version 33.10.0 was used for this study. SPP provided the stability database cases for 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak conditions and the list of contingencies to be examined were created by MEPPI. The model includes the study projects shown in Table 2-1 and the previously queued projects listed in Table 2-2. Refer to Appendix A for the steady-state and dynamic model data for the study projects. A power flow one-line diagram for each generation interconnection project is shown in Figures 2-1 through 2-10. Note that the one-line diagrams represent the 2018 Summer Peak case.

The Stability Analysis determined the impacts of the new interconnecting projects on the stability and voltage recovery of the nearby system and the ability of the interconnecting projects to meet FERC Order 661A. SPP Performance Criteria violations for stability and voltage recovery were identified, the need for reactive compensation or system upgrades was investigated. Three-phase faults and single line-to-ground faults were examined as listed in Table 2-3.

Table 2-1
Interconnection Projects Evaluated

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2016-024	55.86	Solar	Midian 138kV (532990)
GEN-2016-072	300	Wind	Tap Hunter-Renfrow 345kV (560086)
GEN-2016-100	100	Wind	Tap Sooner-Spring Creek 345kV (587804)
GEN-2016-101	195	Wind	Tap Sooner-Spring Creek 345kV (587804)
GEN-2016-119	600	Wind	Tap Sooner-Spring Creek 345 kV (587804)
GEN-2016-127	200	Wind	Shidler 138kV Substation (520214)
GEN-2016-128	252	Wind	Woodring 345kV Substation (514715)
GEN-2016-133	187.5	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-134	187.5	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-135	100	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-136	75	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-137	187.5	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-138	187.5	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-139	100	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-140	75	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-141	350	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-142	350	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-143	175	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-144	175	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-145	175	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-146	175	Wind	Tulsa North 345kV Substation (509852)
GEN-2016-148	150	Wind	Hardy 138kV Substation (520213)
GEN-2016-153	134	Wind	Viola 345kV (532798)
GEN-2016-162	252	Wind	Benton 345kV (532791)
GEN-2016-163	252	Wind	Benton 345kV (532791)
GEN-2016-173	42	Solar	Creswell 69kV Substation (533543)

Table 2-2
Previously Queued Nearby Interconnection Projects Included

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2002-004	199.5	GE.1.5MW	Latham 345kV (532800)
GEN-2005-013	199.8	Vestas V90 VCSS 1.8MW	Caney River 345kV (532780)
GEN-2007-025/GEN-2010-005	598.4	GE 1.6MW & Vestas V110 2.0MW	Viola 345kV (532798)
GEN-2008-013	300	GE 1.68/2.4MW	Hunter 345kV (515476)
GEN-2008-021	42 uprate 1261 Summer 1283 Winter	GENROU	Wolf Creek 345kV (532797)
GEN-2008-098/ GEN-2010-003	199	Gamesa G114 2.0/2.1MW	Waverly 345kV (532799)
GEN-2009-025	59.8	Siemens 93m 2.3MW	Nardins 69kV (515528)
ASGI-2010-006	150	GE 1.5MW	Remington 138kV (301369)
GEN-2010-055	4.8	Caterpiller 1.6MW	Wekiwa 138kV (509757)
GEN-2011-057	150	Vestas V110 2.0MW	Creswell 138kV (532981)
GEN-2012-032	299	Siemens 108m 2.3MW	Open Sky 345kV (515621)
GEN-2012-033/GEN-2015-062	102.56	GE 1.79/1.8MW	Tap and Tie South 4th - Bunch Creek & Enid Tap - Fairmont (GEN-2012-033T) 138kV (514815)
GEN-2012-041	121.5	Thermal 121.488MW	Ranch Road 345kV (515576)
GEN-2013-012	137 uprate 1420	GENROU	Redbud 345kV (514909)
GEN-2013-028	559.5	Gas CT (CC) 360MW, Steam (CC) 199.5MW	Tap on Tulsa N to GRDA1 345kV (512865)

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2013-029	299	Siemens 108m VS 2.3MW	Renfrow 345kV(515543)
GEN-2014-001	199.5	Gamesa 2.1MW	Tap Wichita to Emporia Energy Center 345kV (562476)
GEN-2014-028	35 uprate 259 Winter 256 Summer	Thermal – CT 142MW, Thermal – ST 17MW	Riverton 161kV (547469)
GEN-2014-064	248.4	GE 107m 2.3MW	Otter 138kV (514708)
ASGI-2014-014	56.4 Winter 54.3 Summer	Wartsila 18V50SG 18.8MW	Ferguson 69kV (512664)
GEN-2015-001/GEN-2016-031	201.3	Vestas V126 GridStreamer 3.3MW	Ranch Road 345kV (515576)
GEN-2015-015	154.6	Siemens 108m 2.415MW	Tap Medford Tap – Coyote 138kV (560031)
GEN-2015-016	200	Vestas V110 2.0MW	Tap Marmaton - Centerville 161kV (560029)
GEN-2015-024	217.8	GE 116m 1.8MW	Tap Thistle - Wichita 345kV Dbl CKT (560033)
GEN-2015-025	215.95	GE 1.79/1.8MW	Tap Thistle - Wichita 345kV Dbl CKT (560033)
GEN-2015-030	200.1	GE 107m 2.3MW	Sooner 345kV (514803)
ASGI-2015-004	54.300 Summer 56.364 Winter	Wartsila 18V50SG 18.788MW	Coffeyville Municipal Light & Power Northern Industrial Park Substation 69kV (512735)
GEN-2015-034	200	Vestas V136 GridStreamer 3.45MW	Ranch Road 345kV (515576)
GEN-2015-047	297.8	GE 2.3/2.5MW	Sooner 345kV (514803)

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2015-052	300	Vestas V110 VCSS 2.0MW	Tap on Opensky (515621) to RoseHill (532794) 345kV (560053)
GEN-2015-063	299.25	Acciona 125m 3.15MW	Tap on Woodring (514715) to Matthewson (515497) 345kV (560055)
GEN-2015-066	248.4	GE 2.3MW	Tap on Cleveland (512694) to Sooner (514803) 345 kV (560056)
GEN-2015-069	300	Vestas V110 VCSS 2.0MW	Union Ridge 230kV (532874)
GEN-2015-073	200.1	Vestas V126 GridStreamer 3.45MW	Emporia Energy Center 345kV (532768)
GEN-2015-083/GEN-2016-060	149.5	G.E. 2.3MW	Belle Plain 138kV (533063)
GEN-2015-090	220	G.E. 2.0MW	Wichita (532796)-Thistle (539801) 345kV Tap (GEN-2015-024 (560033) 345kV)
GEN-2016-009	29	Allen Bradley 14.5MW	Osage 69kV (514742)
GEN-2016-022	151.8	Vestas V126 GridStreamer 3.45MW	Ranch Road 345kV (515576)
GEN-2016-032	200	Vestas V110 VCSS 2.0MW	Tap Marshall (514733)- Cottonwood Creek (514827) 138kV, (G16-032-TAP, 560077)
GEN -2016-048	82.32	SMA Sunny Central 2940 2.94MW	Sooner 138kV (514802)
GEN-2016-061	250.7	GE 2.3MW	Tap Woodring (514715) – Sooner (514803) 345kV (G16-061-TAP, 560084)
GEN-2016-068	250	GE 2.0MW	Woodring 345kV (514715)

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2016-071	200.1	GE 2.3MW	Chilocco 138kV (521198)
GEN-2016-073	220	GE 2.0MW	Tap on Thistle (539801) to Wichita (532796) 345kV, ckt1&2 (Buffalo Flats 345kV; 560033)
ASGI-2017-008	158.6	GE 2.3MW & 2.5MW	Tap on Remington (301369) to Shidler (510403) 138 kV (588314)

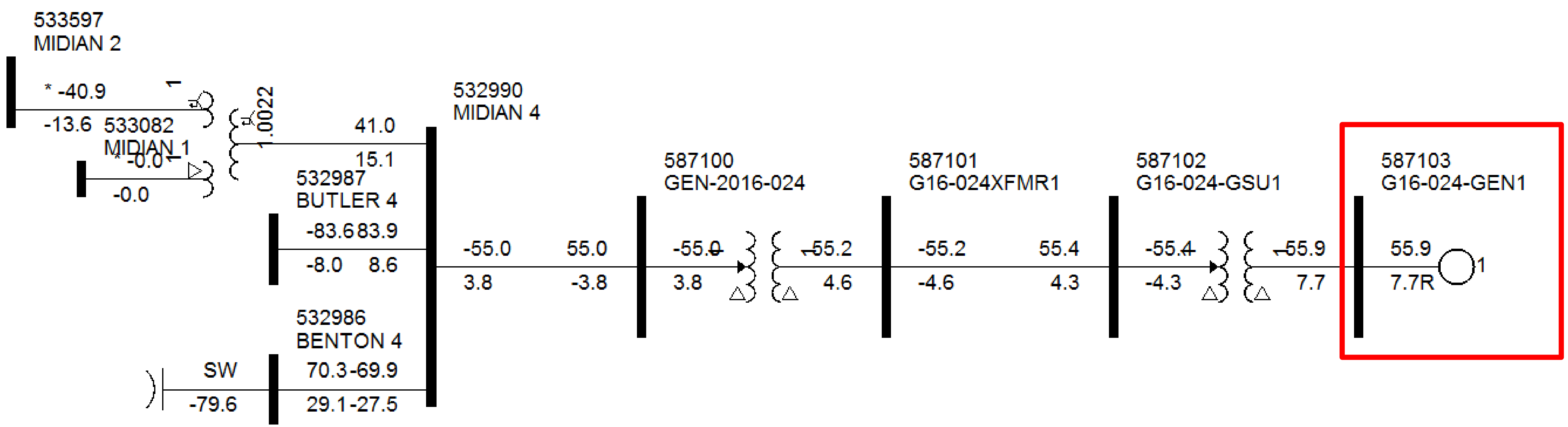


Figure 2-1. Power flow one-line diagram for interconnection project at the Midian 138 kV POI (GEN-2016-024).

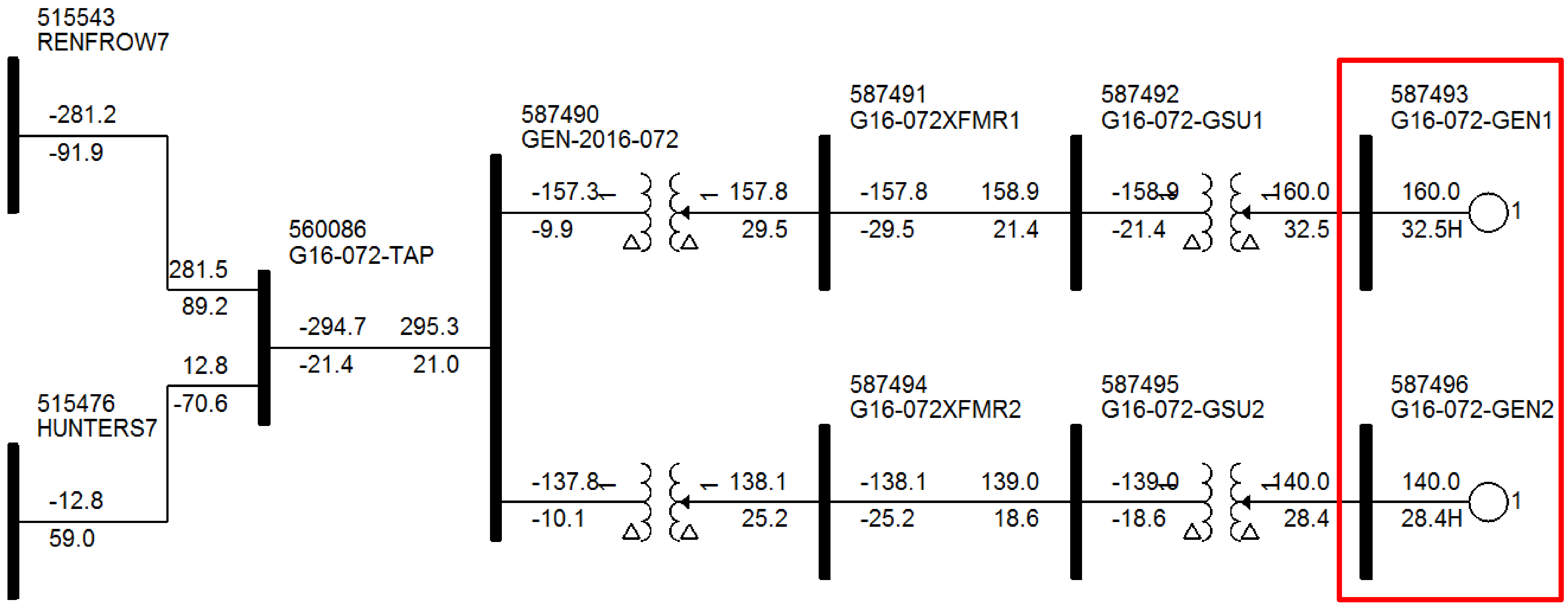


Figure 2-2. Power flow one-line diagram for interconnection project at the Renfrow to Hunters345 kV POI (GEN-16-072).

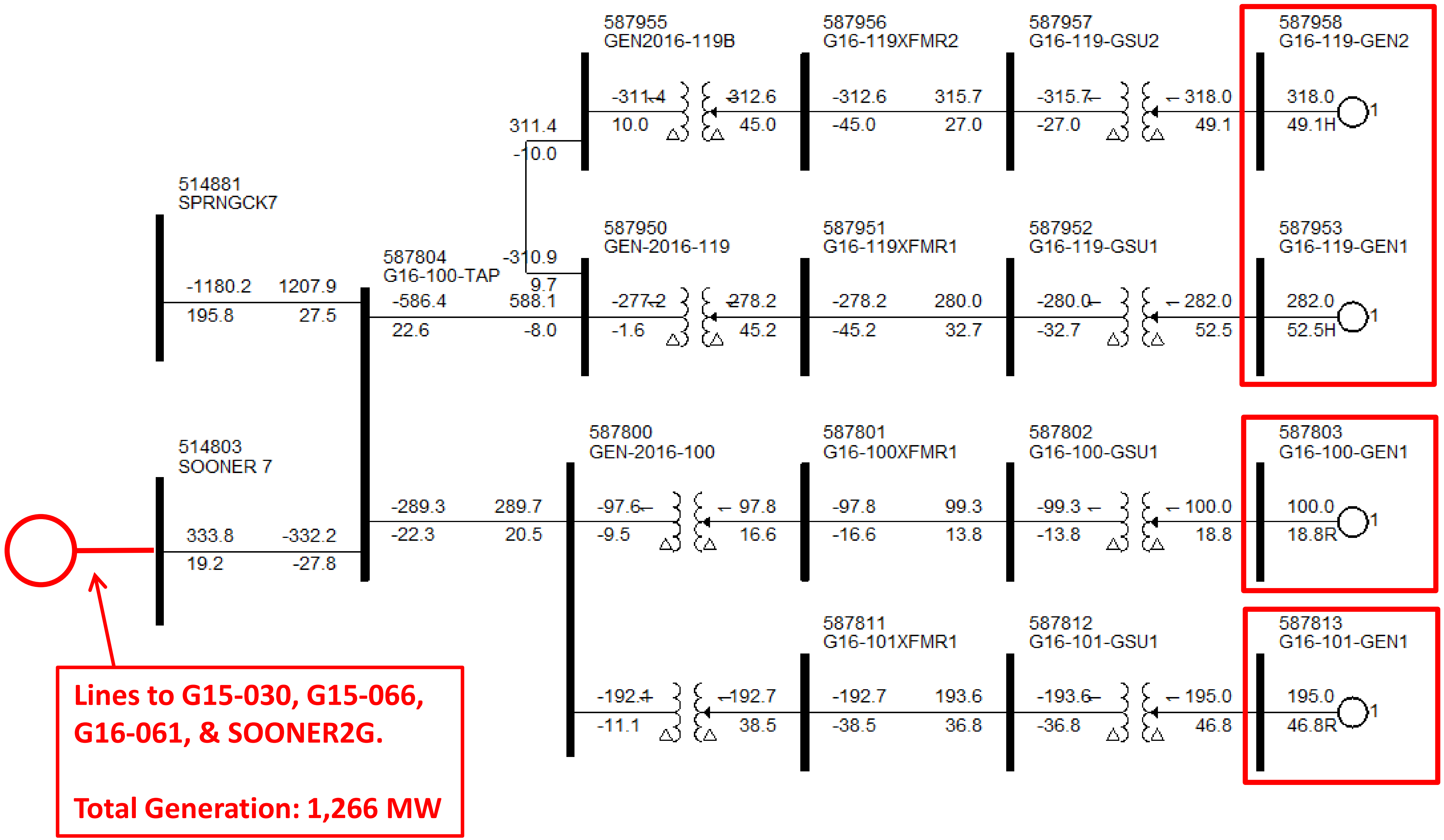


Figure 2-3. Power flow one-line diagram for interconnection project at Sooner to Spring Creek 345 kV POI (GEN-2016-100, GEN-2016-101, GEN-2016-119).

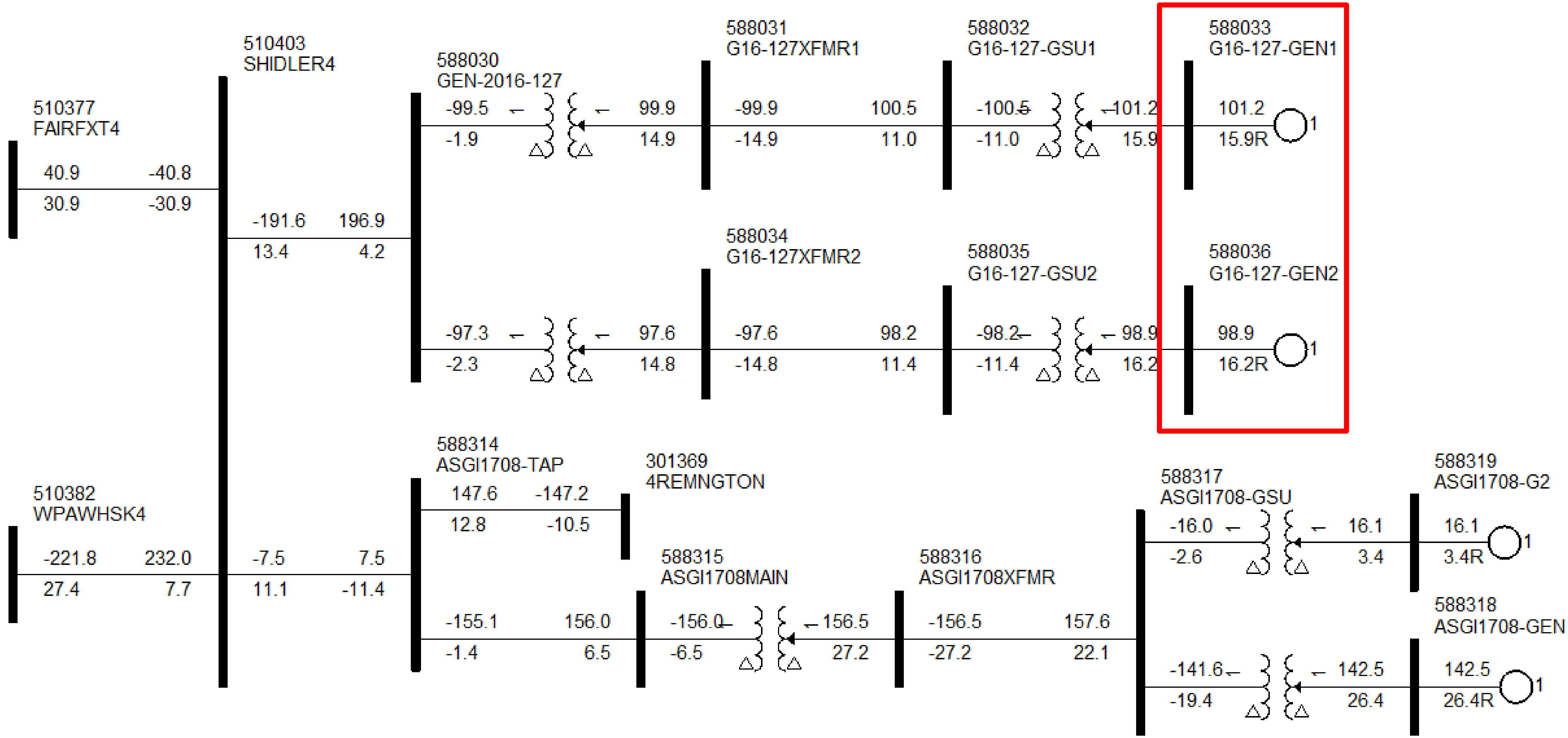


Figure 2-4. Power flow one-line diagram for interconnection project at Shidler 138 kV POI (GEN-2016-127).

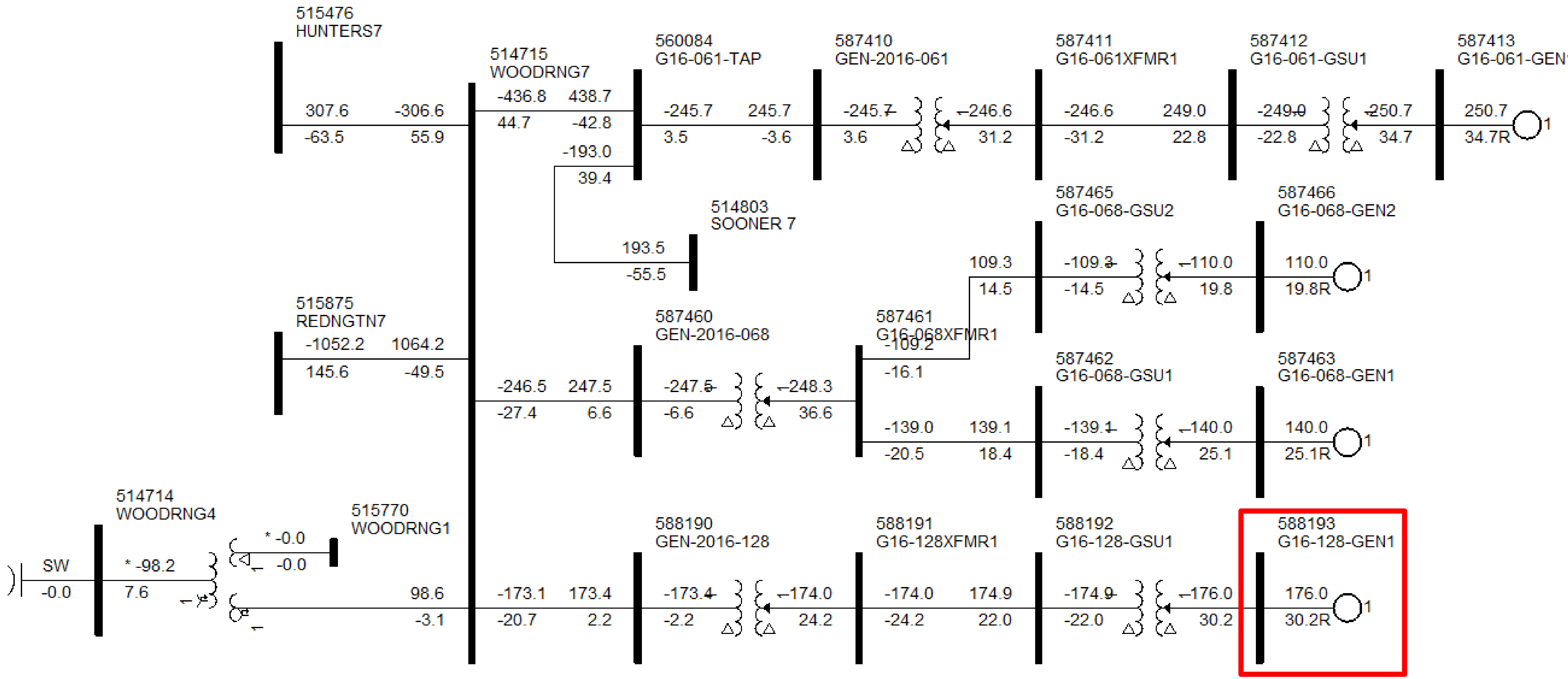


Figure 2-5. Power flow one-line diagram for interconnection project at the Woodring 345 kV POI (GEN-2016-128).

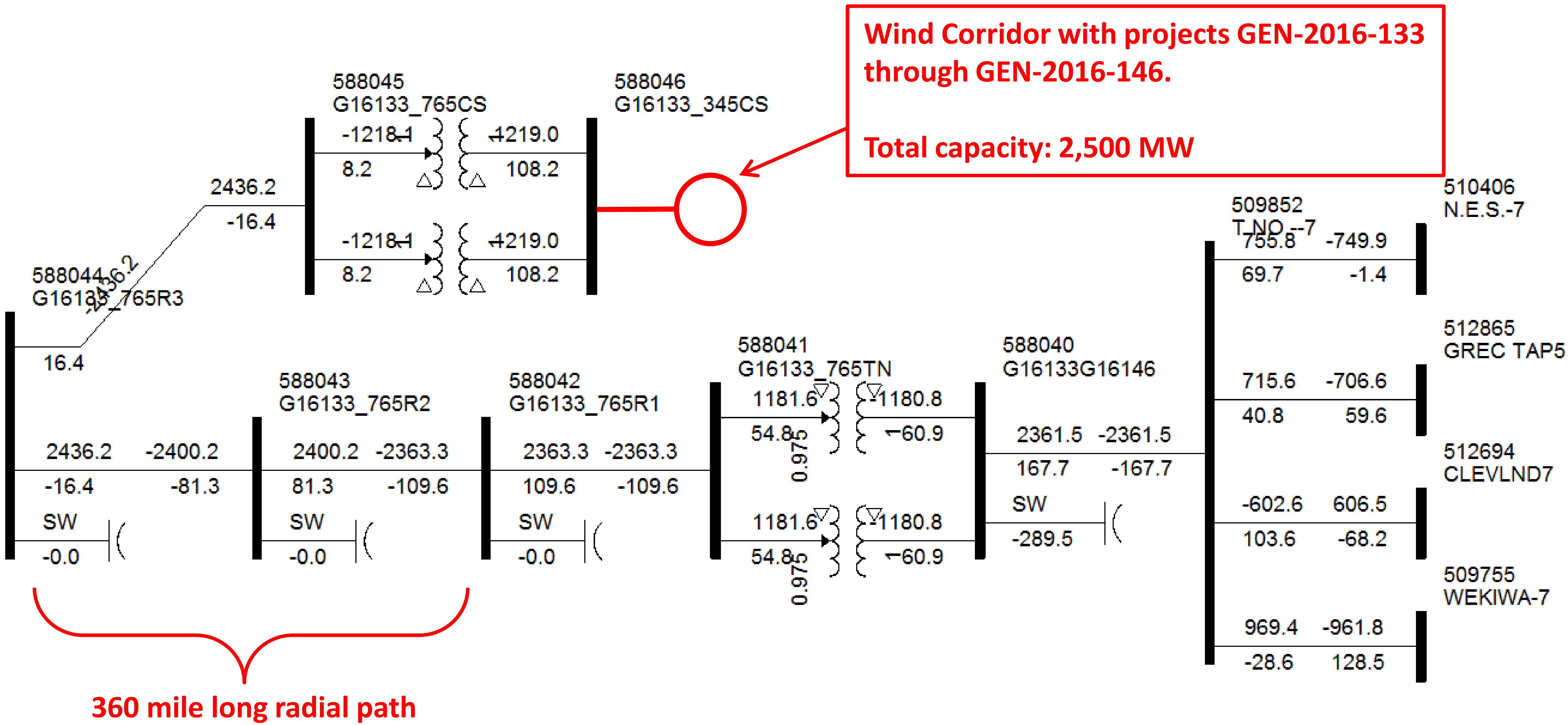


Figure 2-6. Power flow one-line diagram for interconnection project at the Tulsa North 345 kV POI (GEN-2016-133, GEN-2016-134, GEN-2016-135, GEN-2016-136, GEN-2016-137, GEN-2016-138, GEN-2016-139, GEN-2016-140, GEN-2016-141, GEN-2016-142, GEN-2016-144, GEN-2016-145, and GEN-2016-146).

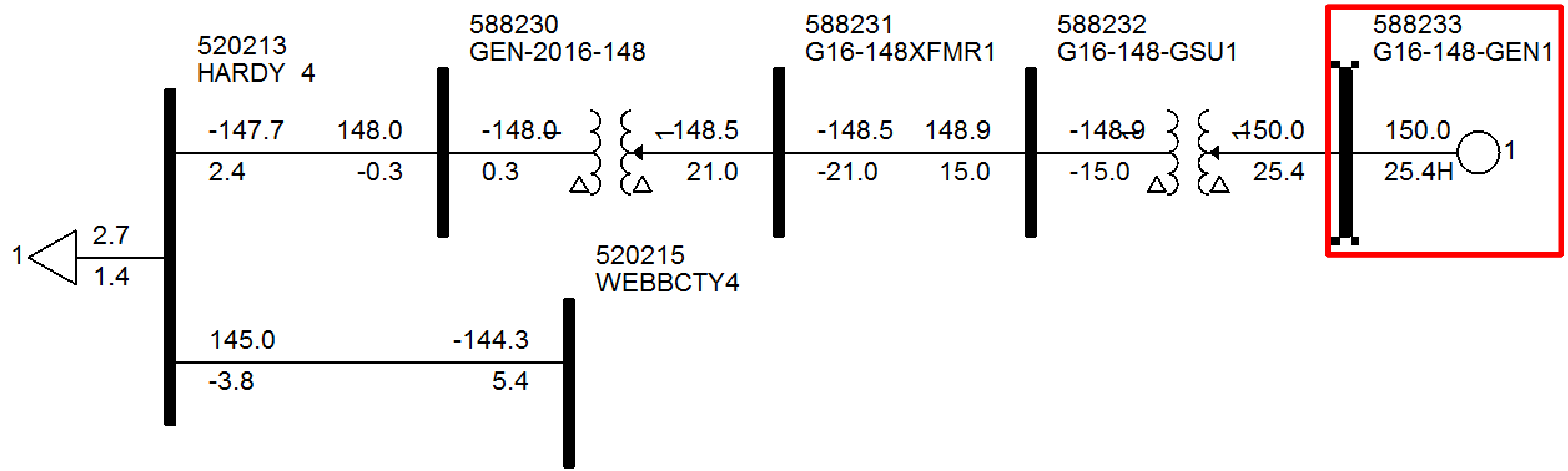


Figure 2-7. Power flow one-line diagram for interconnection project at Hardy 138 kV POI (GEN-2016-148)

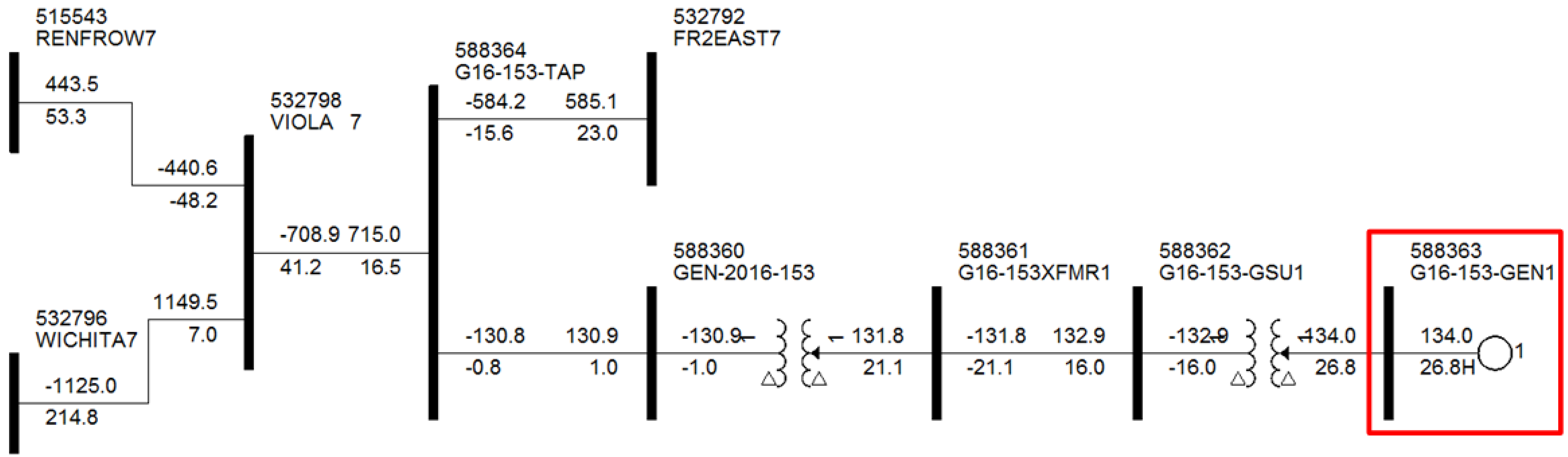


Figure 2-8. Power flow one-line diagram for interconnection project at Viola 345 kV POI (GEN-2016-153)

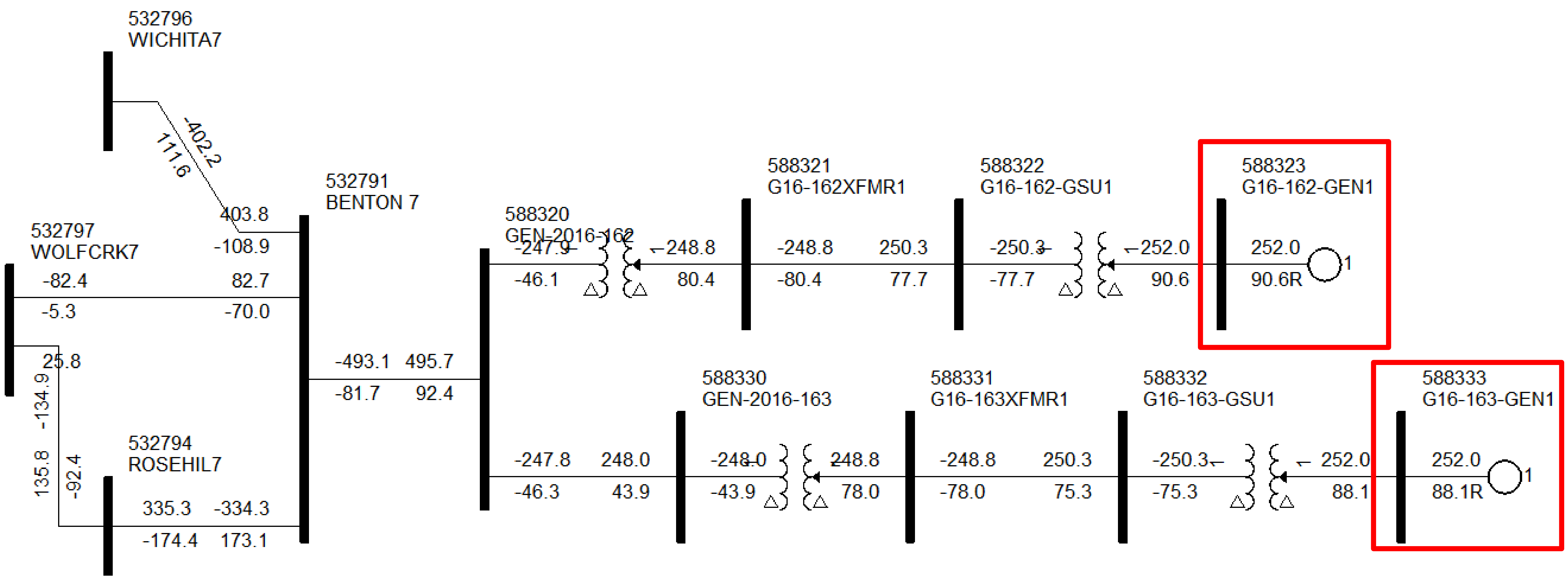


Figure 2-9. Power flow one-line diagram for interconnection project at the Benton 345 kV POI (GEN-2016-163 and GEN-2016-163)

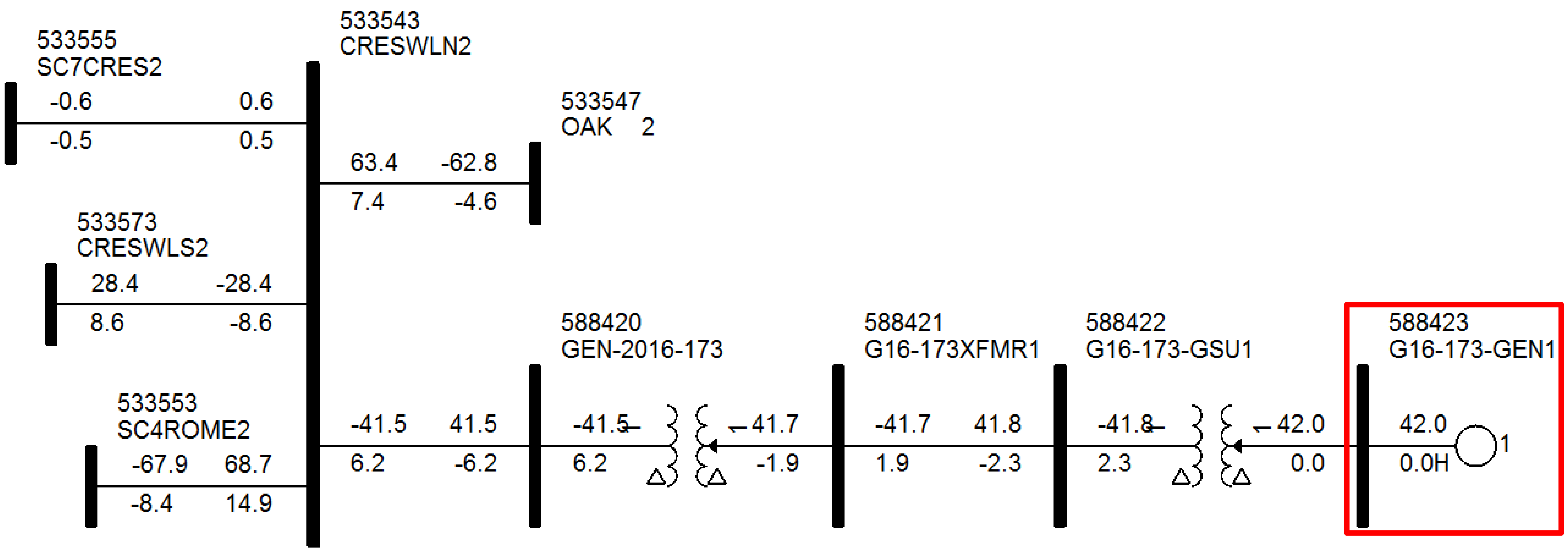


Figure 2-10. Power flow one-line diagram for interconnection project at Creswell 69 kV POI (GEN-2016-173).

Table 2-3
Case List with Contingency Description

Cont. No.	Cont. Name	Description
1	FLT01-3PH	3 phase fault on the Midian (532990) to Butler (532987) 138kV line, near Midian. a. Apply fault at the Midian 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT02-3PH	3 phase fault on the Midian (532990) to Benton (532986) 138kV line, near Midian. a. Apply fault at the Midian 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
3	FLT03-3PH	3 phase fault on the Midian 138/69/13.2kV (532990/533597/533082) transformer, near Midian. a. Apply fault at the Midian 138kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
4	FLT04-3PH	3 phase fault on the Benton (532986) to Chisholm (533035) 138kV line, near Benton. a. Apply fault at the Benton 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
5	FLT05-3PH	3 phase fault on the Benton (532986) to 29th (533024) 138kV line, near Benton. a. Apply fault at the Benton 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT06-3PH	3 phase fault on the Benton (532986) to Belaire (532988) 138kV line, near Benton. a. Apply fault at the Benton 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
7	FLT07-3PH	3 phase fault on the Benton 345/138/13.8kV (532791/532986/532822) transformer, near Benton. a. Apply fault at the Benton 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
8	FLT08-3PH	3 phase fault on the Butler (532987) to Altoona (533001) 138kV line, near Butler. a. Apply fault at the Butler 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
9	FLT09-3PH	3 phase fault on the Butler (532987) to Butler (532989) 138kV line, near Butler. a. Apply fault at the Butler 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT10-3PH	3 phase fault on the Butler 138/69kV (532987/533583) transformer, near Butler. a. Apply fault at the Butler 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
11	FLT11-PO	**Prior outage of the Midian (532990) – Butler (532987) 138kV line** 3 phase fault on the Midian (532990) – Benton (532986) 138kV line, near Midian. a. Apply fault at the Midian 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT12-PO	**Prior outage of the Midian (532990) – Butler (532987) 138kV line** 3 phase fault on the Midian 138/69/13.2kV (532990/533597/533082) transformer, near Midian. a. Apply fault at the Midian 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
13	FLT13-PO	**Prior outage of the Midian (532990) – Benton (532986) 138kV line** 3 phase fault on the Midian 138/69/13.2kV (532990/533597/533082) transformer, near Midian. a. Apply fault at the Midian 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
14	FLT14-PO	**Prior outage of the Midian (532990) –Butler Tap (532989) 138kV line** 3 phase fault on the Midian (532990) – Benton (532986) 138kV line, near Midian. a. Apply fault at the Midian 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
15	FLT15-SB	**Stuck Breaker on Midian – Benton 138kV circuit 1 line** a. Apply single-phase fault at Midian (532990) on the 138kV bus. b. After 16 cycles, trip the Midian – Benton (532986) 138kV circuit 1 line c. Trip the Midian – Butler (532987) 138kV circuit 1 line, and remove the fault
16	FLT16-SB	**Stuck Breaker on Midian – Benton 138kV circuit 1 line** a. Apply single-phase fault at Midian (532990) on the 138kV bus. b. After 16 cycles, trip the Midian – Benton (532986) 138kV circuit 1 line c. Trip the Midian 138/69/13.2kV (532990/533597/533082) transformer, and remove the fault
17	FLT17-SB	**Stuck Breaker on Midian – Butler 138kV circuit 1 line** a. Apply single-phase fault at Midian (532990) on the 138kV bus. b. After 16 cycles, trip the Midian – Butler (532987) 138kV circuit 1 line c. Trip the Midian 138/69/13.2kV (532990/533597/533082) transformer, and remove the fault
18	FLT18-SB	**Stuck Breaker on Butler (532987) – Butler Tap (532989) 138kV circuit 1 line** a. Apply fault at Butler (532987) on the 138kV bus. b. After 16 cycles, trip the Butler – Altoona 138 kV circuit 1 line c. Trip the Butler (532987) – Butler Tap (532989) 138kV circuit 1 line, and remove the fault
19	FLT19-SB	**Stuck Breaker on Midian 138/69/13.2kV (532990/533597/533082) transformer** a. Apply single-phase fault at Midian (532990) on the 138kV bus. b. After 16 cycles, trip the Midian 138/69/13.2kV (532990/533597/533082) transformer c. Trip the Midian – Butler (532987) 138kV circuit 1 line, and remove the fault
20	FLT20-SB	**Stuck Breaker on Midian 138/69/13.2kV (532990/533597/533082) transformer** a. Apply single-phase fault at Midian (532990) on the 138kV bus. b. After 16 cycles, trip the Midian 138/69/13.2kV (532990/533597/533082) transformer c. Trip the Midian – Benton (532986) 138kV circuit 1 line, and remove the fault
21	FLT21-3PH	3 phase fault on the G16-072-TAP (560086) to Renfro (515543) 345kV line, near G16-072-TAP. a. Apply fault at the G16-072-TAP 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
22	FLT22-3PH	3 phase fault on the G16-072-TAP (560086) 345kV to Hunters (515476) 345kV line, near G16-072-TAP. a. Apply fault at the G16-072-TAP 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
23	FLT23-3PH	3 phase fault on the Renfrow (515543) to Viola (532798) 345kV line, near Renfro. a. Apply fault at the Renfro 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
24	FLT24-3PH	3 phase fault on the Renfrow (515543) 345/(515544) 138/(515545) 13.8kV transformer, near Renfrow 345. a. Apply fault at the Renfrow 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
25	FLT25-3PH	3 phase fault on the Renfrow (515544) to MDFRDTP4 (515569) 345kV circuit 1 line, near Renfrow. a. Apply fault at the Renfrow 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
26	FLT26-3PH	3 phase fault on the Hunters (515476) to Woodring (514715) 345kV circuit 1 line, near Hunters. a. Apply fault at the Hunters 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
27	FLT27-3PH	3 phase fault on the Renfrow (515544) to Renfrow (520409) 345kV circuit 1 line, near Hunters. a. Apply fault at the Hunters 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
28	FLT28-PO	**Prior outage on the Renfrow (515543) 345/ (515544) 138/ (515545) 13.8kV transformer** 3 phase fault on the Renfrow (515543) to Viola (532798) 345kV line, near Renfrow. a. Apply fault at the Renfrow 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
29	FLT29-PO	**Prior outage of the G16-072-Tap (560086) – Hunters (515476) 345kV line** 3 phase fault on the Renfrow (515543) – Viola (532798) 345kV line, near Renfrow. a. Apply fault at the Renfrow 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
30	FLT30-PO	**Prior outage on the Renfrow (515543) 345/ (515544) 138/ (515545) 13.8kV transformer** 3 phase fault on the Renfrow (515543) to G16-072-TAP (560086) 345kV line, near Renfrow. a. Apply fault at the Renfrow 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
31	FLT31-PO	**Prior outage on the Renfrow (515543) 345/ (515544) 138/ (515545) 13.8kV transformer** 3 phase fault on the Renfrow (515544) to MDFRDTPH (515569) 345kV line, near Renfrow. a. Apply fault at the Renfrow 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
32	FLT32-PO	**Prior outage of the Hunters (515476) – Woodring (514715) 345kV line** 3 phase fault on the Renfrow (515544) to MDFRDTPH (515569) 345kV line, near G16-072-TAP. a. Apply fault at the G16-072-TAP 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
33	FLT33-PO	**Prior outage of the Renfrow (515543) – Viola (532798) 345kV line** 3 phase fault on the Hunters (515476) – G16-072-TAP (560086) 345kV line, near G16-072-TAP. a. Apply fault at the G16-072-TAP 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
34	FLT34-SB	**Stuck Breaker on Renfrow– G16-072-TAP 345kV circuit 1 line** a. Apply single-phase fault at Renfrow (515543) on the 345kV bus. b. After 16 cycles, trip the Renfrow (515543) 345/(515544) 138/(515545) 13.8kV transformer c. Trip the Renfrow – G16-072-TAP (560086) 345 kV circuit 1 line, and remove the fault
35	FLT35-SB	**Stuck Breaker on Renfrow – Viola 345kV circuit 1 line** a. Apply single-phase fault at Renfrow (515543) on the 345kV bus. b. After 16 cycles, trip the Renfrow 345/138/13.8kV (515543/515544/515545) transformer c. Trip the Renfrow – Viola (532798) 345 kV circuit 1 line, and remove the fault
36	FLT36-SB	**Stuck Breaker on Renfrow – G16-072-TAP 345kV circuit 1 line** a. Apply single-phase fault at Renfrow (515543) on the 345kV bus. b. After 16 cycles, trip the Renfrow – Viola (532798) 345 kV circuit 1 line, and remove the fault c. Trip the Renfrow – G16-072-TAP (560086) 345kV circuit 1 line, and remove the fault
37	FLT37-3PH	3 phase fault on the G16-100-TAP (587804) to Spring Creek (514881) 345kV line, near G16-100-TAP. a. Apply fault at the G16-100-TAP 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
38	FLT38-3PH	3 phase fault on the G16-100-TAP (587804) to Sooner (514803) 345kV line, near G16-100-TAP. a. Apply fault at the G16-100-TAP 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
39	FLT39-3PH	3 phase fault on the Sooner 345/138/13.8kV (514803/514802/515760) transformer, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
40	FLT40-3PH	3 phase fault on the Sooner (514803) to Ranch Road (515576) 345kV line, near Sooner. a. Apply fault at Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
41	FLT41-3PH	3 phase fault on the Sooner (514803) to Thunder (515894) 345kV line, near Sooner. a. Apply fault at Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
42	FLT42-3PH	3 phase fault on the Sooner (514803) to G15-066T (560056) 345kV line, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
43	FLT43-3PH	3 phase fault on the Sooner (514803) to G16-061-Tap (560084) 345kV line, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT44-3PH	3 phase fault on the Spring Creek (514881) to Northwest (514880) 345kV line, near Spring Creek. a. Apply fault at the Spring Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
45	FLT45-3PH	3 phase fault on the Spring Creek (514881) to G16-100-TAP (587804) 345kV line, near Spring Creek. a. Apply fault at the Spring Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
46	FLT46-3PH	3 phase fault on the Sooner (514803) to G16-100-TAP (587804) 345kV line, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
47	FLT47-PO	**Prior outage of the G16-100-Tap – Sooner (514803) 345kV circuit 1 line** 3 phase fault on the Sooner (514803) – Thunder7 (515576) 345kV line, near G16-100-Tap. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
48	FLT48-PO	**Prior outage of the G16-100-Tap – Sooner (514803) 345kV circuit 1 line** 3 phase fault on the Sooner (514803) – Ranch Road (515576) 345kV line, near G16-100-Tap. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
49	FLT49-PO	**Prior outage of the G16-100-Tap – Sooner (514803) 345kV circuit 1 line** 3 phase fault on the Sooner 345/138/13.8kV (514803/514802/515760) transformer, near Sooner. a. Apply fault at the G16-100-Tap 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
50	FLT50-SB	**Stuck Breaker on Northwest7 – Spring Creek 345kV circuit 1 line** a. Apply single-phase fault at Northwest7 (514880) on the 345kV bus. b. After 16 cycles, trip the Northwest7 – Arcadia (514908) 345kV circuit 1 line c. Trip the NorthWst7 (514880) – Spring Creek (514881) 345kV circuit 1 line, and remove the fault
51	FLT51-PO	**Prior outage of the Sooner (514803) – G15-066T (560056) 345kV line** 3 phase fault on the Ranch Road (515576) – Sooner (514803) 345kV line, near Ranch Road. a. Apply fault at the Ranch Road 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
52	FLT52-PO	**Prior outage of the Sooner (514803) – Ranch Road (515576) 345kV line** 3 phase fault on the Sooner (514803) – G16-100-TAP (587804) 345kV line, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
53	FLT53-PO	**Prior outage of the Sooner (514803) – Ranch Road (515576) 345kV line** 3 phase fault on the Sooner 345/138/13.8kV (514803/514802/515760) transformer, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer and remove fault.
54	FLT54-PO	**Prior outage of the Sooner (514803) – Ranch Road (515576) 345kV line** 3 phase fault on the Sooner (514803) – Thunder (515894) 345kV line, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
55	FLT55-PO	**Prior outage of the Spring Creek (514881) – Northwest (514880) 345kV line** 3 phase fault on the Sooner (514803) –Ranch Road (515576) 345kV line, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
56	FLT56-PO	**Prior outage of the Spring Creek (514881) – G16-100-TAP (587804) 345kV line** 3 phase fault on the Sooner (514803) –Ranch Road (515576) 345kV line, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
57	FLT57-SB	**Stuck Breaker on Sooner – G16-100-TAP 345kV circuit 1 line** a. Apply single-phase fault at Sooner (514803) on the 345kV bus. b. After 16 cycles, trip the Sooner – G16-100-TAP (587804) 345kV circuit 1 line c. Trip the Sooner – Ranch Road (515576) 345kV circuit 1 line, and remove the fault
58	FLT58-SB	**Stuck Breaker on Sooner – G15-066T 345kV circuit 1 line** a. Apply single-phase fault at Sooner (514803) on the 345kV bus. b. After 16 cycles, trip the Sooner – G15-066T (560056) 345kV circuit 1 line c. Trip the Sooner – Ranch Road (515576) 345kV circuit 1 line, and remove the fault
59	FLT59-SB	**Stuck Breaker on Northwest7 – Mathewson 345kV circuit 1 line** a. Apply single-phase fault at Northwest7 (514880) on the 345kV bus. b. After 16 cycles, trip the Northwest7 – Arcadia (514908) 345kV circuit 1 line c. Trip the Northwest (514880) – Mathewson (515497) 345kV circuit 1 line, and remove the fault
60	FLT60-3PH	3 phase fault on the Shidler (510403) to Fairfat Tap (510377) 138kV line, near Shidler. a. Apply fault at the Shidler 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
61	FLT61-3PH	3 phase fault on the Fairfax Tap (510377) to Webber Tap (510376) 138kV line, near Shidler. a. Apply fault at the Shidler 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
62	FLT62-3PH	3 phase fault on the Webber Tap (510376) to Osage (514743) 138kV line, near Webber Tap. a. Apply fault at the Webber Tap 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
63	FLT63-3PH	3 phase fault on the Webber Tap (510376) to Fairfax Tap (510377) 138kV line, near Webber Tap. a. Apply fault at the Webber Tap 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
64	FLT64-3PH	3 phase fault on the Shidler (510403) to WPAWWHSKY4 (510382) 138kV line, near Hardy. a. Apply fault at the Shidler 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
65	FLT65-3PH	3 phase fault on the Osage (514743) to Marland Tap (514770) 138kV line, near Osage. a. Apply fault at the Osage 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
66	FLT66-3PH	3 phase fault on the Osage (514743) to White Eagle (514761) 138kV line, near Osage. a. Apply fault at the Osage 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
67	FLT67-3PH	3 phase fault on the Osage (514743) to Sooner Pump Tap (514798) 138kV line, near Osage. a. Apply fault at the Osage 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
68	FLT68-3PH	3 phase fault on the Osage 138/69/13.2kV (514743/514742/515745) transformer circuit 1, near Osage. a. Apply fault at the Osage 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
69	FLT69-3PH	3 phase fault on the Osage 138/69/13.2kV (514743/514742/515744) transformer circuit 2, near Osage. a. Apply fault at the Osage 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
70	FLT70-3PH	3 phase fault on the Osage (514743) to Standing Bear (514758) 138kV line, near Osage. a. Apply fault at the Osage 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
71	FLT71-PO	**Prior outage of the Osage (514743) – Maryland Tap (514770) 138kV line** 3 phase fault on the Webber Tap (510376) – Osage (514743) 138kV line, near Webber Tap. a. Apply fault at the Webber Tap 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
72	FLT72-PO	**Prior outage of the Webber Tap (510376) – Fairfax Tap (510377) 138kV line** 3 phase fault on the Osage (514743) to White Eagle (514761) 138kV line, near Webber County. a. Apply fault at the Webber County 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
73	FLT73-PO	**Prior outage of the Webber Tap (510376) – Osage (514743) 138kV line** 3 phase fault on the Osage (514743) to Standing Bear (514758) 138kV line, near Webber County. a. Apply fault at the Osage 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
74	FLT74-PO	**Prior outage on the Osage (514743) – Standing Bear (514758) 138kV line** 3 phase fault on the Osage (514743) – White Eagle (514761) 138kV line, near Osage. a. Apply fault at the Osage 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
75	FLT75-SB	**Stuck Breaker on Osage (514743) 138kV – Webber Tap (510376) circuit 1 line** a. Apply single-phase fault at Osage on the 138kV bus. b. After 16 cycles, trip the Osage – Standing Bear (514758) 138kV circuit 1 line c. Trip the Osage – Webber Tap 138kV circuit 1 line, and remove the fault
76	FLT76-SB	**Stuck Breaker on Osage (514743) 138kV – Webber Tap (510376) circuit 1 line** a. Apply single-phase fault at Osage on the 138kV bus. b. After 16 cycles, trip the Osage – White Eagle (514761) 138kV circuit 1 line c. Trip the Osage – Webber Tap 138kV circuit 1 line, and remove the fault
77	FLT77-SB	**Stuck Breaker on Osage (514743) 138kV – Webber Tap (510376) circuit 1 line** a. Apply single-phase fault at Osage on the 138kV bus. b. After 16 cycles, trip the Osage – SNRPMPT4 (514798) 138kV circuit 1 line c. Trip the Osage – Webber Tap 138kV circuit 1 line, and remove the fault
78	FLT78-SB	**Stuck Breaker on Osage – Marland Tap 138kV circuit 1 line** a. Apply single-phase fault at Osage (514743) on the 138kV bus. b. After 16 cycles, trip the Osage – Webber Tap (510376) 138kV circuit 1 line c. Trip the Osage – Marland Tap (514770) 138kV circuit 1 line, and remove the fault
79	FLT79-3PH	3 phase fault on the Woodring 345/138/13.8kV (514715/514714/515770) transformer, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
80	FLT80-3PH	3 phase fault on the Woodring (514715) to Redington (515875) 345kV line, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
81	FLT81-3PH	3 phase fault on the Woodring (514715) to G16-061-Tap (560084) 345kV line, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
82	FLT82-3PH	3 phase fault on the Redington (515875) to Mathewson (515497) 345kV line, near Redington. a. Apply fault at the Redington 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
83	FLT83-3PH	3 phase fault on the Mathewson (515497) to Northwest7 (514880) 345kV line, near Mathewson. a. Apply fault at the Mathewson 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
84	FLT84-3PH	3 phase fault on the Woodring (514714) to Otter (514708) 345kV line, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
85	FLT85-PO	**Prior outage of the Woodring (514715) – Redington (515875) 345kV line** 3 phase fault on the Woodring 345/138/13.8kV (514715/514714/515770) transformer, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
86	FLT86-PO	**Prior outage of the Woodring (514715) – Hunters (514476) 345kV line** 3 phase fault on the Woodring (514715) to Redington (515875) 345kV line, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
87	FLT87-PO	**Prior outage of the Woodring (514715) – Hunters (514476) 345kV line** 3 phase fault on the G16-061-Tap (560084) to Sooner (514803) 345kV line, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
88	FLT88-PO	**Prior outage of the Woodring 345/138/13.8kV (514715/514714/515770) transformer** 3 phase fault on the Woodring (514715) to Redington (515875) 345kV line, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
89	FLT89-PO	**Prior outage of the Woodring 345/138/13.8kV (514715/514714/515770) transformer** 3 phase fault on the Woodring (514715) to Hunters (515476) 345kV line, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
90	FLT90-SB	**Stuck Breaker on Woodring – Hunters 345kV circuit 1 line** a. Apply single-phase fault at Woodring (514715) on the 345kV bus. b. After 16 cycles, trip the Woodring – Hunters (515476) 345kV circuit 1 line c. Trip the Woodring – Redington (515875) 345kV circuit 1 line, and remove the fault
91	FLT91-SB	**Stuck Breaker on Mathewson – Northwest7 345kV circuit 1 line** a. Apply single-phase fault at Mathewson (515497) on the 345kV bus. b. After 16 cycles, trip the Mathewson – Northwest7 (514880) 345kV circuit 1 line c. Trip the Mathewson – Tatonga (515407) 345kV circuit 1 line, and remove the fault
92	FLT92-SB	**Stuck Breaker on Woodring – Hunters 345kV circuit 1 line** a. Apply single-phase fault at Woodring (514715) on the 345kV bus. b. After 16 cycles, trip the Woodring – Hunters (515476) 345kV circuit 1 line c. Trip the Woodring 345/138/13.8kV (514715/514714/515770) transformer, and remove the fault
93	FLT93-SB	**Stuck Breaker on Woodring – Redington 345kV circuit 1 line** a. Apply single-phase fault at Woodring (514715) on the 345kV bus. b. After 16 cycles, trip the Woodring – Redington (515875) 345kV circuit 1 line c. Trip the Woodring 345/138/13.8kV (514715/514714/515770) transformer, and remove the fault
94	FLT94-SB	**Stuck Breaker on Woodring – Redington 345kV circuit 1 line** a. Apply single-phase fault at Woodring (514715) on the 345kV bus. b. After 16 cycles, trip the Woodring – Redington (515875) 345kV circuit 1 line c. Trip the Woodring – G16-061-Tap (560084) 345kV circuit 1 line, and remove the fault
95	FLT95-3PH	3 phase fault on the Tulsa North (509852) to N.E.S (510406) 345kV line, near Tulsa North. a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
96	FLT96-3PH	3 phase fault on the Tulsa North (509852) to Grec Tap (512865) 345kV line, near Tulsa North. a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
97	FLT97-3PH	3 phase fault on the Tulsa North (509852) to Cleveland (512694) 345kV line, near Tulsa North. a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
98	FLT98-3PH	3 phase fault on the Tulsa North (509852) to Wekiwa (509755) 345kV line, near Tulsa North. a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
99	FLT99-3PH	3 phase fault on the Tulsa North 345/138/34.5kV (509852/509895/509894) transformer, near Tulsa North. a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
100	FLT100-3PH	3 phase fault on the N.E.S (510406) to Oneta (509807) 345kV line, near N.E.S. a. Apply fault at the N.E.S. 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
101	FLT101-3PH	3 phase fault on the N.E.S (510406) to Delaware (510380) 345kV line, near N.E.S. a. Apply fault at the N.E.S. 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
102	FLT102-3PH	3 phase fault on the Grec Tap (512865) to GRDA1 (512650) 345kV line, near Grec Tap a. Apply fault at the Grec Tap 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
103	FLT103-3PH	3 phase fault on the Tulsa North (509817) to P&PWTP4 (509851) 138 kV line, near Tulsa North a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
104	FLT104-3PH	3 phase fault on the Wekiwa (509757) to P&PWTP4 (509851) 138 kV line, near Wekiwa a. Apply fault at the Wekiwa 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
105	FLT105-3PH	3 phase fault on the Cleveland (512694) to G15-066T (560056) 345kV line, near Cleveland a. Apply fault at the Cleveland 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
106	FLT106-3PH	3 phase fault on the Cleveland 345/138/13.8kV (512694/512729/512817) transformer, near Cleveland a. Apply fault at the Cleveland 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
107	FLT107-3PH	3 phase fault on the Wekiwa 345/138/34.5kV (509755/509757/509879) transformer, near Wekiwa a. Apply fault at the Wekiwa 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
108	FLT108-3PH	3 phase fault on the Wekiwa (509755) to SAPLPRD (509870) 345kV line, near Wekiwa a. Apply fault at the Wekiwa 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
109	FLT109-PO	**Prior outage of the Tulsa North 345/138/34.5kV (509852/509895/509894) transformer** 3 phase fault on the Tulsa North (509852) to Cleveland (512694) 345kV line, near Tulsa North. a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
110	FLT110-PO	**Prior outage of the Tulsa North 345/138/34.5kV (509852/509895/509894) transformer** 3 phase fault on the Tulsa North (509852) to N.E.S. (510406) 345kV line, near Tulsa North. a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
111	FLT111-PO	**Prior outage of the Tulsa North 345/138/34.5kV (509852/509895/509894) transformer** 3 phase fault on the Tulsa North (509852) to Grec Tap (512865) 345kV line, near Tulsa North. a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
112	FLT112-PO	**Prior outage of the Tulsa North (509852) to Wekiwa (509755) 345kV line, near Tulsa North.** 3 phase fault on the Tulsa North (509852) to Grec Tap (512865) 345kV line, near Tulsa North. a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
113	FLT113-PO	**Prior outage of the Tulsa North (509852) to Wekiwa (509755) 345kV line, near Tulsa North.** 3 phase fault on the Tulsa North (509852) to N.E.S. (510406) 345kV line, near Tulsa North. a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
114	FLT114-PO	**Prior outage of the Tulsa North (509852) to Cleveland (512694) 345kV line, near Tulsa North.** 3 phase fault on the Tulsa North (509852) to Grec Tap (512865) 345kV line, near Tulsa North. a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
115	FLT115-PO	**Prior outage of the Tulsa North (509852) to Cleveland (512694) 345kV line, near Tulsa North.** 3 phase fault on the Tulsa North (509852) to Wekiwa (509744) 345kV line, near Tulsa North. a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
116	FLT116-PO	**Prior outage of the Tulsa North (509852) to N.E.S. (510406) 345kV line, near Tulsa North.** 3 phase fault on the Tulsa North (509852) to Wekiwa (509744) 345kV line, near Tulsa North. a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
117	FLT117-PO	**Prior outage of the Tulsa North (509852) to N.E.S. (510406) 345kV line, near Tulsa North.** 3 phase fault on the Tulsa North (509852) to Cleveland (512694) 345kV line, near Tulsa North. a. Apply fault at the Tulsa North 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
118	FLT118-SB	**Stuck Breaker on Tulsa North – Cleveland 345kV circuit 1 line** a. Apply single-phase fault at Tulsa North (509852) on the 345kV bus. b. After 16 cycles, trip the Tulsa North – Cleveland (512694) 345kV circuit 1 line c. Trip the Tulsa North – N.E.S. (510406) 345kV circuit 1 line, and remove the fault
119	FLT119-SB	**Stuck Breaker on Tulsa North – Cleveland 345kV circuit 1 line** a. Apply single-phase fault at Tulsa North (509852) on the 345kV bus. b. After 16 cycles, trip the Tulsa North – Cleveland (512694) 345kV circuit 1 line c. Trip the Tulsa North 345/138/34.5kV (509852/509895/509894) transformer, and remove the fault.
120	FLT120-SB	**Stuck Breaker on Tulsa North – N.E.S. 345kV circuit 1 line** a. Apply single-phase fault at Tulsa North (509852) on the 345kV bus. b. After 16 cycles, trip the Tulsa North – N.E.S. (510406) 345kV circuit 1 line c. Trip the Tulsa North 345/138/34.5kV (509852/509895/509894) transformer, and remove the fault.
121	FLT121-SB	**Stuck Breaker on Tulsa North – N.E.S. 345kV circuit 1 line** a. Apply single-phase fault at Tulsa North (509852) on the 345kV bus. b. After 16 cycles, trip the Tulsa North – N.E.S. (510406) 345kV circuit 1 line c. Trip the Tulsa North – Grec Tap (512865) 345kV circuit 1 line, and remove the fault.
122	FLT122-SB	**Stuck Breaker on Tulsa North – Wekiwa 345kV circuit 1 line** a. Apply single-phase fault at Tulsa North (509852) on the 345kV bus. b. After 16 cycles, trip the Tulsa North – Wekiwa (509755) 345kV circuit 1 line c. Trip the Tulsa North – Grec Tap (512865) 345kV circuit 1 line, and remove the fault.
123	FLT123-SB	**Stuck Breaker on Tulsa North – Wekiwa 345kV circuit 1 line** a. Apply single-phase fault at Tulsa North (509852) on the 345kV bus. b. After 16 cycles, trip the Tulsa North – Wekiwa (509755) 345kV circuit 1 line c. Trip the Tulsa North 345/138/34.5kV (509894/509895/509894) transformer, and remove the fault.

Cont. No.	Cont. Name	Description
124	FLT124-SB	**Stuck Breaker on Tulsa North 345/138/34.5kV (509852/509895/509894) transformer** a. Apply single-phase fault at Tulsa North (509852) on the 345kV bus. b. After 16 cycles, trip the Tulsa North 345/138/34.5kV (509894/509895/509894) transformer c. Trip the Tulsa North – Grec Tap (512865) 345kV circuit 1 line, and remove the fault.
125	FLT125-3PH	3 phase fault on the Buffalo Flats (532782) to Thistle (539801) 345kV circuit 1 line, near Buffalo Flats. a. Apply fault at the Buffalo Flats 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
126	FLT126-3PH	3 phase fault on the Buffalo Flats (532782) to Thistle (539801) 345kV circuit 2 line, near Buffalo Flats. a. Apply fault at the Buffalo Flats 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
127	FLT127-3PH	3 phase fault on the Thistle 345/138/13.8kV (539801/539802/539804) transformer a. Apply fault at the Thistle 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line and remove fault.
128	FLT128-3PH	3 phase fault on the Wichita 345/138/13.8kV (532796/532829/533040) transformer a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line and remove fault.
129	FLT129-3PH	3 phase fault on the Thistle (539801) to Woodward (535375) 345kV circuit 1 line, near Thistle. a. Apply fault at the Thistle 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
130	FLT130-3PH	3 phase fault on the Viola (532798) to Wichita (532796) 345kV circuit 1 line, near Viola. a. Apply fault at the Viola 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
131	FLT131-3PH	3 phase fault on the Thistle (539801) to Woodward (535375) 345kV circuit 2 line, near Viola. a. Apply fault at the Thistle 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
132	FLT132-3PH	3 phase fault on the Wichita (532796) to Benton (532791) 345kV circuit 1 line, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
133	FLT133-3PH	3 phase fault on the Wichita (532796) to Reno (532771) 345kV circuit 1 line, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
134	FLT134-3PH	3 phase fault on the Wichita (532796) to Buffalo Flats (532782) 345kV circuit 1 line, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
135	FLT135-PO	**Prior outage of the Buffalo Flats (532782) to Thistle (539801) 345kV line** 3 phase fault on the Thistle (539801) to Woodward (535375) 345kV line, near Thistle. a. Apply fault at the Thistle 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
136	FLT136-PO	**Prior outage of the Benton (532791) to Wichita (532796) 345kV line** 3 phase fault on the Wichita (532796) to Viola (532798) 345kV line, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
137	FLT137-PO	**Prior outage of the Buffalo Flats (532782) to Thistle (539801) 345kV line 1** 3 phase fault on the Buffalo Flats (532792) to Thistle (539801) 345kV line 2, near Buffalo Flats. a. Apply fault at the Buffalo Flats 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
138	FLT138-PO	**Prior outage of the Buffalo Flats (532782) to Wichita (532796) 345kV line 1** 3 phase fault on the Buffalo Flats (532792) to Wichita (532796) 345kV line 2, near Buffalo Flats. a. Apply fault at the Buffalo Flats 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
139	FLT139-SB	**Stuck Breaker on Wichita (532796) to Benton (532791) circuit 1 line** a. Apply single-phase fault at Wichita on the 345kV bus. b. After 16 cycles, trip the Wichita – Reno (532771) 345kV circuit 1 line c. Trip the Wichita – Benton 345kV circuit 1 line, and remove the fault.
140	FLT140-SB	**Stuck Breaker on Wichita (532796) – Reno (532771) 345kV circuit 1 line** a. Apply single-phase fault at Wichita (532791) on the 345kV bus. b. After 16 cycles, trip the Wichita – Buffalo Flats (532782) 345kV circuit 1 line c. Trip the Wichita – Reno 345kV circuit 1 line, and remove the fault.
141	FLT141-SB	**Stuck Breaker on Wichita (532796) – Reno (532771) circuit 1 line** a. Apply single-phase fault at Wichita (532791) on the 345kV bus. b. After 16 cycles, trip the Wichita – Buffalo Flats (532782) 345kV circuit 2 line c. Trip the Wichita – Reno 345kV circuit 1 line, and remove the fault.
142	FLT142-SB	**Stuck Breaker on Wichita – Viola 345kV circuit 1 line** a. Apply single-phase fault at Wichita (532796) on the 345kV bus. b. After 16 cycles, trip the Wichita (532796) – Buffalo Flats (532798) 345kV circuit 1 line c. Trip the Wichita – Viola (532798) 345kV circuit 1 line, and remove the fault.
143	FLT143-SB	**Stuck Breaker on to Thistle (539801) – Woodward (535375) circuit 1 line** a. Apply single-phase fault at Thistle on the 345kV bus. b. After 16 cycles, trip the Thistle – Buffalo Flats (532782) 345kV circuit 1 line c. Trip the Thistle – Woodward 345 kV line, and remove the fault.
144	FLT144-SB	**Stuck Breaker on Thistle (539801) – Buffalo Flats (532782) 345kV circuit 1 line** a. Apply single-phase fault at Thistle on the 345kV bus. b. After 16 cycles, trip the Thistle – Buffalo Flats (532782) 345kV circuit 2 line c. Trip the Thistle – Buffalo Flats (532782) 345kV circuit 1 line, and remove the fault.
145	FLT145-3PH	3 phase fault on the Benton (532791) to Rose Hill (532794) 345kV circuit 1 line, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
146	FLT146-3PH	3 phase fault on the Rose Hill (532794) to Lathams (532800) 345kV circuit 1 line, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
147	FLT147-3PH	3 phase fault on the Benton (532791) to Wolf Creek (532797) 345kV circuit 1 line, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line. c. Reduce Waverly generation (532957) to 0 MW. d. Reduce Wolf Creek generation (532751) to 700 MW.
148	FLT148-3PH	3 phase fault on the Rose Hill 345/138/13.8kV (532794/533062/532826) transformer a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
149	FLT149-3PH	3 phase fault on the Benton 345/138/13.8kV (532791/532986/532821) transformer a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
150	FLT150-3PH	3 phase fault on the Rose Hill (532794) to Wolf Creek (532797) 345kV circuit 1 line, near Rose Hill. a. Apply fault at the Rose Hill 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line. c. Reduce Waverly generation (532957) to 0 MW. d. Reduce Wolf Creek generation (532751) to 700 MW.
151	FLT151-3PH	3 phase fault on the Wolf Creek (532797) to Waverly (532799) 345kV circuit 1 line, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove fault. c. Reduce Wolf Creek generation (532751) to 700 MW.
152	FLT152-3PH	3 phase fault on the Wolf Creek 345/69/17 (532797/532962/533653) transformer. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line.
153	FLT153-3PH	3 phase fault on the Rosehill 345/138/13.8 kV (532794/533062/532831) transformer. a. Apply fault at the Rosehill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
154	FLT154-PO	**Prior outage of the Benton to Rosehill (532794) 345kV line** 3 phase fault on the Benton (532791) to Wichita (532796) 345kV line, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
155	FLT155-PO	**Prior outage of the Benton to Rosehill (532794) 345kV line** 3 phase fault on the Benton (532791) to Wolf Creek (532797) 345kV line, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line. c. Reduce Waverly generation (532957) to 0 MW. d. Reduce Wolf Creek generation (532751) to 700 MW.
156	FLT156-PO	**Prior outage of the Benton to Rosehill (532794) 345kV line** 3 phase fault on the Benton 345/138/13.8kV (532791/532986/532822) transformer a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
157	FLT157-PO	**Prior outage of the Benton 345/138/13.8kV (532791/532986/532821) transformer** 3 phase fault on the Benton (532791) to Wolf Creek (532797) 345kV line, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line. c. Reduce Waverly generation (532957) to 0 MW. d. Reduce Wolf Creek generation (532751) to 700 MW.
158	FLT158-PO	**Prior outage of the Benton 345/138/13.8kV (532791/532986/532821) transformer** 3 phase fault on the Benton 345/138/13.8kV (532791/532986/532822) transformer a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
159	FLT159-SB	**Stuck Breaker on Benton – Rosehill 345kV circuit 1 line** a. Apply single-phase fault at Benton (532791) on the 345kV bus. b. After 16 cycles, trip the Benton – Rosehill (532794) 345kV circuit 1 line c. Trip the Benton – Wolf Creek (532797) 345kV circuit 1 line, and remove the fault.
160	FLT160-SB	**Stuck Breaker on Benton – Rosehill 345kV circuit 1 line** a. Apply single-phase fault at Benton (532791) on the 345kV bus. b. After 16 cycles, trip the Benton – Rosehill (532794) 345kV circuit 1 line c. Trip the Benton 345/138/13.8kV (532791/532986/532822) transformer
161	FLT161-SB	**Stuck Breaker on Benton 345/138/13.8kV (532791/532986/532821) transformer** a. Apply single-phase fault at Benton (532791) on the 345kV bus. b. After 16 cycles, trip the Benton 345/138/13.8kV (532791/532986/532821) transformer c. Trip the Benton 345/138/13.8kV (532791/532986/532822) transformer
162	FLT162-SB	**Stuck Breaker on Benton 345/138/13.8kV (532791/532986/532821) transformer** a. Apply single-phase fault at Benton (532791) on the 345kV bus. b. After 16 cycles, trip the Benton 345/138/13.8kV (532791/532986/532821) transformer c. Trip the Benton – Wolf Creek (532797) 345kV circuit 1 line, and remove the fault.

Cont. No.	Cont. Name	Description
163	FLT163-3PH	3 phase fault on the Creswell 138/69/13.2kV (532981/533543/533080) transformer, near Creswell. a. Apply fault at the Creswell 69kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer and remove fault.
164	FLT164-3PH	3 phase fault on the Creswell (533543) to Oak2 (533547) 69kV circuit 1 line, near Creswell. a. Apply fault at the Creswell 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
165	FLT165-3PH	3 phase fault on the Creswell (533543) to SC7Cres2 (533555) 69kV circuit 1 line, near Creswell. a. Apply fault at the Creswell 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
166	FLT166-3PH	3 phase fault on the Creswell (533543) to SC4Rome2 (533553) 69kV circuit 1 line, near Creswell. a. Apply fault at the Creswell 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
167	FLT167-3PH	3 phase fault on the Creswell (533543) to Creswels2 (533573) 69kV circuit 1 line, near Creswell. a. Apply fault at the Creswell 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
168	FLT168-3PH	3 phase fault on the Creswels2 (533573) to Paris (533548) 69kV circuit 1 line, near Creswels2. a. Apply fault at the Creswels2 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
169	FLT169-3PH	3 phase fault on the Creswels2 138/69/13.2kV (532981/533573/533081) transformer, near Creswels2. a. Apply fault at the Creswels2 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
170	FLT170-3PH	3 phase fault on the Oak 2 (533547) to PrairieJ2 (533563) 69kV circuit 1 line, near Oak 2. a. Apply fault at the Oak 2 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
171	FLT171-3PH	3 phase fault on the Oak 2 (533547) to Rainbow2 (533549) 69kV circuit 1 line, near Oak 2. a. Apply fault at the Oak 2 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
172	FLT172-3PH	3 phase fault on the Oak 2 (533547) to Strothr2 (533556) 69kV circuit 1 line, near Oak 2. a. Apply fault at the Oak 2 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
173	FLT173-PO	**Prior outage of the Creswell to Oak 2 (533547) 69kV line** 3 phase fault on the Creswell (533543) to Creswls2 (533573) 69kV line, near Creswell. a. Apply fault at the Creswell 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
174	FLT174-PO	**Prior outage of the Creswell to Oak 2 (533547) 69kV line** 3 phase fault on the Creswell (533543) to SC4Rome2 (533560) 69kV line, near Creswell. a. Apply fault at the Creswell 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
175	FLT175-PO	**Prior outage of the Creswell to Oak 2 (533547) 69kV line** 3 phase fault on the Creswell (533543) to Creswell 138/69/13.2kV (532981/533543/533080) transformer a. Apply fault at the Creswell 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
176	FLT176-PO	**Prior outage of the Creswell 138/69/13.2kV (532981/533543/533080) transformer** 3 phase fault on the Creswell (533543) to Creswls2 (533573) 69kV line, near Creswell. a. Apply fault at the Creswell 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
177	FLT177-PO	**Prior outage of the Creswell 138/69/13.2kV (532981/533543/533080) transformer** 3 phase fault on the Creswell (533543) to SC4Rome2 (533553) 69kV line, near Creswell. a. Apply fault at the Creswell 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
178	FLT178-SB	**Stuck Breaker on Creswell – Creswls2 345kV circuit 1 line** a. Apply single-phase fault at Creswell (533543) on the 69kV bus. b. After 16 cycles, trip the Creswell – Creswls2 (533573) 69kV circuit 1 line c. Trip the Creswell – Oak 2 (533547) 69kV circuit 1 line, and remove the fault.
179	FLT179-SB	**Stuck Breaker on Creswell – Creswls2 345kV circuit 1 line** a. Apply single-phase fault at Creswell (533543) on the 69kV bus. b. After 16 cycles, trip the Creswell – Creswls2 (533573) 69kV circuit 1 line c. Trip the Creswels2 138/69/13.2kV (532981/533543/533080) transformer, and remove the fault.
180	FLT180-3PH	3 phase fault on the LaCygne (542981) to Stilwell (542968) 345kV circuit 1 line, near LaCygne. a. Apply fault at the LaCygne 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
181	FLT181-3PH	3 phase fault on the LaCygne (542981) to West Gardner (542965) 345kV circuit 1 line, near LaCygne. a. Apply fault at the LaCygne 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
182	FLT182-3PH	3 phase fault on the LaCygne (542981) to Neosho (532793) 345kV circuit 1 line, near LaCygne. a. Apply fault at the LaCygne 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
183	FLT183-3PH	3 phase fault on the Neosho (532793) to Blackberry (300739) 345kV circuit 1 line, near Neosho. a. Apply fault at the Neosho 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
184	FLT184-3PH	3 phase fault on the Neosho (532793) to Caney River (532780) 345kV circuit 1 line, near Neosho. a. Apply fault at the Neosho 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
185	FLT185-3PH	3 phase fault on the Rose Hill (532794) to Lathams (532800) 345kV circuit 1 line, near Rose Hill. a. Apply fault at the Rose Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
186	FLT186-3PH	3 phase fault on the Waverly (532799) to LaCygne (542981) 345kV circuit 1 line, near Waverly. a. Apply fault at the Waverly 345kV bus. b. Clear Waverly end of the line after 3.6 cycles c. Clear the LaCygne end of the line after an additional 0.65 cycles d. Reduce Waverly generation (532957) to 0 MW. e. Reduce Wolf Creek generation (532751) to 700 MW

Cont. No.	Cont. Name	Description
187	FLT187-PO	**Prior outage of the Waverly (532799) to LaCygne (542981) 345kV line** a. Trip the Waverly to LaCygne 345 kV line. b. Reduce Wolf Creek generation (532751) to 700 MW and Waverly Windfarm to 0.0 MW. c. Solve for powerflow steady state. Then the following stability contingency: 3 phase fault on the Wolf Creek (532797) to Rose Hill (532794) 345kV line, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove fault.
188	FLT188-PO	**Prior outage of the Wolf Creek (532797) to Rose Hill (532794) 345kV line** a. Trip the Wolf Creek to Rose Hill 345 kV line. b. Reduce Wolf Creek generation (532751) to 700 MW and Waverly Windfarm to 0.0 MW. c. Solve for powerflow steady state. Then the following stability contingency: 3 phase fault on the Wolf Creek (532797) to Benton (532791) 345kV line, near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line.

SECTION 3: STABILITY ANALYSIS

The objective of the Stability Analysis was to determine the impacts of the generator interconnections on the stability and voltage recovery on the SPP transmission system. The need for reactive compensation was investigated as stability and voltage recovery violations were identified.

3.1 Approach

SPP provided MEPPI with the following three power flow cases:

- MDWG16-17W_DIS1602_G08
- MDWG16-18S_DIS1602_G08
- MDWG16-26W_DIS1602_G08

Each case was examined prior to the Stability Analysis to ensure the case contained the proposed study projects and any previously queued projects listed in Tables 2-1 and 2-2 respectively. There was no suspect power flow data in the study area. The dynamic datasets were also verified and stable initial system conditions (i.e., “flat lines”) were achieved. Three-phase and single phase-to-ground faults listed in Table 2-3 were examined. Single-phase fault impedances were calculated for each season to result in a voltage of approximately 60% of the pre-fault voltage. Refer to Table 3-1 for a list of the calculated single-phase fault impedances utilized.

Table 3-1
Calculated Single-Phase Fault Impedances

Cont. No.*	Cont. Name	Single-Phase Fault Impedance (MVA)		
		2017 Winter	2018 Summer	2026 Summer
15	FLT15-1PH	-1500.0	-1625.0	-1625.0
16	FLT16-1PH	-1500.0	-1625.0	-1625.0
17	FLT17-1PH	-1500.0	-1625.0	-1625.0
18	FLT18-1PH	-1500.0	-1625.0	-1625.0
19	FLT19-1PH	-1500.0	-1625.0	-1625.0
20	FLT20-1PH	-1500.0	-1625.0	-1625.0
34	FLT34-1PH	-4843.8	-5250.0	5250.0
35	FLT35-1PH	-4843.8	-5250.0	5250.0
36	FLT36-1PH	-4843.8	-5250.0	5250.0
50	FLT50-1PH	-11750.0	-12562.5	-12562.5
57	FLT57-1PH	-10125.0	-10125.0	-10125.0
58	FLT58-1PH	-10125.0	-10125.0	-10125.0
59	FLT59-1PH	-11750.0	-12562.5	-12562.5
75	FLT75-1PH	-2812.5	-2812.5	-2812.5
76	FLT76-1PH	-2812.5	-2812.5	-2812.5
77	FLT77-1PH	-2812.5	-2812.5	-2812.5
78	FLT78-1PH	-2812.5	-2812.5	-2812.5
90	FLT90-1PH	-7687.5	-7687.5	-7687.5
91	FLT91-1PH	-12562.5	-12562.5	-12562.5
92	FLT92-1PH	-7687.5	-7687.5	-7687.5
93	FLT93-1PH	-7687.5	-7687.5	-7687.5
94	FLT94-1PH	-7687.5	-7687.5	-7687.5
118	FLT118-1PH	-8500.0	-8500.0	-8500.0
119	FLT119-1PH	-8500.0	-8500.0	-8500.0
120	FLT120-1PH	-8500.0	-8500.0	-8500.0
121	FLT121-1PH	-8500.0	-8500.0	-8500.0
122	FLT122-1PH	-8500.0	-8500.0	-8500.0
123	FLT123-1PH	-8500.0	-8500.0	-8500.0
124	FLT124-1PH	-8500.0	-8500.0	-8500.0
139	FLT139-1PH	-7687.5	-10125.0	-10125.0
140	FLT140-1PH	-7687.5	-10125.0	-10125.0
141	FLT141-1PH	-7687.5	-10125.0	-10125.0
142	FLT142-1PH	-7687.5	-10125.0	-10125.0
143	FLT143-1PH	-6468.8	-6875.0	-6875.0
144	FLT144-1PH	-6468.8	-6875.0	-6875.0
159	FLT159-1PH	-6468.8	-7687.5	-7687.5
160	FLT160-1PH	-6468.8	-7687.5	-7687.5
161	FLT161-1PH	-6468.8	-7687.5	-7687.5
162	FLT162-1PH	-6468.8	-7687.5	-7687.5
178	FLT178-1PH	-812.5	-875.0	-875.0
179	FLT179-1PH	-812.5	-875.0	-875.0

*Refer to Table 2-3 for a description of the contingency scenerio

Bus voltages, machine rotor angles, and previously queued generation in the study area were monitored in addition to bus voltages and machine rotor angles in the following areas:

- 520 AEPW
- 524 OKGE
- 525 WFEC
- 526 SPS
- 531 MIDW
- 534 SUNC
- 536 WERE
- 540 GMO
- 541 KCPL

Requested and previously queued generation outside the above study area was also monitored.

The results of the analysis determined that reactive compensation and/or system upgrades were required to obtain acceptable system performance. The proposed reactive reinforcements ensure the wind or solar farm meets FERC Order 661A low voltage requirements and return the wind or solar farm to its pre-disturbance operating voltage.

3.2 Stability Analysis Results

The Stability Analysis determined that there were multiple contingencies across all seasons that resulted in voltage instability, generation tripping offline, and poor post-fault voltage recovery when all generation interconnection requests were at 100% output.

Refer to Table 3-2 for a summary of the Stability Analysis results for the contingencies listed in Table 2-3. Table 3-2 is a summary of the stability results for the 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak conditions and states whether the system remained stable or generation tripped offline, if acceptable voltage recovery was observed after the fault was cleared, and if the voltage recovered to above 0.9 p.u. and below 1.1 p.u. post fault steady-state conditions. Voltage recovery criteria includes ensuring that the transient voltage recovery is between 0.7 p.u. within 2.5 seconds after the fault is cleared and 1.2 p.u. at any point after the fault is cleared and ending in a steady-state voltage (for N-1 contingencies) at the pre-contingent level or at least above 0.9 p.u. and below 1.1. p.u.

Refer to Appendix B, Appendix C, and Appendix D, for a complete set of plots for all contingencies for 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak conditions, respectively.

Table 3-2
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
1	FLT01-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
2	FLT02-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
3	FLT03-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
4	FLT04-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
5	FLT05-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
6	FLT06-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
7	FLT07-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
8	FLT08-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
9	FLT09-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
10	FLT10-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
11	FLT11-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
12	FLT12-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
13	FLT13-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
14	FLT14-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
15	FLT15-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
16	FLT16-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
17	FLT17-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
18	FLT18-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
19	FLT19-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
20	FLT20-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
21	FLT21-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
22	FLT22-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
23	FLT23-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
24	FLT24-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
25	FLT25-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
26	FLT26-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
27	FLT27-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
28	FLT28-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable

Table 3-2 (continued)

Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
29	FLT29-PO	-	-	V < 0.9 p.u.	Unstable[1]	-	-	V < 0.9 p.u.	Unstable[1]	-	-	V < 0.9 p.u.	Unstable[1]
30	FLT30-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
31	FLT31-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
32	FLT32-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
33	FLT33-PO	-	-	V < 0.9 p.u.	Gen Trip[1]	-	-	V < 0.9 p.u.	Gen Trip[1]	-	-	V < 0.9 p.u.	Gen Trip[1]
34	FLT34-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
35	FLT35-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
36	FLT36-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
37	FLT37-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
38	FLT38-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
39	FLT39-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
40	FLT40-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
41	FLT41-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
42	FLT42-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
43	FLT43-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
44	FLT44-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
45	FLT45-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
46	FLT46-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
47	FLT47-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
48	FLT48-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
49	FLT49-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
50	FLT50-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
51	FLT51-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
52	FLT52-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
53	FLT53-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
54	FLT54-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
55	FLT55-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
56	FLT56-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
57	FLT57-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
58	FLT58-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip

[1]Voltage Instability

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
59	FLT59-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
60	FLT60-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
61	FLT61-3PH	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
62	FLT62-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
63	FLT63-3PH	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
64	FLT64-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
65	FLT65-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
66	FLT66-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
67	FLT67-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
68	FLT68-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
69	FLT69-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
70	FLT70-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
71	FLT71-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
72	FLT72-PO	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
73	FLT73-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
74	FLT74-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
75	FLT75-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
76	FLT76-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
77	FLT77-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
78	FLT78-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
79	FLT79-3PH	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
80	FLT80-3PH	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
81	FLT81-3PH	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
82	FLT82-3PH	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
83	FLT83-3PH	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
84	FLT84-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
85	FLT85-PO	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
86	FLT86-PO	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
87	FLT87-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
88	FLT88-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable

[1]Voltage Instability

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
89	FLT89-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
90	FLT90-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
91	FLT91-SB	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
92	FLT92-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
93	FLT93-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
94	FLT94-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
95	FLT95-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
96	FLT96-3PH			Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
97	FLT97-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
98	FLT98-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
99	FLT99-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
100	FLT100-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
101	FLT101-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
102	FLT102-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
103	FLT103-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
104	FLT104-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
105	FLT105-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
106	FLT106-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
107	FLT107-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
108	FLT108-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
109	FLT109-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
110	FLT110-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
111	FLT111-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
112	FLT112-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
113	FLT113-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
114	FLT114-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
115	FLT115-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
116	FLT116-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
117	FLT117-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
118	FLT118-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip

[1]Voltage Instability

Table 3-2 (continued)

Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
119	FLT119-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
120	FLT120-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
121	FLT121-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
122	FLT122-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
123	FLT123-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
124	FLT124-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
125	FLT125-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
126	FLT126-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
127	FLT127-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
128	FLT128-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
129	FLT129-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
130	FLT130-3PH	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
131	FLT131-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
132	FLT132-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
133	FLT133-3PH	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
134	FLT134-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
135	FLT135-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
136	FLT136-PO	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
137	FLT137-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
138	FLT138-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
139	FLT139-SB	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
140	FLT140-SB	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
141	FLT141-SB	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
142	FLT142-SB	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable	-	-	V > 1.05	Stable
143	FLT143-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
144	FLT144-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
145	FLT145-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
146	FLT146-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
147	FLT147-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
148	FLT148-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
149	FLT149-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
150	FLT150-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
151	FLT151-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
152	FLT152-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
153	FLT153-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
154	FLT154-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
155	FLT155-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
156	FLT156-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
157	FLT157-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
158	FLT158-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
159	FLT159-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
160	FLT160-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
161	FLT161-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
162	FLT162-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
163	FLT163-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
164	FLT164-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
165	FLT165-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
166	FLT166-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
167	FLT167-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
168	FLT168-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
169	FLT169-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
170	FLT170-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
171	FLT171-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
172	FLT172-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable

Table 3-2 (continued)

Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
173	FLT173-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
174	FLT174-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
175	FLT175-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
176	FLT176-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
177	FLT177-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
178	FLT178-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
179	FLT179-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
180	FLT180-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
181	FLT181-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
182	FLT182-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
183	FLT183-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
184	FLT184-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
185	FLT185-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
186	FLT186-3PH	-	-	Compliant	Gen Trip[1]	-	-	Compliant	Gen Trip[1]	-	-	Compliant	Gen Trip[1]
187	FLT187-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
188	FLT188-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable

[1]Voltage Instability

To mitigate the system/voltage instability, voltage violations, generation tripping offline, and poor post-fault steady-state voltages, the following upgrades were provided by SPP and implemented in each season:

- Redington to Woodring 345 kV circuit #2
- Hunter to Woodring 345 kV circuit #2
- Redington to Spring Creek 345 kV circuit #1
- Tulsa North 345/138 kV transformer #2
- Benton 138 kV capacitor bank initialized at 153.6 Mvar (an existing capacitor bank)
- GEN-2016-045 34.5 kV reactor: 175 Mvar (an existing reactor)
- GEN-2016-057 34.5 kV reactor #1 and #2: 175 Mvar each (existing reactors)
- Static Var Compensators (SVC)
    - +300 Mvar SVC at Tulsa North 345 kV bus (wind plant side of 765 kV line)
    - +300 Mvar SVC at Tulsa North 345 kV bus (transmission side of 765 kV line)

The SVC solutions identified above mitigated the contingencies around Tulsa North except for the following:

- FLT100: N.E.S to Onea 345 kV line
- FLT101: N.E.S to Delaware 345 kV line
- FLT104: Wekiwa to P&PWTP4 138 kV line
- FLT105: Cleveland to G16-066T 345 kV line
- FLT107: Weikiwa 345/138/34.5 kV transformer
- FLT108: Wekiwa to SAPLPRD 345 kV line
- FLT112: Tulsa North to Grec Tap 345 kV line with prior outage of Tulsa North to Wekiwa 345 kV line
- FLT 113: Tulsa North to N.E.S 345 kV line and prior outage of Tulsa North to Wekiwa 345 kV line
- FLT 114; Tulsa North to Grec Tap 345 kV line with prior outage of Tulsa North to Wekiwa 345 kV line and prior outage of Tulsa North to Cleveland345 kV line
- FLT115: Tulsa North to Wekiwa 345 kV line and prior outage of Tulsa North to Cleveland345 kV line
- FLT 116: Tulsa North to Wekiwa 345 kV line and prior outage of Tulsa North to N.E.S 345 kV line
- FLT117: Tulsa North to Cleveland345 kV line and prior outage of Tulsa North to N.E.S 345 kV line
- FLT118: Stuck Breaker on Tulsa North to Cleveland 345 kV line that also clears the Tulsa North to N.E.S 345 kV line
- FLT120: Stuck Breaker on Tulsa North to N.E.S 345 kV line that also clears the Tulsa North 345/138/34.5 kV transformer

- FLT121: Stuck Breaker on Tulsa North to N.E.S 345 kV line that also clears the Tulsa North Grec Tap 345 kV line
- FLT124: Stuck Breaker on Tulsa North 345/138/34.5 kV transformer that also clears the Tulsa North Grec Tap 345 kV line.

The above contingencies were not able to be mitigated with a reasonable solution. The projects GEN-2016-133 through GEN-2016-146 are attempting to interconnect 2,500 MW of wind generation through a 360 mile 765 kV line. In addition to this, the wind turbines are acting in voltage control mode with a 0.90 power factor. In steady state, compensation of approximately 2,100 MVars of line charging current is provided primarily by the active current flow injected into the system. During the fault, reactive current is prioritized over real current and is being injected into the system from the wind turbines and from the identified SVC's. Upon clearing of the fault, real current ramps up from approximately 25% of the initial value to 100% within approximately 250 milliseconds but the dynamic reactive power capability of the wind turbines and the SVC is not able to react quick enough to dampen the voltage overshoot observed at the wind turbine terminals. This overshoot is the result of both the momentary uncompensated line charging current and the response time of both the wind turbines and SVC's to a drastic change in reactive power required. As a result, the wind plant trips on overvoltage protection. Refer to Figure 3-1 for a representative voltage plot at the generator terminals and Tulsa North 345 kV POI for FLT105. FLT105 is a three phase, reclose fault that results in the loss of the Cleveland to G15-066T 345 kV line. It can be observed that following the second fault, the generator terminal voltage rises to above 1.3 p.u. Refer to Figure 3-2 for a plot of the real and reactive power of GEN-2016-133 which shows the reactive current injection spike following the clearing of the fault. Refer to Figure 3-3 for a plot of the SVC response to this fault.

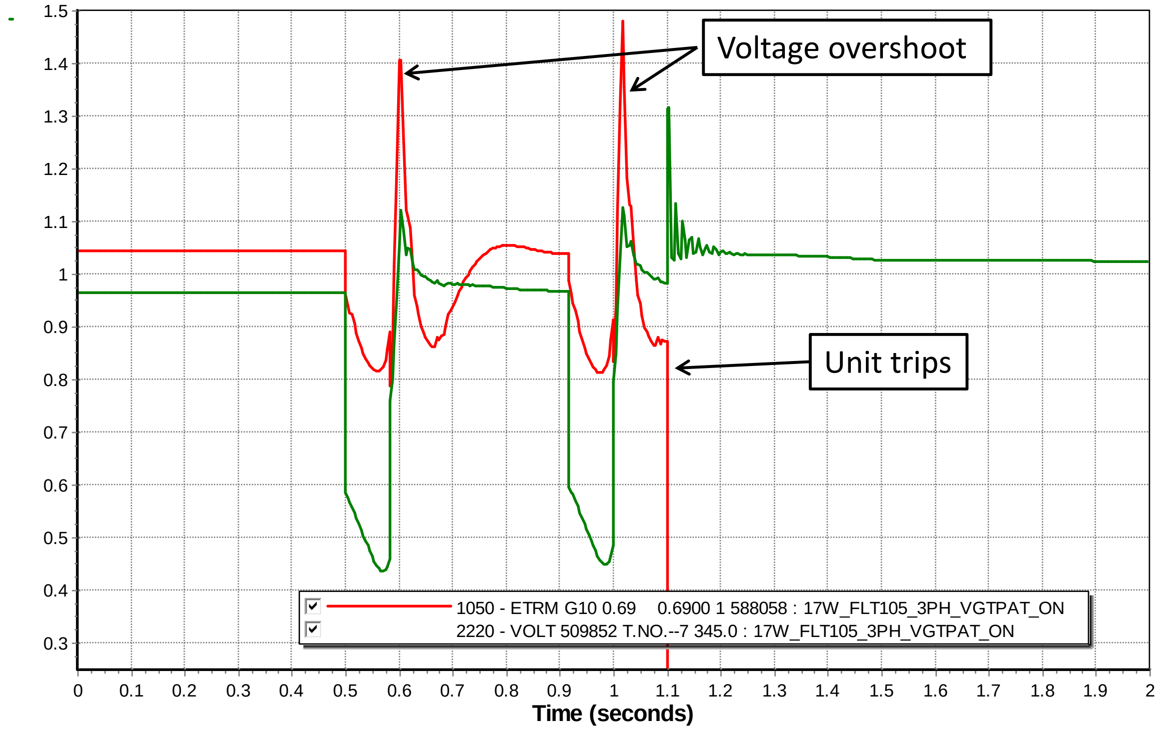


Figure 3-1: Representative plot of Tulsa North area voltages for 2017 Winter Peak conditions.

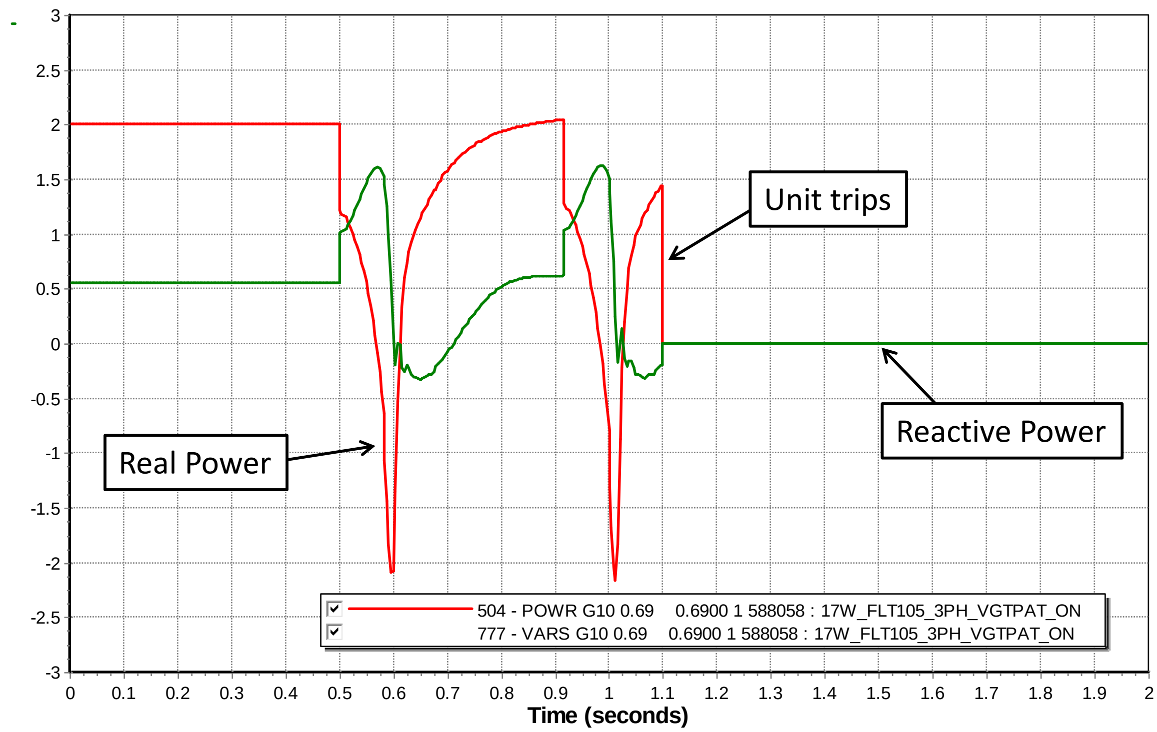


Figure 3-2: Representative plot of Tulsa North generation real and reactive power for 2017 Winter Peak conditions.

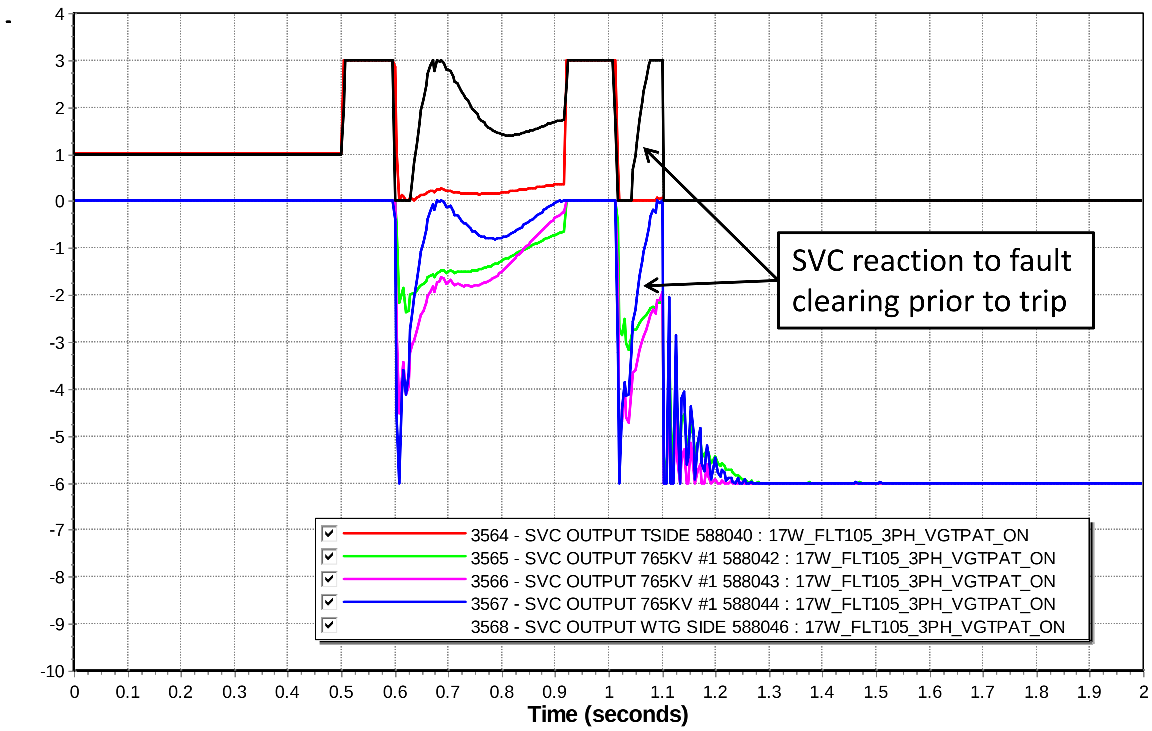


Figure 3-3: Representative plot of Tulsa North SVC output for 2017 Winter Peak conditions.

Figures 3-4 through Figure 3-6 are representative plots of FLT105 with the voltage protection for GEN-2016-133 through GEN-2016-144 disabled. It is recommended the interconnection customer re-examine the design of the interconnection request. As a result of this study and with the current design configuration, GEN-2016-133 through GEN-2016-144 does not meet FERC Order 661A criteria.

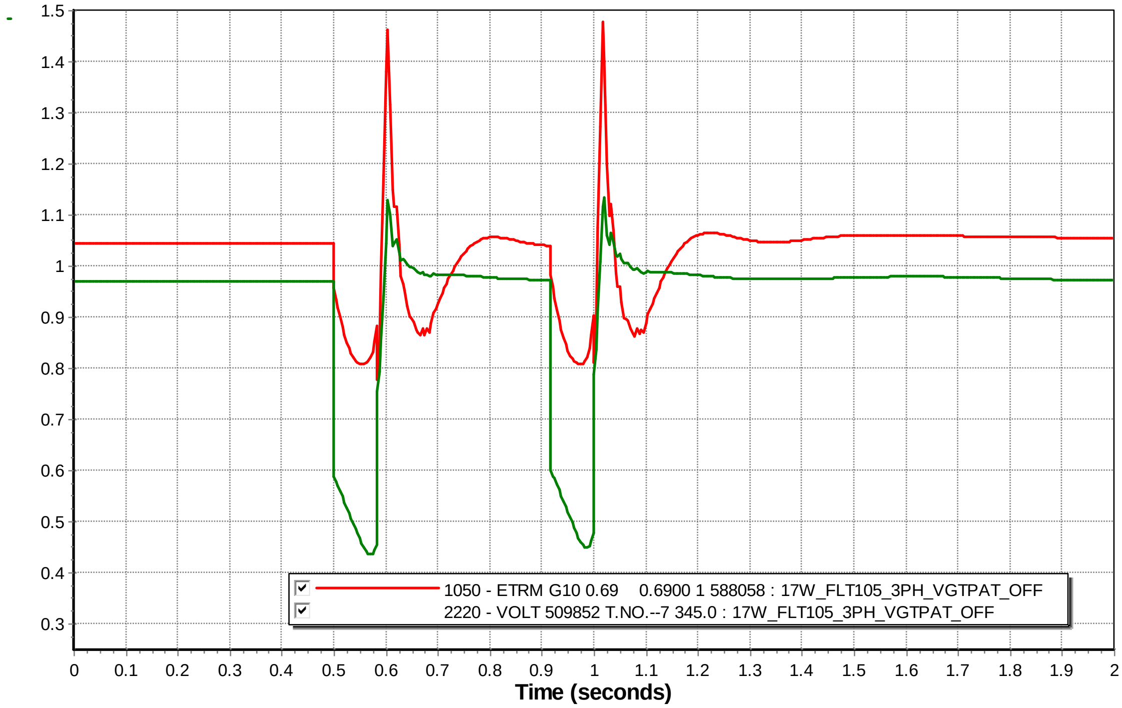


Figure 3-4: Representative plot of Tulsa North area voltages for 2017 Winter Peak conditions with high voltage tripping disabled.

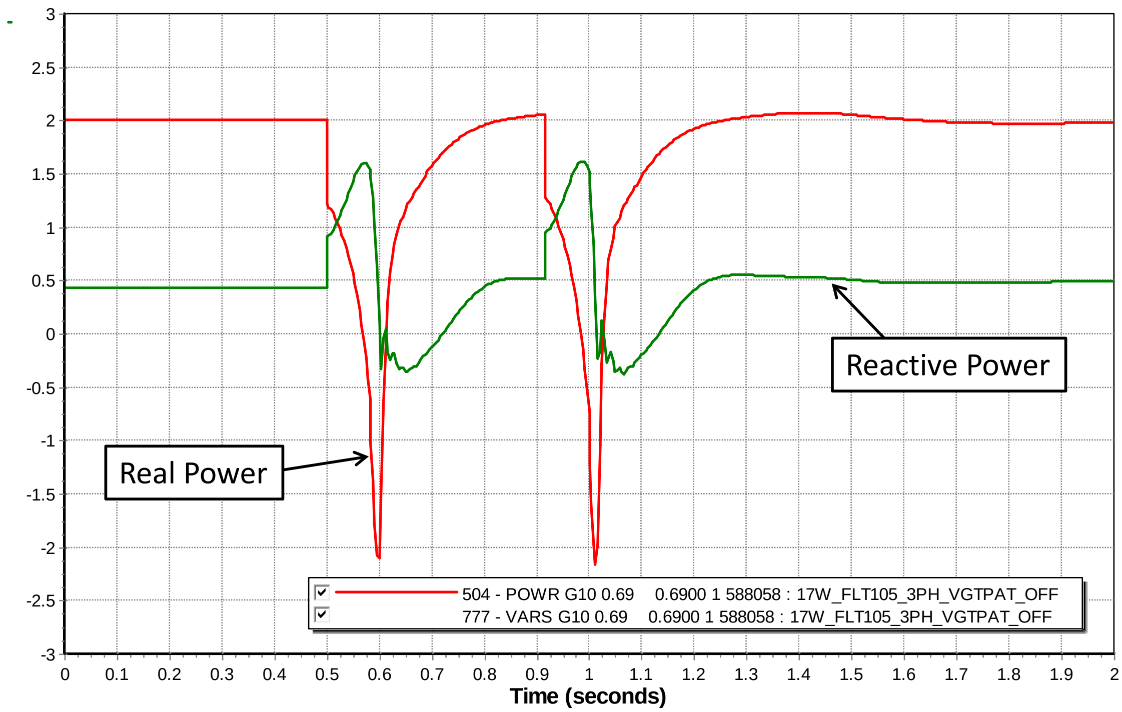


Figure 3-5: Representative plot of Tulsa North generation real and reactive power for 2017 Winter Peak conditions with high voltage tripping disabled.

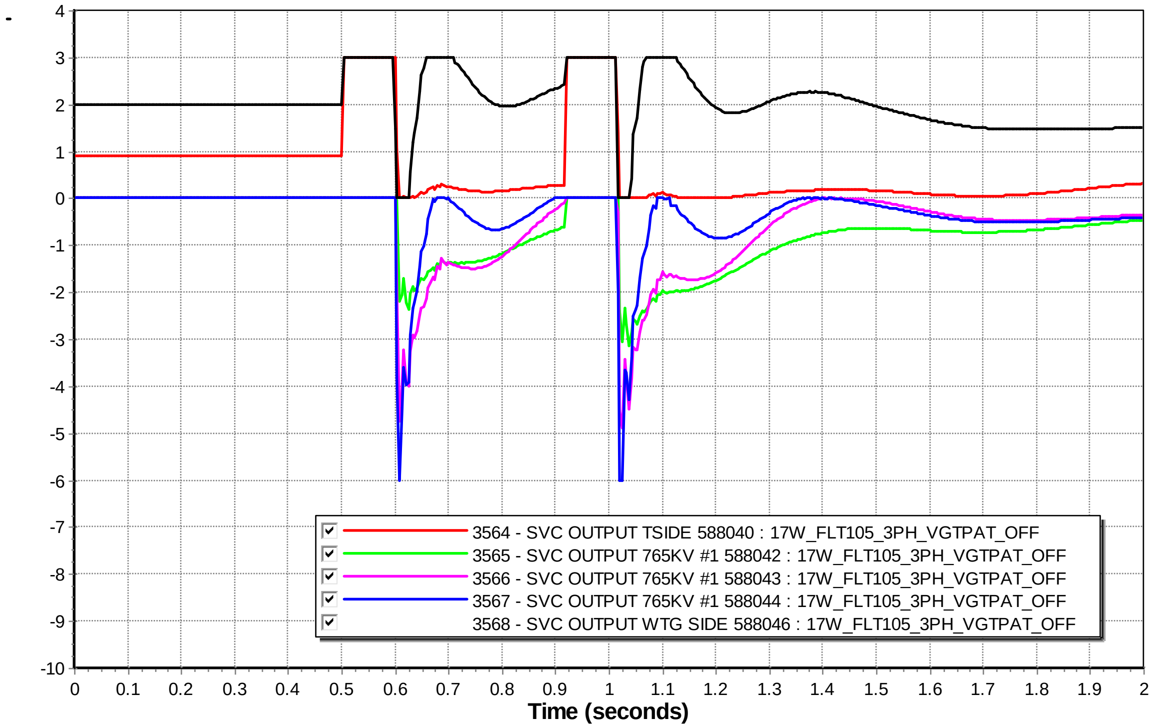


Figure 3-6: Representative plot of Tulsa North SVC output for 2017 Winter Peak conditions with high voltage tripping disabled.

For FLT29-PO, which is a prior outage of G16-072-Tap to Hunters 345 kV line, followed by a three phase fault on the Renfrow to Viola 345 kV line, voltage and generator instability of GEN-2016-072 exists. In order to mitigate this violation, it is recommended GEN-2016-072 be curtailed to 210 MW (reduction of 90 MW) following the prior outage condition for the 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak conditions. Refer to Figure 3-7 for comparison plot of GEN-2016-072's terminal voltage for the 2017 Winter Peak case with and without system upgrades. After the upgrades as stated above were implemented, there was no additional violation of SPP criteria.

Similarly, FLT33-PO is a prior outage of the Renfrow to Viola 345 kV line followed by a three phase fault on the G16-072-Tap to Hunters 345 kV line, voltage and generator instability of GEN-2016-072 exists. In order to mitigate this violation, it is recommended GEN-2016-072 be curtailed to 210 MW (reduction of 90 MW) following the prior outage condition for the 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak conditions.

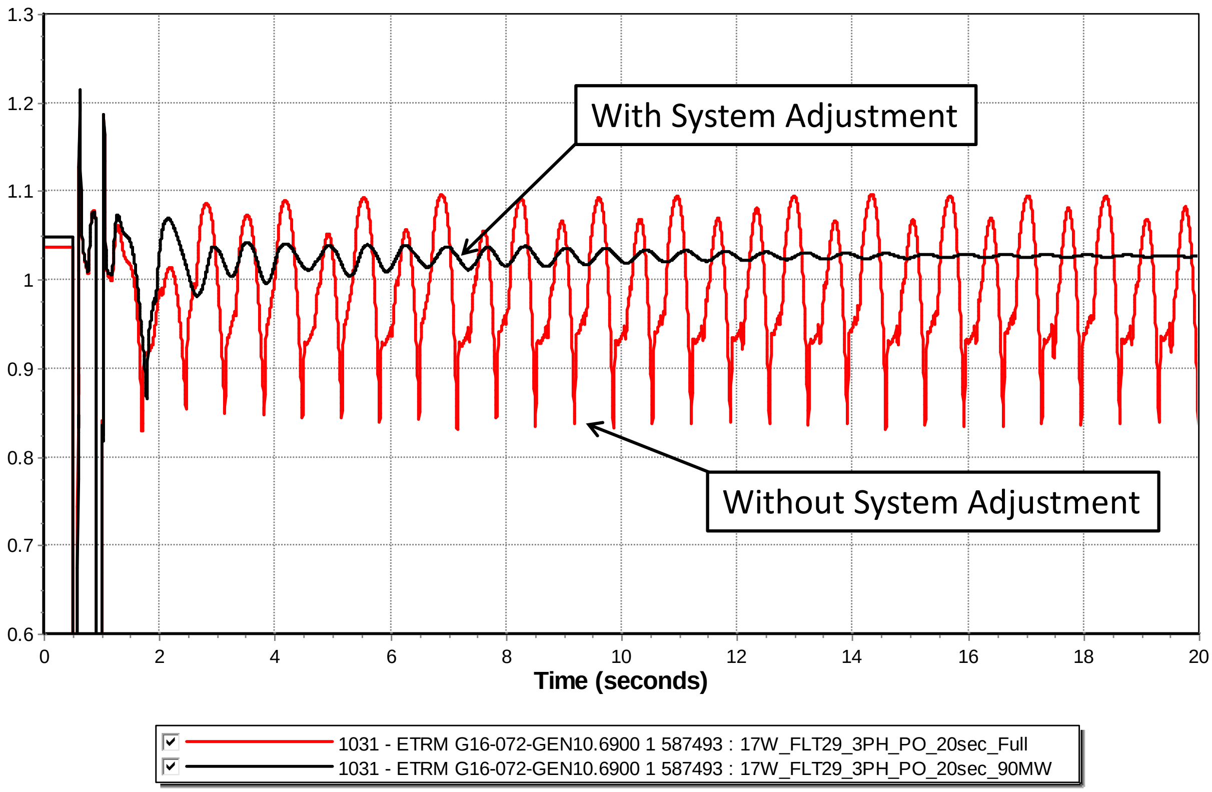


Figure 3-7: Representative plot of GEN-2016-072 terminal voltage for 2017 Winter Peak conditions.

FLT80-3PH, a three-phase fault resulting in the loss of Woodring to Redington 345 kV circuit #1, was observed to have several voltages recovering above the steady-state limit and several voltages recovering below the steady-state limit. Refer to Figure 3-8 for a representative comparison plot of Caney River and Redington area voltages for the 2017 Winter Peak case with and without system upgrades. After the upgrades as stated earlier were implemented, there were no additional voltage violations. The system recovered within SPP criteria.

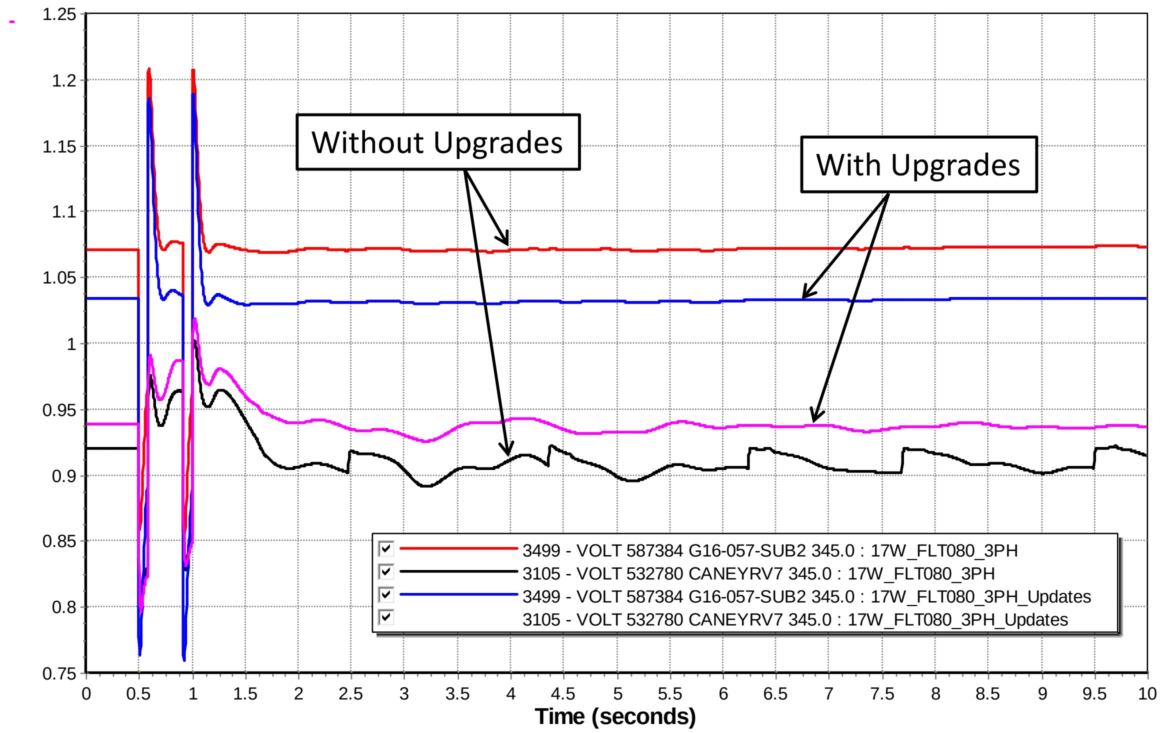


Figure 3-8: Representative plot of Caney River and Redington area voltages for 2017 Winter Peak conditions.

For faults FLT164 through FLT177, which are three phase faults near Creswell 69 kV and adjacent buses, the Power Electronics HEC-US V1500 inverter model tripped offline due to over frequency protection. For this study, the over frequency protection was set to 80 Hz to avoid instantaneous tripping. It is recommended the supplier of the Power Electronic inverter model examine this model for three-phase faults that cause the model to trip on over frequency protection.

For FLT186, which is a three phase fault on the Waverly to LaCygne 345 kV line near Waverly, it was determined the system response of area generators and voltage did not meet SPP disturbance requirements following the fault until the power output at Waverly Wind Farm and Wolf Creek Generating Station were reduced.

After implementing the above upgrades, the contingency analysis was re-simulated for all contingencies. With the upgrades, the Stability Analysis determined that there was no generation tripping or system instability observed as a result of interconnecting all study projects at 100% output except for several contingencies near Tulsa North. It is recommended that the interconnection customer(s) for GEN-2016-133 through GEN-2016-146 re-examine the design of the interconnection request(s).

SECTION 4: SHORT CIRCUIT ANALYSIS

The objective of this task is to quantify the three-phase to ground fault currents for the 2018 Summer Peak and 2026 Summer Peak seasons for each interconnecting generator.

4.1 Approach

The short-circuit analysis will assess breaker adequacy and fault duties for the generator interconnection bus and five buses away from the point of interconnection. MEPPI will assume no outages to find maximum short-circuit currents that flow through the breaker. The Automatic Sequencing Fault Calculation (ASCC) function in PSS/E was utilized to perform this task. FLAT conditions were applied to pre-fault conditions and the following adjustments were utilized:

- All synchronous and asynchronous machine P and Q output was set to zero
- All transformer tap ratios were set to 1.0 p.u. and all phase shift angles were set to zero
- All generator reactance's were fixed to the subtransient reactance
- All line charging was set to zero
- All shunts were set to zero
- All loads were set to zero
- All pre-fault bus voltages were set to 1.0 p.u. and a phase shift angle of zero

Note upgrades found to be necessary for the Stability Analysis were included in the Short-Circuit Analysis.

4.2 Short Circuit Results: 2018 Summer Peak

The maximum fault current for each bus is provided for the 2018 Summer Peak conditions. The following tables show the short circuit results for the study generators for the 2018 Summer Peak condition:

- Table 4-1: Short Circuit Analysis for GEN-2016-024 (18SP)
- Table 4-2: Short Circuit Analysis for GEN-2016-072 (18SP)
- Table 4-3: Short Circuit Analysis for GEN-2016-100, GEN-2016-101, and GEN-2016-119 (18SP)
- Table 4-4: Short Circuit Analysis for GEN-2016-127 (18SP)
- Table 4-5: Short Circuit Analysis for GEN-2016-128 (18SP)
- Table 4-6: Short Circuit Analysis for GEN-2016-133 through GEN-2016-146 (18SP)
- Table 4-7: Short Circuit Analysis for GEN-2016-148 (18SP)
- Table 4-8: Short Circuit Analysis for GEN-2016-153 (18SP)
- Table 4-9: Short Circuit Analysis for GEN-2016-162 and GEN-2016-163 (18SP)
- Table 4-10: Short Circuit Analysis for GEN-2016-173 (18SP)

Table 4-1
Short Circuit Analysis for Study Project GEN-2016-024 (18SP)

Study Generator GEN-2016-024

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
515543	RENFROW7	345	12.97	533061	NOEASTW4	138	20.92	533629	CC2SHAR2	69	4.51
515621	OPENSKY7	345	12.27	533062	ROSEHIL4	138	32.10	533633	COALCRK2	69	4.98
532768	EMPEC 7	345	17.35	533064	17TH 4	138	18.11	533646	TIOGA 2	69	6.15
532771	RENO 7	345	12.04	533065	SG12COL4	138	21.20	533649	UN7ROSE2	69	4.19
532780	CANEYRV7	345	9.97	533067	SPRNGDL4	138	14.59	533653	WOLFCRK2	69	5.81
532782	BUFFALO7	345	21.50	533068	STEARMN4	138	19.99	533660	ASHGRJ22	69	5.27
532783	KINGMAN7	345	6.86	533075	VIOLA 4	138	18.66	533666	CHANTAP2	69	5.08
532791	BENTON 7	345	20.46	533157	FORBES 3	115	9.57	533673	ALTOO E2	69	4.01
532794	ROSEHIL7	345	19.52	533177	6 GOLDN3	115	15.25	533674	ALTOO W2	69	2.94
532796	WICHITA7	345	25.87	533181	TECHILW3	115	27.69	533675	ARGO 2	69	2.87
532797	WOLFCRK7	345	15.93	533182	TECHILE3	115	27.69	533684	CONSOL 2	69	1.64
532798	VIOLA 7	345	14.04	533183	WM BROS3	115	4.58	533698	MONTGOM2	69	7.07
532799	WAVERLY7	345	14.61	533189	UNDRPAS3	115	18.17	533700	NEODJCT2	69	3.47
532800	LATHAMS7	345	10.57	533197	HARTLND3	115	4.66	533705	RA1FRED2	69	1.77
532801	ELKRVR17	345	9.32	533203	TEC E 3	115	27.17	533706	RA5HIPR2	69	3.99
532802	WAVERTX7	345	12.42	533390	MAIZEW 4	138	27.59	533707	RA6BROO2	69	2.23
532920	TECHILL5	161	5.70	533391	MAIZEE 4	138	21.90	533768	NEOSHON2	69	22.11
532986	BENTON 4	138	29.04	533416	RENO 3	115	23.10	533786	CHISHLM2	69	19.00
532987	BUTLER 4	138	9.97	533581	ADA 2	69	7.80	533799	GRANT 2	69	10.81
532988	BELAIRE4	138	19.15	533582	AUGUSTA2	69	7.06	533800	GRANT J2	69	9.55
532989	BUTLERS4	138	9.97	533583	BUTLER 2	69	12.54	533814	MASCOT 2	69	19.86
532990	MIDIAN 4	138	10.16	533584	BU6DEGR2	69	1.92	533815	MEAD 2	69	26.29
532991	WEAVER 4	138	22.40	533587	CHASJCT2	69	9.84	533817	MINNEHA2	69	16.17
532993	TALLGRS4	138	10.09	533588	CHASE 2	69	7.39	533820	MOSSMAN2	69	17.47
532996	TIOGA 4	138	4.11	533589	CHESNEY2	69	8.33	533822	NOEASTW2	69	25.65
533001	ALTOONA4	138	7.64	533590	ELDORAD2	69	7.96	533823	NOEASTE2	69	25.65
533002	DEARING4	138	9.06	533592	GETTY 2	69	10.82	533831	RENEW 2	69	17.36
533004	MONTGOM4	138	6.65	533593	FRNTIER2	69	10.99	533832	RIPLEYM2	69	22.34
533005	NEPARSN4	138	11.78	533594	LEON 2	69	2.66	533835	17TH TP2	69	25.43
533006	TAYLOR 4	138	6.47	533595	MAGNA 2	69	2.02	533840	17TH 2	69	27.65
533021	NEOSHO 4	138	22.63	533596	MAG JCT2	69	3.55	533846	21ST 2	69	16.14
533022	NEOSHON4	138	22.63	533597	MIDIAN 2	69	12.24	533861	BU5FURL2	69	4.47
533024	29TH 4	138	19.95	533598	MOBIL 2	69	7.37	539801	THISTLE7	345	16.15
533026	ANDOVER4	138	18.05	533599	PEABODY2	69	1.44	542981	LACYGNE7	345	25.40
533032	BU11PON4	138	15.20	533600	PESTER 2	69	8.12	560053	G15-052T	345	13.07
533033	CANAL 4	138	16.86	533601	POTWIN 2	69	2.54	562476	G14-001-TAP	345	11.14
533035	CHISHLM4	138	22.66	533602	SKELLY 2	69	11.41	583850	GEN-2014-001	345	7.59
533037	COMOTAR4	138	18.90	533603	TOWANDA2	69	5.52	584900	GEN-2015-052	345	13.03
533039	ELPASO 4	138	25.52	533604	WEAVER 2	69	11.64	587100	GEN-2016-024	138	8.25
533040	EVANS N4	138	40.84	533605	WHITE J2	69	7.10	587500	GEN-2016-073	345	15.61
533041	EVANS S4	138	40.84	533606	TOWTAPW2	69	1.84	587884	G16-111-TAP	345	11.00
533043	FOWLER 4	138	16.59	533607	TOWTAPE2	69	5.66	588320	GEN-2016-162	345	9.93
533054	MAIZE 4	138	23.32	533608	POTWNTP2	69	5.22	588330	GEN-2016-163	345	8.76
533060	NOEASTE4	138	20.92	533626	BURLJCT2	69	4.78	588364	G16-153-TAP	345	7.77

Table 4-2
Short Circuit Analysis for Study Project GEN-2016-072 (18SP)

Study Generators GEN-2016-072											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
514708	OTTER 4	138	9.68	515894	THUNDER7	345	10.57	539004	MAYFLD 4	138	7.11
514709	FRMNTAP4	138	18.43	520204	SANDY_CN_138	138	5.45	539008	MILAN_GOAB	138	10.41
514710	WAUKOMI4	138	10.31	520205	WAKITA_138	138	5.53	539009	CONWAY	138	11.19
514711	WAUKOTP4	138	15.84	520409	RENFROW4	138	10.23	539675	MILANTP4	138	9.05
514712	FAIRMON4	138	14.19	521006	MARSHAL4	138	8.34	539676	MILAN 4	138	9.33
514713	WRVALLY4	138	8.74	521085	WAKITA 2	69	4.77	539801	THISTLE7	345	16.15
514714	WOODRNG4	138	19.75	522397	MDFRDJCT	138	7.34	560031	G15-015-TAP	138	8.31
514715	WOODRNG7	345	18.96	522398	PONDCREEK	138	6.81	560056	G15-066T	345	18.42
514719	CLYDE 2	69	4.38	532768	EMPEC 7	345	17.35	560077	G16-032-TAP	345	4.16
514731	SO4TH 4	138	15.54	532771	RENO 7	345	12.04	560084	G16-061-TAP	345	15.86
514733	MARSHL 4	138	8.38	532782	BUFFALO7	345	21.50	560086	G16-072-TAP	345	13.08
514739	MEDFORD2	69	5.33	532783	KINGMAN7	345	6.86	562476	G14-001-TAP	345	11.14
514802	SOONER 4	138	31.56	532791	BENTON 7	345	20.46	583850	GEN-2014-001	345	7.59
514803	SOONER 7	345	25.43	532792	FR2EAST7	345	7.07	584170	GEN-2014-064	138	9.61
514880	NORTWST7	345	32.44	532794	ROSEHIL7	345	19.52	584570	GEN-2015-015	138	5.80
514901	CIMARON7	345	32.84	532795	FR2WEST7	345	5.74	584690	GEN-2015-030	345	19.21
515407	TATONGA7	345	15.79	532796	WICHITA7	345	25.87	587300	G16-045-SUB1	345	1.56
515476	HUNTERS7	345	13.55	532797	WOLFCRK7	345	15.93	587304	G16-045-SUB2	345	1.52
515477	CHSHLMV7	345	13.53	532798	VIOLA 7	345	14.04	587380	G16-057-SUB1	345	1.53
515497	MATHWSN7	345	31.85	532986	BENTON 4	138	29.04	587384	G16-057-SUB2	345	1.47
515543	RENFROW7	345	12.97	533036	CLEARWT4	138	14.45	587410	GEN-2016-061	345	15.53
515544	RENFROW4	138	14.10	533040	EVANS N4	138	40.84	587460	GEN-2016-068	345	6.51
515546	GRANTCO4	138	6.38	533041	EVANS S4	138	40.84	587490	GEN-2016-072	345	10.12
515547	GRANTCO2	69	7.36	533045	GILL W 4	138	26.00	587500	GEN-2016-073	345	15.61
515569	MDFRDTP4	138	11.30	533046	GILL S 4	138	26.00	587804	G16-100-TAP	345	16.29
515576	RANCHRD7	345	13.18	533047	GILL 4	138	26.00	587884	G16-111-TAP	345	11.00
515581	COYOTE 4	138	8.30	533065	SG12COL4	138	21.20	588190	GEN-2016-128	345	7.92
515646	GRNTWD 7	345	11.32	533075	VIOLA 4	138	18.66	588320	GEN-2016-162	345	9.93
515875	REDNGTN7	345	18.05	533390	MAIZEW 4	138	27.59	588360	GEN-2016-153	345	7.43
515877	REDDIRT7	345	17.73	533416	RENO 3	115	23.10	588364	G16-153-TAP	345	7.77

Table 4-3
Short Circuit Analysis for Study Project GEN-2016-100, GEN-2016-101, and GEN-2016-119 (18SP)

Study Generators GEN-2016-100, GEN-2016-101, and GEN-2016-119											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
300138	4CLEVLND	138	16.85	514851	QUAILCK4	138	29.56	515549	MNCWND37	345	11.77
509755	WEKIWA-7	345	19.25	514852	SLVRLAK4	138	32.92	515576	RANCHRD7	345	13.18
509782	R.S.S.-7	345	31.40	514854	BRADEN 4	138	31.59	515582	SLNGWND7	345	7.20
509852	T.NO.--7	345	25.91	514862	RICHRDS4	138	21.82	515585	MAMTHPW7	345	12.50
509895	T.NO.2-4	138	35.22	514863	HAYMAKR4	138	26.43	515600	KNGFSHR7	345	11.33
510376	WEBBTAP4	138	10.37	514864	PIEDMNT4	138	22.47	515605	CANADN7	345	11.72
510406	N.E.S.-7	345	19.20	514873	LNEOAK 4	138	27.06	515610	FSHRTAP7	345	16.67
510907	PITTSB-7	345	13.59	514879	NORTWST4	138	44.32	515621	OPENSKY7	345	12.27
511425	TUTCONT4	138	10.60	514880	NORTWST7	345	32.44	515688	FRNTWND7	345	10.52
512694	CLEVLND7	345	15.28	514881	SPRNGCK7	345	23.37	515800	GRACMNT7	345	16.64
512729	CLEVLND 4	138	16.85	514894	CZECHAL4	138	28.21	515875	REDNGTN7	345	18.05
512865	GREC TAP5	345	26.15	514895	SARA 4	138	18.74	515877	REDDIRT7	345	17.73
514704	MILLERT4	138	20.36	514898	CIMARON4	138	43.24	515894	THUNDER7	345	10.57
514705	COWCRK 2	69	4.05	514901	CIMARON7	345	32.84	529200	OMCDLEC7	345	13.15
514706	COWCRK 4	138	11.35	514906	JNSKAMO4	138	20.77	532794	ROSEHIL7	345	19.52
514707	PERRY 4	138	11.04	514907	ARCADIA4	138	42.26	560053	G15-052T	345	13.07
514708	OTTER 4	138	9.68	514908	ARCADIA7	345	26.40	560056	G15-066T	345	18.42
514709	FRMNTAP4	138	18.43	514909	REDBUD 7	345	25.40	560084	G16-061-TAP	345	15.86
514711	WAUKOTP4	138	15.84	514933	DRAPER 4	138	39.27	560086	G16-072-TAP	345	13.08
514713	WRVALLY4	138	8.74	514934	DRAPER 7	345	20.91	584690	GEN-2015-030	345	19.21
514714	WOODRNG4	138	19.75	515006	MORRISN4	138	13.87	584700	GEN-2015-029	345	9.55
514715	WOODRNG7	345	18.96	515009	MCELROY4	138	13.63	584770	GEN-2015-034	345	11.18
514733	MARSHL 4	138	8.38	515011	STILWTR4	138	13.94	584900	GEN-2015-052	345	13.03
514737	OTOE 4	138	16.24	515044	SEMINOL4	138	40.05	585040	GEN-2015-066	345	18.24
514742	OSGE 2	69	15.74	515045	SEMINOL7	345	26.56	587160	GEN-2016-022	345	10.65
514743	OSAGE 4	138	16.65	515224	MUSKOGE7	345	29.00	587300	G16-045-SUB1	345	1.56
514758	STDBEAR4	138	13.93	515375	WWRDEHV7	345	18.88	587304	G16-045-SUB2	345	1.52
514761	WHEAGLE4	138	15.78	515400	DMANCRK4	138	8.06	587380	G16-057-SUB1	345	1.53
514770	MARLNDT4	138	10.96	515407	TATONGA7	345	15.79	587384	G16-057-SUB2	345	1.47
514798	SNRPMPT4	138	20.41	515412	DMNCRKT4	138	13.75	587410	GEN-2016-061	345	15.53
514799	SNRPMP 4	138	11.26	515444	MCNOWND7	345	17.20	587460	GEN-2016-068	345	6.51
514801	MINCO 7	345	17.25	515447	MORISNT4	138	13.91	587800	GEN-2016-100	345	12.13
514802	SOONER 4	138	31.56	515448	CRSRDSW7	345	11.04	587804	G16-100-TAP	345	16.29
514803	SOONER 7	345	25.43	515461	RNDBARN4	138	40.13	587950	GEN-2016-119	345	10.25
514819	EL-RENO4	138	15.36	515465	LGARBER4	138	21.35	587955	GEN2016-119B	345	8.84
514820	JENSENT4	138	15.30	515466	MITCHSB4	138	21.55	588040	G16133G16146	345	25.91
514825	KAYWIND7	345	12.24	515476	HUNTERS7	345	13.55	588190	GEN-2016-128	345	7.92
514827	CTNWOOD4	138	17.95	515477	CHSHLMV7	345	13.53				
514828	KETCHTP4	138	26.66	515497	MATHWSN7	345	31.85				
514834	KETCH 4	138	27.12	515512	SPVALLY4	138	10.4353				

Table 4-4
Short Circuit Analysis for Study Project GEN-2016-127 (18SP)

Study Generator GEN-2016-127											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
301369	4REMNGTON	138	10.38	514760	KILDARE4	138	11.02	515542	CWBOYHT4	138	8.05
510376	WEBBTAP4	138	10.37	514761	WHEAGLE4	138	15.78	520213	HARDY 4	138	5.56
510377	FAIRFXT4	138	10.43	514763	CONBLKS2	69	14.08	520214	SHIDWFC4	138	7.41
510382	WPAWHSK4	138	6.48	514764	NWKRKAT4	138	10.71	520215	WEBBCTY4	138	5.96
510403	SHIDLER4	138	11.07	514770	MARLNDT4	138	10.96	521007	MARLAND_138	138	7.46
510412	WESTERNWALL4	138	6.40	514798	SNRPMPT4	138	20.41	529241	OMMORANT	69	9.50
514704	MILLERT4	138	20.36	514799	SNRPMP 4	138	11.26	529242	OMHUFFYT	69	8.92
514707	PERRY 4	138	11.04	514802	SOONER 4	138	31.56	529248	OMPECANT	69	10.30
514742	OSGE 2	69	15.74	514803	SOONER 7	345	25.43	529249	OMWW	69	11.87
514743	OSAGE 4	138	16.65	515400	DMANCRK4	138	8.06	587070	GEN-2016-009	69	14.84
514745	CHERPLT2	69	11.70	515402	CONBLKT2	69	14.17	588030	GEN-2016-127	138	5.41
514748	CONTEMP4	138	13.54	515403	FNTANTP4	138	6.85	588230	GEN-2016-148	138	5.21
514753	CONORTH4	138	13.59	515412	DMNCRKT4	138	13.75	588314	ASGI1708-TAP	138	10.68
514757	CHIKASI4	138	9.11	515447	MORISNT4	138	13.91	588315	ASGI1708MAIN	138	7.11
514758	STDBEAR4	138	13.93	515541	COWBOYH4	138	7.47				

Table 4-5
Short Circuit Analysis for Study Project GEN-2016-128 (18SP)

Study Generator GEN-2016-128											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
509852	T.NO.--7	345	25.91	514863	HAYMAKR4	138	26.43	515610	FSHRTAP7	345	16.67
511425	TUTCONT4	138	10.60	514864	PIEDMNT4	138	22.47	515621	OPENSKY7	345	12.27
512694	CLEVLND7	345	15.28	514873	LNEOAK 4	138	27.06	515641	PLNSMEN4	138	14.04
512729	CLEVLND 4	138	16.85	514879	NORTWST4	138	44.32	515646	GRNTWD 7	345	11.32
514642	BRCKWND4	138	7.46	514880	NORTWST7	345	32.44	515688	FRNTWND7	345	10.52
514701	BUNCHCK4	138	6.60	514881	SPRNGCK7	345	23.37	515800	GRACMNT7	345	16.64
514704	MILLERT4	138	20.36	514894	CZECHAL4	138	28.21	515875	REDNGTN7	345	18.05
514705	COWCRK 2	69	4.05	514895	SARA 4	138	18.74	515877	REDDIRT7	345	17.73
514706	COWCRK 4	138	11.35	514898	CIMARON4	138	43.24	515894	THUNDER7	345	10.57
514707	PERRY 4	138	11.04	514901	CIMARON7	345	32.84	520409	RENFROW4	138	10.23
514708	OTTER 4	138	9.68	514907	ARCADIA4	138	42.26	520882	DOVERSW4	138	9.57
514709	FRMNTAP4	138	18.43	514908	ARCADIA7	345	26.40	521006	MARSHAL4	138	8.34
514710	WAUKOMI4	138	10.31	514909	REDBUD 7	345	25.40	521100	WARREN 4	138	8.74
514711	WAUKOTP4	138	15.84	514933	DRAPER 4	138	39.27	529200	OMCDLEC7	345	13.15
514712	FAIRMON4	138	14.19	514934	DRAPER 7	345	20.91	532796	WICHITA7	345	25.87
514713	WRVALLY4	138	8.74	515006	MORRISN4	138	13.87	532798	VIOLA 7	345	14.04
514714	WOODRNG4	138	19.75	515011	STILWTR4	138	13.94	533075	VIOLA 4	138	18.66
514715	WOODRNG7	345	18.96	515045	SEMINOL7	345	26.56	539801	THISTLE7	345	16.15
514718	VANCE 2	69	7.02	515373	LBRTYLK4	138	14.05	560053	G15-052T	345	13.07
514721	IMO 2	69	11.96	515375	WWRDEHV7	345	18.88	560056	G15-066T	345	18.42
514722	CLEVETP2	69	11.74	515376	WWRDEHV4	138	22.60	560071	G16-003-TAP	345	14.66
514727	ENID 2	69	10.89	515377	CRESENT4	138	7.96	560077	G16-032-TAP	345	4.16
514730	SO4TH 2	69	13.79	515383	ENIDINT4	138	13.11	560084	G16-061-TAP	345	15.86
514731	SO4TH 4	138	15.54	515407	TATONGA7	345	15.79	560086	G16-072-TAP	345	13.08
514733	MARSHL 4	138	8.38	515412	DMNCRKT4	138	13.75	584170	GEN-2014-064	138	9.61
514734	GLENWD 4	138	10.36	515444	MCNOWND7	345	17.20	584690	GEN-2015-030	345	19.21
514737	OTOE 4	138	16.24	515447	MORISNT4	138	13.91	584700	GEN-2015-029	345	9.55
514743	OSAGE 4	138	16.65	515448	CRSRDSW7	345	11.04	584770	GEN-2015-034	345	11.18
514774	HENESEY4	138	8.69	515456	CHSTNTT2	69	11.54	585040	GEN-2015-066	345	18.24
514789	MENOTAP4	138	7.12	515458	BORDER 7	345	5.28	587160	GEN-2016-022	345	10.65
514790	IMO 4	138	12.01	515476	HUNTERS7	345	13.55	587210	GEN-2016-032	138	8.80
514798	SNRPMPT4	138	20.41	515477	CHSHLMV7	345	13.53	587300	G16-045-SUB1	345	1.56
514799	SNRPMP 4	138	11.26	515497	MATHWSN7	345	31.85	587304	G16-045-SUB2	345	1.52
514801	MINCO 7	345	17.25	515543	RENFROW7	345	12.97	587380	G16-057-SUB1	345	1.53
514802	SOONER 4	138	31.56	515544	RENFROW4	138	14.10	587384	G16-057-SUB2	345	1.47
514803	SOONER 7	345	25.43	515546	GRANTCO4	138	6.38	587410	GEN-2016-061	345	15.53
514815	BRECKNR4	138	14.01	515549	MNCWND37	345	11.77	587460	GEN-2016-068	345	6.51
514819	EL-RENO4	138	15.36	515569	MDFRDTP4	138	11.30	587490	GEN-2016-072	345	10.12
514820	JENSENT4	138	15.30	515576	RANCHRD7	345	13.18	587800	GEN-2016-100	345	12.13
514825	KAYWIND7	345	12.24	515582	SLNGWND7	345	7.20	587804	G16-100-TAP	345	16.29
514827	CTNWOOD4	138	17.95	515585	MAMTHPW7	345	12.50	587950	GEN-2016-119	345	10.25
514828	KETCHTP4	138	26.66	515599	G07621119-20	345	12.83	587955	GEN2016-119B	345	8.84
514829	PINE ST4	138	12.23	515600	KNGFSHR7	345	11.33	588190	GEN-2016-128	345	7.92
514854	BRADEN 4	138	31.59	515605	CANADN7	345	11.72	588364	G16-153-TAP	345	7.77

Table 4-6
Short Circuit Analysis for Study Project GEN-2016-133 through GEN-2016-146 (18SP)

Study Generator GEN-2016-133, GEN-2016-134, GEN-2016-135, GEN-2016-136, GEN-2016-137, GEN-2016-138, GEN-2016-139, GEN-2016-140, GEN-2016-141, GEN-2016-142, GEN-2016-143, GEN-2016-144, GEN-2016-145, and GEN-2016-146

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
300069	5CHOTEAU1	161	43.23	509816	S.S.---2	69	6.24	512729	CLEVLND 4	138	16.85
300131	4FISHERTP	138	14.59	509817	T.NO.--4	138	35.26	512734	FARML 4	138	8.33
300137	4BRISTOW	138	7.11	509818	PP----E4	138	7.76	512735	COFCTY2	69	9.70
300138	4CLEVLND	138	16.85	509821	HWY20-T4	138	3.89	512742	WMAIN ST5	161	26.18
300139	4FAIRFAX	138	8.63	509822	W.ED.-E4	138	8.01	512749	PAWNSW4	138	10.24
300140	4SILVCTY	138	15.73	509823	WED-TAP4	138	19.05	512750	TONECE7	345	14.48
300141	4STILWTR	138	11.86	509825	YARCH-N4	138	6.70	512751	TONECE5	161	14.74
300145	4FISHER	138	12.33	509832	W.ED.-W4	138	11.63	512753	TONNEC2	69	4.71
300274	5LOCSTGV	161	13.42	509834	COGENT 7	345	29.56	512757	NWMAID5	161	25.76
300739	7BLACKBERRY	345	12.27	509836	OEC 7	345	29.69	512760	GERALDGAY4	161	26.82
300740	7SPORTSMAN	345	24.15	509837	46ST--E4	138	14.18	512865	GREC TAP5	345	26.15
300741	5SPORTSMAN	161	40.97	509839	CDC-ET 4	138	18.74	514704	MILLERT4	138	20.36
300795	4OOLOGAH	138	20.53	509840	WHIRLPO4	138	18.46	514707	PERRY 4	138	11.04
300927	2CLEVLND	69	9.79	509841	PCATSAT4	138	17.63	514715	WOODRNG7	345	18.96
300943	2SILVCTY	69	10.17	509842	CDC-WT 4	138	19.51	514798	SNRPMPT4	138	20.41
300949	7JASPER	345	10.69	509843	OWASO2_4	138	13.92	514802	SOONER 4	138	31.56
300996	4JAVINE	138	6.56	509844	OWASOTP4	138	15.02	514803	SOONER 7	345	25.43
300997	5KETONVL	161	11.45	509848	OAKSWTP4	138	24.62	514881	SPRNGCK7	345	23.37
301339	4SFORKKTP	138	6.85	509851	P&P WTP4	138	15.06	514908	ARCADIA7	345	26.40
301348	5CHOTEAU2	161	43.23	509852	T.NO.--7	345	25.91	514909	REDBUD 7	345	25.40
301425	4GLENCOE	138	9.47	509854	VERDIGS4	138	13.60	515045	SEMINOL7	345	26.56
301430	2CLEVLNDXFMR	69	9.79	509860	OWAS1094	138	14.42	515224	MUSKOGE7	345	29.00
505609	KEYSTON5	161	6.97	509862	YARCHT 4	138	8.75	515234	PECANCK5	161	21.04
505610	KEYSTON4	138	21.59	509863	PPTAP 4	138	10.35	515235	PECANCK7	345	21.74
506934	FLINTCR5	161	31.71	509864	CLARTOK4	138	13.60	515302	FTSMITH7	345	9.96
506935	FLINTCR7	345	14.64	509865	CARSONT4	138	12.05	515422	C-RIVER7	345	9.62
506944	CHAMSPR5	161	21.57	509869	121LYNN4	138	17.57	515447	MORISNT4	138	13.91
506945	CHAMSPR7	345	9.47	509870	SAPLPRD7	345	21.52	515576	RANCHRD7	345	13.18
506959	TONTITN7	345	8.43	509871	SAPLPRD4	138	32.40	515621	OPENSKY7	345	12.27
506979	SHIPERD7	345	9.90	509875	RSS T2 4	138	50.40	515688	FRNTWND7	345	10.52
509714	CIP 4	138	13.45	509884	SKIATOK4	138	10.51	515894	THUNDER7	345	10.57
509715	CDC 4	138	13.44	509887	OWAS88_4	138	16.65	529200	OMCDLEC7	345	13.15
509721	BA.NO-S4	138	12.23	509888	72ELWOD4	138	23.09	532780	CANEYRV7	345	9.97
509726	OWASO1_4	138	13.96	509889	E_121ST4	138	15.64	532781	CANEYWF7	345	9.70
509727	OAKS W4	138	15.42	509891	BA_71ST4	138	25.26	532793	NEOSHO 7	345	16.07
509737	BA101 S4	138	17.94	509895	T.NO.2-4	138	35.22	532799	WAVERLY7	345	14.61
509739	CARSN-T4	138	32.11	510378	SCOFCTY4	138	8.55	532800	LATHAMS7	345	10.57
509741	CARSN-N4	138	9.45	510379	DELWARE4	138	11.01	532934	MARMTNE5	161	8.08
509743	DENVR-E4	138	8.28	510380	DELWARE7	345	11.52	532937	NEOSHO 5	161	20.94
509745	CLARKSV7	345	20.26	510384	WATOVA 4	138	9.03	533020	NEOSHOS4	138	22.63
509746	DENVTAP4	138	9.66	510385	RICE CK4	138	11.31	533021	NEOSHO 4	138	22.63
509747	BA81---4	138	17.93	510388	BARNSAL4	138	6.68	533022	NEOSHON4	138	22.63
509748	DENVR-W4	138	9.82	510391	BV-SE--4	138	12.17	533778	NEOSHOS2	69	22.11
509753	116JENK4	138	41.62	510396	N.E.S.-4	138	35.70	542965	W.GRDNR7	345	26.42
509755	WEKIWA-7	345	19.25	510397	NOWATA-4	138	8.40	542968	STILWEL7	345	24.61
509757	WEKIWA-4	138	31.78	510406	N.E.S.-7	345	19.20	542981	LACYGNE7	345	25.40
509758	PRATTV-4	138	20.07	510410	CHELSA4	138	5.99	543629	LACYGNE11_7	345	24.76
509759	JENKS--4	138	24.96	510413	HAWTHRN4	138	20.28	543632	LACYGNE22_7	345	24.72
509767	B111---4	138	15.75	510433	BARNPMP4	138	6.66	547469	RIV4525	161	23.38
509768	BA101ST4	138	18.62	512625	MAIDTP2	69	11.84	549984	BROOKLINE 7	345	11.08

Table 4-6 (continued)
Short Circuit Analysis for Study Project GEN-2016-133 through GEN-2016-146 (18SP)

Study Generator GEN-2016-133, GEN-2016-134, GEN-2016-135, GEN-2016-136, GEN-2016-137, GEN-2016-138, GEN-2016-139, GEN-2016-140, GEN-2016-141, GEN-2016-142, GEN-2016-143, GEN-2016-144, GEN-2016-145, and GEN-2016-146

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
509769	BA101-N4	138	19.50	512626	MAID 2	69	14.50	560056	G15-066T	345	18.42
509773	RSS T1 4	138	49.57	512629	DRYGULCH5	161	14.64	560084	G16-061-TAP	345	15.86
509782	R.S.S.-7	345	31.40	512635	KERR GR5	161	26.88	560389	GEN-2010-055	138	31.78
509783	R.S.S.-4	138	59.00	512638	CATSAGR5	161	23.50	584690	GEN-2015-030	345	19.21
509784	A.A.---4	138	16.69	512640	OKAYGR 5	161	9.57	584770	GEN-2015-034	345	11.18
509785	BANNTAP4	138	18.51	512643	SILMCTY5	161	19.26	585040	GEN-2015-066	345	18.24
509786	BA.N-ST4	138	24.06	512648	MAID 5	161	42.15	587160	GEN-2016-022	345	10.65
509788	T.P.S.-4	138	39.07	512650	GRDA1 7	345	26.60	587410	GEN-2016-061	345	15.53
509790	CATOOSA4	138	35.20	512651	CLARMR 5	161	13.02	587800	GEN-2016-100	345	12.13
509801	MOHAWK 4	138	10.92	512656	GRDA1 5	161	41.89	587804	G16-100-TAP	345	16.29
509802	MINGORD4	138	16.69	512679	CLARMR 2	69	12.53	587950	GEN-2016-119	345	10.25
509804	LLANETP4	138	26.90	512694	CLEVLND7	345	15.28	588040	G16133G16146	345	25.91
509805	PP----W4	138	8.29	512697	WAGNOR 2	69	6.68	588041	G16133_765TN	765	7.90
509806	ONETA--4	138	50.28	512700	WAGNOR 5	161	9.44	588042	G16133_765R1	765	7.90
509807	ONETA--7	345	29.96	512707	CLARMR 4	138	13.38	588043	G16133_765R2	765	4.36
509812	SHEFFD-4	138	25.53	512726	SILVCTYGR4	138	15.58	588044	G16133_765R3	765	3.74
509815	S.S.---4	138	28.28	512727	GRDA1 2	69	12.17				

Table 4-7
Short Circuit Analysis for Study Project GEN-2016-148 (18SP)

Study Generator GEN-2016-148

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
510376	WEBBTAP4	138	10.37	514758	STDBEAR4	138	13.93	520214	SHIDWFC4	138	7.41
510377	FAIRFXT4	138	10.43	514761	WHEAGLE4	138	15.78	520215	WEBBCTY4	138	5.96
510403	SHIDLER4	138	11.07	514770	MARLNDT4	138	10.96	588230	GEN-2016-148	138	5.21
514742	OSGE 2	69	15.74	514798	SNRPMPT4	138	20.41				
514743	OSAGE 4	138	16.65	520213	HARDY 4	138	5.56				

Table 4-8
Short Circuit Analysis for Study Project GEN-2016-153

Study Generator GEN-2016-153											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
514715	WOODRNG7	345	18.96	532800	LATHAMS7	345	10.57	533795	GILL E 2	69	32.66
515375	WWRDEHV7	345	18.88	532986	BENTON 4	138	29.04	533796	GILL W 2	69	32.66
515476	HUNTERS7	345	13.55	532988	BELAIRE4	138	19.15	539003	CLDWELL4	138	4.74
515477	CHSHLMV7	345	13.53	532990	MIDIAN 4	138	10.16	539004	MAYFLD 4	138	7.11
515543	RENFROW7	345	12.97	533015	BENTLEY4	138	10.06	539008	MILAN_GOAB	138	10.41
515544	RENFROW4	138	14.10	533024	29TH 4	138	19.95	539009	CONWAY	138	11.19
515546	GRANTCO4	138	6.38	533029	59TH ST4	138	18.58	539668	HARPER 4	138	6.91
515547	GRANTCO2	69	7.36	533035	CHISHLM4	138	22.66	539675	MILANTP4	138	9.05
515569	MDFRDTP4	138	11.30	533036	CLEARWT4	138	14.45	539676	MILAN 4	138	9.33
515646	GRNTWD 7	345	11.32	533040	EVANS N4	138	40.84	539801	THISTLE7	345	16.15
520205	WAKITA_138	138	5.53	533041	EVANS S4	138	40.84	539804	THISTLE4	138	17.35
520409	RENFROW4	138	10.23	533044	GILL E 4	138	26.00	560031	G15-015-TAP	138	8.31
522397	MDFRDJCT	138	7.34	533045	GILL W 4	138	26.00	560053	G15-052T	345	13.07
532768	EMPEC 7	345	17.35	533046	GILL S 4	138	26.00	560072	G16-005-TAP	345	12.74
532769	LANG 7	345	17.14	533047	GILL 4	138	26.00	560086	G16-072-TAP	345	13.08
532770	MORRIS 7	345	12.81	533053	LAKERDG4	138	18.98	562476	G14-001-TAP	345	11.14
532771	RENO 7	345	12.04	533054	MAIZE 4	138	23.32	578530	FR3HV	345	5.29
532774	SWISVAL7	345	16.44	533062	ROSEHIL4	138	32.10	583850	GEN-2014-001	345	7.59
532782	BUFFALO7	345	21.50	533065	SG12COL4	138	21.20	585100	GEN-2015-073	345	14.20
532783	KINGMAN7	345	6.86	533071	WACO S 4	138	21.97	587490	GEN-2016-072	345	10.12
532784	NINN1WF7	345	5.69	533074	45TH ST4	138	27.78	587500	GEN-2016-073	345	15.61
532791	BENTON 7	345	20.46	533075	VIOLA 4	138	18.66	587880	GEN-2016-111	345	6.98
532792	FR2EAST7	345	7.07	533390	MAIZEW 4	138	27.59	587884	G16-111-TAP	345	11.00
532794	ROSEHIL7	345	19.52	533413	CIRCLE 3	115	19.12	587894	G16-112-TAP	345	10.84
532795	FR2WEST7	345	5.74	533415	DAVIS 3	115	8.31	587910	GEN-2016-114	345	9.85
532796	WICHITA7	345	25.87	533416	RENO 3	115	23.10	588320	GEN-2016-162	345	9.93
532797	WOLFCRK7	345	15.93	533429	MOUNDRG3	115	7.11	588330	GEN-2016-163	345	8.76
532798	VIOLA 7	345	14.04	533438	WMCPHER3	115	12.24	588360	GEN-2016-153	345	7.43
532799	WAVERLY7	345	14.61	533653	WOLFCRK2	69	5.81	588364	G16-153-TAP	345	7.77

Table 4-9
Short Circuit Analysis for Study Project GEN-2016-162 and GEN-2016-163 (18SP)

Study Generator GEN-2016-162 and GEN-2016-163

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
300739	7BLACKBERRY	345	12.27	532988	BELAIRE4	138	19.15	533304	LANG 3	115	14.45
510380	DELWARE7	345	11.52	532989	BUTLERS4	138	9.97	533380	SPRGCRK3	115	3.61
514803	SOONER 7	345	25.43	532990	MIDIAN 4	138	10.16	533390	MAIZEW 4	138	27.59
514825	KAYWIND7	345	12.24	532991	WEAVER 4	138	22.40	533391	MAIZEE 4	138	21.90
515375	WWRDEHV7	345	18.88	532993	TALLGRS4	138	10.09	533394	CORONAD3	115	7.19
515376	WWRDEHV4	138	22.60	532996	TIOGA 4	138	4.11	533412	ARKVALJ3	115	9.87
515407	TATONGA7	345	15.79	533001	ALTOONA4	138	7.64	533413	CIRCLE 3	115	19.12
515458	BORDER 7	345	5.28	533005	NEPARSN4	138	11.78	533414	CITIES 3	115	8.31
515476	HUNTERS7	345	13.55	533006	TAYLOR 4	138	6.47	533415	DAVIS 3	115	8.31
515543	RENFROW7	345	12.97	533011	HALSTD 4	138	4.25	533416	RENO 3	115	23.10
515544	RENFROW4	138	14.10	533013	MOUND 4	138	4.85	533419	HEC 3	115	17.83
515546	GRANTCO4	138	6.38	533015	BENTLEY4	138	10.06	533421	HEC GT 3	115	18.56
515569	MDFRDTP4	138	11.30	533016	WWUPLNT4	138	7.72	533426	MANVILE3	115	10.10
515576	RANCHRD7	345	13.18	533021	NEOSHO 4	138	22.63	533428	MCPHER 3	115	11.77
515599	G07621119-20	345	12.83	533024	29TH 4	138	19.95	533429	MOUNDRG3	115	7.11
515621	OPENSKY7	345	12.27	533026	ANDOVER4	138	18.05	533438	WMCPHER3	115	12.24
515646	GRNTWD 7	345	11.32	533028	BEECHTP4	138	13.63	533439	WHEATLD3	115	7.11
515688	FRNTWND7	345	10.52	533029	59TH ST4	138	18.58	533506	DAVIS 2	69	7.33
520409	RENFROW4	138	10.23	533030	BOEINGE4	138	17.30	533583	BUTLER 2	69	12.54
529200	OMCDLEC7	345	13.15	533032	BU11PON4	138	15.20	533585	BU10BEN2	69	10.44
532766	JEC N 7	345	23.72	533033	CANAL 4	138	16.86	533587	CHASJCT2	69	9.84
532768	EMPEC 7	345	17.35	533035	CHISHLM4	138	22.66	533588	CHASE 2	69	7.39
532769	LANG 7	345	17.14	533036	CLEARWT4	138	14.45	533589	CHESNEY2	69	8.33
532770	MORRIS 7	345	12.81	533037	COMOTAR4	138	18.90	533593	FRNTIER2	69	10.99
532771	RENO 7	345	12.04	533038	COWSKIN4	138	19.32	533597	MIDIAN 2	69	12.24
532773	SUMMIT 7	345	11.43	533039	ELPASO 4	138	25.52	533600	PESTER 2	69	8.12
532774	SWISVAL7	345	16.44	533040	EVANS N4	138	40.84	533601	POTWIN 2	69	2.54
532780	CANEYRV7	345	9.97	533041	EVANS S4	138	40.84	533602	SKELLY 2	69	11.41
532781	CANEYWF7	345	9.70	533042	FARBER 4	138	16.07	533603	TOWANDA2	69	5.52
532782	BUFFALO7	345	21.50	533043	FOWLER 4	138	16.59	533604	WEAVER 2	69	11.64
532783	KINGMAN7	345	6.86	533045	GILL W 4	138	26.00	533605	WHITE J2	69	7.10
532784	NINN1WF7	345	5.69	533046	GILL S 4	138	26.00	533607	TOWTAPE2	69	5.66
532791	BENTON 7	345	20.46	533047	GILL 4	138	26.00	533608	POTWNTP2	69	5.22
532792	FR2EAST7	345	7.07	533049	HOOVERN4	138	18.81	533624	BURLING2	69	3.31
532793	NEOSHO 7	345	16.07	533053	LAKERDG4	138	18.98	533625	BURLIND2	69	2.96
532794	ROSEHIL7	345	19.52	533054	MAIZE 4	138	23.32	533626	BURLJCT2	69	4.78
532795	FR2WEST7	345	5.74	533055	BOEINGW4	138	17.30	533628	CC1BURL2	69	3.30
532796	WICHITA7	345	25.87	533058	47TH ST4	138	16.41	533629	CC2SHAR2	69	4.51
532797	WOLFCRK7	345	15.93	533059	ELPASOE4	138	25.52	533630	CC3WEST2	69	4.39
532798	VIOLA 7	345	14.04	533060	NOEASTE4	138	20.92	533636	GREEN 2	69	3.79
532799	WAVERLY7	345	14.61	533061	NOEASTW4	138	20.92	533653	WOLFCRK2	69	5.81
532800	LATHAMS7	345	10.57	533062	ROSEHIL4	138	32.10	533673	ALTOO E2	69	4.01
532801	ELKRVR17	345	9.32	533064	17TH 4	138	18.11	533674	ALTOO W2	69	2.94
532802	WAVERTX7	345	12.42	533065	SG12COL4	138	21.20	533786	CHISHLM2	69	19.00
532856	SWISVAL6	230	21.43	533067	SPRNGDL4	138	14.59	533793	ELPASO 2	69	11.85
532863	MORRIS 6	230	13.87	533068	STEARMN4	138	19.99	533799	GRANT 2	69	10.81
532871	CIRCLE 6	230	8.99	533074	45TH ST4	138	27.78	533800	GRANT J2	69	9.55
532937	NEOSHO 5	161	20.94	533075	VIOLA 4	138	18.66	533814	MASCOT 2	69	19.86
532986	BENTON 4	138	29.04	533183	WM BROS3	115	4.58	533815	MEAD 2	69	26.29
532987	BUTLER 4	138	9.97	533197	HARTLND3	115	4.66	533817	MINNEHA2	69	16.17

Table 4-9 (continued)
Short Circuit Analysis for Study Project GEN-2016-162 and GEN-2016-163 (18SP)

Study Generator GEN-2016-162 and GEN-2016-163											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
533820	MOSSMAN2	69	17.47	539804	THISTLE4	138	17.35	585100	GEN-2015-073	345	14.20
533822	NOEASTW2	69	25.65	541198	PECULR 7	345	20.26	585250	GEN-2015-090	345	5.07
533823	NOEASTE2	69	25.65	542965	W.GRDNR7	345	26.42	587040	GEN-2016-005	345	10.51
533831	RENEW 2	69	17.36	542966	WGARDNR5	161	27.08	587100	GEN-2016-024	138	8.25
533832	RIPLEYM2	69	22.34	542968	STILWEL7	345	24.61	587160	GEN-2016-022	345	10.65
533835	17TH TP2	69	25.43	542969	STILWEL5	161	38.88	587490	GEN-2016-072	345	10.12
533837	RH JCT 2	69	6.53	542977	CRAIG 7	345	22.61	587500	GEN-2016-073	345	15.61
533840	17TH 2	69	27.65	542981	LACYGNE7	345	25.40	587880	GEN-2016-111	345	6.98
533846	21ST 2	69	16.14	543629	LACYGNE11_7	345	24.76	587884	G16-111-TAP	345	11.00
533861	BU5FURL2	69	4.47	543632	LACYGNE22_7	345	24.72	587894	G16-112-TAP	345	10.84
539004	MAYFLD 4	138	7.11	560053	G15-052T	345	13.07	587910	GEN-2016-114	345	9.85
539008	MILAN_GOAB	138	10.41	560071	G16-003-TAP	345	14.66	587980	GEN-2016-122	345	5.39
539009	CONWAY	138	11.19	560072	G16-005-TAP	345	12.74	588300	GEN-2016-157	345	4.94
539638	FLATRDG4	138	15.38	560086	G16-072-TAP	345	13.08	588320	GEN-2016-162	345	9.93
539675	MILANTP4	138	9.05	562476	G14-001-TAP	345	11.14	588330	GEN-2016-163	345	8.76
539676	MILAN 4	138	9.33	583850	GEN-2014-001	345	7.59	588360	GEN-2016-153	345	7.43
539800	CLARKCOUNTY7	345	13.48	584770	GEN-2015-034	345	11.18	588364	G16-153-TAP	345	7.77
539801	THISTLE7	345	16.15	584900	GEN-2015-052	345	13.03				

Table 4-10
Short Circuit Analysis for Study Project GEN-2016-173 (18SP)

Study Generator GEN-2016-162 and GEN-2016-163											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
514759	NEWKIRK4	138	9.33	533070	SLATECRK4	138	6.45	533558	TIMBJCT2	69	7.63
514764	NWKRKAT4	138	10.71	533540	ARKCTYW2	69	6.14	533559	UDALL 2	69	6.70
514804	MIDLTNT4	138	8.72	533541	AKRON 2	69	6.37	533560	WELLING2	69	4.24
515381	PECKHMT4	138	9.05	533542	ARKCTYE2	69	6.14	533561	WINFLD 2	69	5.84
521198	CHILOCCO4	138	6.16	533543	CRESWLN2	69	10.63	533562	PRAIRIE2	69	6.04
529290	OMNUKRK4	138	9.23	533547	OAK 2	69	7.33	533563	PRAIRIJ2	69	6.55
532981	CRESWLN4	138	8.49	533548	PARIS 2	69	6.47	533573	CRESWLS2	69	10.63
532982	OXFORD 4	138	7.48	533549	RAINBOW2	69	5.42	533783	BELL 2	69	4.55
532984	SUMNER 4	138	7.81	533552	SC3MILL2	69	4.21	533830	PECK 2	69	6.36
532985	TCROCK 4	138	4.82	533553	SC4ROME2	69	5.13	533866	SC9ANSN2	69	4.53
532992	TIMBJCT4	138	5.12	533554	SC5SILV2	69	6.06	585200	GEN-2015-083	138	6.54
533042	FARBER 4	138	16.07	533555	SC7CRES2	69	10.50	587480	GEN-2016-071	138	5.99
533063	SC10BEL4	138	9.03	533556	STROTHR2	69	5.59	588420	GEN-2016-173	69	10.51

4.3 Short Circuit Results: 2026 Summer Peak

The maximum fault current for each bus is provided for the 2026 Summer Peak conditions. The following tables show the short circuit results for the study generators for the 2026 Summer Peak conditions:

- Table 4-11: Short Circuit Analysis for GEN-2016-024 (26SP)
- Table 4-12: Short Circuit Analysis for GEN-2016-072 (26SP)
- Table 4-13: Short Circuit Analysis for GEN-2016-100, GEN-2016-101, and GEN-2016-119 (26SP)
- Table 4-14: Short Circuit Analysis for GEN-2016-127 (26SP)
- Table 4-15: Short Circuit Analysis for GEN-2016-128 (26SP)
- Table 4-16: Short Circuit Analysis for GEN-2016-133 through GEN-2016-146 (26SP)
- Table 4-17: Short Circuit Analysis for GEN-2016-148 (26SP)
- Table 4-18: Short Circuit Analysis for GEN-2016-153 (26SP)
- Table 4-19: Short Circuit Analysis for GEN-2016-162 and GEN-2016-163 (26SP)
- Table 4-20: Short Circuit Analysis for GEN-2016-173 (26SP)

Table 4-11
Short Circuit Analysis for Study Project GEN-2016-024 (26SP)

Study Generator GEN-2016-024											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
515543	RENFROW7	345	14.40	533061	NOEASTW4	138	20.97	533629	CC2SHAR2	69	4.51
515621	OPENSKY7	345	12.29	533062	ROSEHIL4	138	32.27	533633	COALCRK2	69	4.98
532768	EMPEC 7	345	17.38	533064	17TH 4	138	18.15	533646	TIOGA 2	69	6.15
532771	RENO 7	345	12.55	533065	SG12COL4	138	21.26	533649	UN7ROSE2	69	4.19
532780	CANEYRV7	345	9.96	533067	SPRNGDL4	138	14.65	533653	WOLFCRK2	69	5.81
532782	BUFFALO7	345	21.72	533068	STEARMN4	138	20.08	533660	ASHGRJ22	69	5.27
532783	KINGMAN7	345	6.87	533075	VIOLA 4	138	20.64	533666	CHANTAP2	69	5.08
532791	BENTON 7	345	20.55	533157	FORBES 3	115	12.28	533673	ALTOO E2	69	4.01
532794	ROSEHIL7	345	19.58	533177	6 GOLDN3	115	15.25	533674	ALTOO W2	69	2.94
532796	WICHITA7	345	26.23	533181	TECHILW3	115	27.53	533675	ARGO 2	69	2.87
532797	WOLFCRK7	345	15.94	533182	TECHILE3	115	27.53	533684	CONSOL 2	69	1.64
532798	VIOLA 7	345	14.67	533183	WM BROS3	115	4.57	533698	MONTGOM2	69	7.06
532799	WAVERLY7	345	14.61	533188	CNTRLXN3	115	17.06	533700	NEODJCT2	69	3.47
532800	LATHAMS7	345	10.57	533197	HARTLND3	115	4.65	533705	RA1FRED2	69	1.77
532801	ELKRVR17	345	9.32	533203	TEC E 3	115	27.03	533706	RA5HIPR2	69	3.99
532802	WAVERTX7	345	12.42	533390	MAIZEW 4	138	27.68	533707	RA6BROO2	69	2.23
532920	TECHILL5	161	5.70	533391	MAIZEE 4	138	21.95	533768	NEOSHON2	69	22.08
532986	BENTON 4	138	29.12	533416	RENO 3	115	25.42	533786	CHISHLM2	69	19.02
532987	BUTLER 4	138	9.99	533581	ADA 2	69	7.81	533799	GRANT 2	69	10.82
532988	BELAIRE4	138	19.19	533582	AUGUSTA2	69	7.07	533800	GRANT J2	69	9.56
532989	BUTLERS4	138	9.99	533583	BUTLER 2	69	12.55	533814	MASCOT 2	69	19.88
532990	MIDIAN 4	138	10.18	533584	BU6DEGR2	69	1.92	533815	MEAD 2	69	26.33
532991	WEAVER 4	138	22.52	533587	CHASJCT2	69	9.85	533817	MINNEHA2	69	16.19
532993	TALLGRS4	138	10.11	533588	CHASE 2	69	7.40	533820	MOSSMAN2	69	17.48
532996	TIOGA 4	138	4.11	533589	CHESNEY2	69	8.34	533822	NOEASTW2	69	25.69
533001	ALTOONA4	138	7.63	533590	ELDORAD2	69	7.96	533823	NOEASTE2	69	25.69
533002	DEARING4	138	9.05	533592	GETTY 2	69	10.84	533831	RENEW 2	69	17.37
533004	MONTGOM4	138	6.64	533593	FRNTIER2	69	11.00	533832	RIPLEYM2	69	22.37
533005	NEPARSN4	138	11.76	533594	LEON 2	69	2.66	533835	17TH TP2	69	25.46
533006	TAYLOR 4	138	6.46	533595	MAGNA 2	69	2.02	533840	17TH 2	69	27.69
533021	NEOSHO 4	138	22.55	533596	MAG JCT2	69	3.55	533846	21ST 2	69	16.16
533022	NEOSHON4	138	22.55	533597	MIDIAN 2	69	12.26	533861	BU5FURL2	69	4.48
533024	29TH 4	138	20.00	533598	MOBIL 2	69	7.39	539801	THISTLE7	345	16.22
533026	ANDOVER4	138	18.11	533599	PEABODY2	69	1.44	542981	LACYGNE7	345	25.37
533032	BU11PON4	138	15.27	533600	PESTER 2	69	8.13	560053	G15-052T	345	13.09
533033	CANAL 4	138	16.90	533601	POTWIN 2	69	2.54	562476	G14-001-TAP	345	11.17
533035	CHISHLM4	138	22.71	533602	SKELLY 2	69	11.42	583850	GEN-2014-001	345	7.60
533037	COMOTAR4	138	18.94	533603	TOWANDA2	69	5.52	584900	GEN-2015-052	345	13.04
533039	ELPASO 4	138	25.83	533604	WEAVER 2	69	11.71	587100	GEN-2016-024	138	8.26
533040	EVANS N4	138	41.05	533605	WHITE J2	69	7.11	587500	GEN-2016-073	345	15.73
533041	EVANS S4	138	41.05	533606	TOWTAPW2	69	1.84	587884	G16-111-TAP	345	11.30
533043	FOWLER 4	138	16.62	533607	TOWTAPE2	69	5.67	588320	GEN-2016-162	345	9.95
533054	MAIZE 4	138	23.38	533608	POTWNTP2	69	5.23	588330	GEN-2016-163	345	8.77
533060	NOEASTE4	138	20.97	533626	BURLJCT2	69	4.78	588364	G16-153-TAP	345	7.91

Table 4-12
Short Circuit Analysis for Study Project GEN-2016-072 (26SP)

Study Generators GEN-2016-072											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
514708	OTTER 4	138	9.74	515894	THUNDER7	345	10.60	533075	VIOLA 4	138	20.64
514709	FRMNTAP4	138	18.78	520204	SANDY_CN_138	138	5.49	533390	MAIZEW 4	138	27.68
514710	WAUKOMI4	138	10.40	520205	WAKITA_138	138	5.56	533416	RENO 3	115	25.42
514711	WAUKOTP4	138	16.07	520409	RENFROW4	138	10.42	539004	MAYFLD 4	138	7.34
514712	FAIRMON4	138	14.38	521006	MARSHAL4	138	8.36	539008	MILAN_GOAB	138	10.96
514713	WRVALLY4	138	8.78	521085	WAKITA 2	69	4.79	539009	CONWAY	138	11.77
514714	WOODRNG4	138	20.17	522397	MDFRDJCT	138	7.44	539675	MILANTP4	138	9.39
514715	WOODRNG7	345	22.99	522398	PONDCREEK	138	6.89	539676	MILAN 4	138	9.77
514719	CLYDE 2	69	4.39	532768	EMPEC 7	345	17.38	539801	THISTLE7	345	16.22
514731	SO4TH 4	138	15.76	532771	RENO 7	345	12.55	560031	G15-015-TAP	138	8.42
514733	MARSHL 4	138	8.41	532782	BUFFALO7	345	21.72	560056	G15-066T	345	18.49
514739	MEDFORD2	69	5.35	532783	KINGMAN7	345	6.87	560077	G16-032-TAP	345	4.16
514802	SOONER 4	138	31.97	532791	BENTON 7	345	20.55	560084	G16-061-TAP	345	16.84
514803	SOONER 7	345	25.66	532792	FR2EAST7	345	7.18	560086	G16-072-TAP	345	15.00
514880	NORTWST7	345	33.70	532794	ROSEHIL7	345	19.58	562476	G14-001-TAP	345	11.17
514881	SPRNGCK7	345	26.68	532795	FR2WEST7	345	5.81	583850	GEN-2014-001	345	7.60
514901	CIMARON7	345	33.26	532796	WICHITA7	345	26.23	584170	GEN-2014-064	138	9.66
515407	TATONGA7	345	15.86	532797	WOLFCRK7	345	15.94	584570	GEN-2015-015	138	5.85
515476	HUNTERS7	345	17.43	532798	VIOLA 7	345	14.67	584690	GEN-2015-030	345	19.34
515477	CHSHLMV7	345	17.39	532982	OXFORD 4	138	9.63	587300	G16-045-SUB1	345	1.56
515497	MATHWSN7	345	32.60	532984	SUMNER 4	138	10.57	587304	G16-045-SUB2	345	1.52
515543	RENFROW7	345	14.40	532986	BENTON 4	138	29.12	587380	G16-057-SUB1	345	1.53
515544	RENFROW4	138	14.50	532992	TIMBJCT4	138	5.96	587384	G16-057-SUB2	345	1.47
515546	GRANTCO4	138	6.45	533036	CLEARWT4	138	14.70	587410	GEN-2016-061	345	16.47
515547	GRANTCO2	69	7.40	533040	EVANS N4	138	41.05	587460	GEN-2016-068	345	6.89
515569	MDFRDTP4	138	11.53	533041	EVANS S4	138	41.05	587490	GEN-2016-072	345	11.14
515576	RANCHRD7	345	13.21	533045	GILL W 4	138	26.22	587500	GEN-2016-073	345	15.73
515581	COYOTE 4	138	8.42	533046	GILL S 4	138	26.22	587804	G16-100-TAP	345	16.49
515646	GRNTWD 7	345	12.39	533047	GILL 4	138	26.22	587884	G16-111-TAP	345	11.30
515875	REDNGTN7	345	24.05	533063	SC10BEL4	138	10.41	588190	GEN-2016-128	345	8.52
515877	REDDIRT7	345	23.47	533065	SG12COL4	138	21.26				

Table 4-13
Short Circuit Analysis for Study Project GEN-2016-100, GEN-2016-101, and GEN-2016-119 (26SP)

Study Generators GEN-2016-100, GEN-2016-101, and GEN-2016-119											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
300138	4CLEVLND	138	16.85	514834	KETCH 4	138	27.02	515497	MATHWSN7	345	32.60
509755	WEKIWA-7	345	19.06	514851	QUAILCK4	138	29.45	515512	SPVALLY4	138	10.63
509782	R.S.S.-7	345	31.10	514852	SLVRLAK4	138	32.83	515549	MNCWND37	345	11.83
509852	T.NO.--7	345	25.73	514854	BRADEN 4	138	31.61	515576	RANCHRD7	345	13.21
509895	T.NO.2-4	138	42.75	514862	RICHRDS4	138	21.78	515582	SLNGWND7	345	7.22
510376	WEBBTAP4	138	10.42	514863	HAYMAKR4	138	26.33	515585	MAMTHPW7	345	12.54
510406	N.E.S.-7	345	16.36	514864	PIEDMNT4	138	22.49	515600	KNGFSHR7	345	11.37
510907	PITTSB-7	345	13.60	514873	LNEOAK 4	138	27.07	515605	CANADN7	345	11.76
511425	TUTCONT4	138	10.63	514879	NORTWST4	138	44.55	515610	FSHRTAP7	345	16.77
512694	CLEVLND7	345	15.26	514880	NORTWST7	345	33.70	515621	OPENSKY7	345	12.29
512729	CLEVLND 4	138	16.85	514881	SPRNGCK7	345	26.68	515644	STLWTR2	69	16.27
512865	GREC TAP5	345	26.30	514894	CZECHAL4	138	27.79	515688	FRNTWND7	345	10.54
514704	MILLERT4	138	20.61	514895	SARA 4	138	18.70	515800	GRACMNT7	345	16.88
514705	COWCRK 2	69	4.06	514898	CIMARON4	138	43.12	515875	REDNGTN7	345	24.05
514706	COWCRK 4	138	11.42	514901	CIMARON7	345	33.26	515877	REDDIRT7	345	23.47
514707	PERRY 4	138	11.11	514906	JNSKAMO4	138	20.51	515894	THUNDER7	345	10.60
514708	OTTER 4	138	9.74	514907	ARCADIA4	138	42.10	529200	OMCDLEC7	345	13.18
514709	FRMNTAP4	138	18.78	514908	ARCADIA7	345	26.67	532794	ROSEHIL7	345	19.58
514711	WAUKOTP4	138	16.07	514909	REDBUD 7	345	25.87	560053	G15-052T	345	13.09
514713	WRVALLY4	138	8.78	514933	DRAPER 4	138	39.10	560056	G15-066T	345	18.49
514714	WOODRNG4	138	20.17	514934	DRAPER 7	345	20.90	560084	G16-061-TAP	345	16.84
514715	WOODRNG7	345	22.99	515006	MORRISN4	138	14.07	560086	G16-072-TAP	345	15.00
514733	MARSHL 4	138	8.41	515009	MCELROY4	138	13.83	584690	GEN-2015-030	345	19.34
514737	OTOE 4	138	16.40	515011	STILWTR4	138	14.53	584700	GEN-2015-029	345	9.58
514742	OSGE 2	69	18.62	515044	SEMINOL4	138	40.06	584770	GEN-2015-034	345	11.20
514743	OSAGE 4	138	17.55	515045	SEMINOL7	345	26.56	584900	GEN-2015-052	345	13.04
514758	STDBEAR4	138	14.52	515224	MUSKOGE7	345	28.80	585040	GEN-2015-066	345	18.32
514761	WHEAGLE4	138	16.43	515375	WWRDEHV7	345	18.94	587160	GEN-2016-022	345	10.66
514770	MARLNDT4	138	11.29	515400	DMANCRK4	138	8.13	587300	G16-045-SUB1	345	1.56
514798	SNRPMPT4	138	20.68	515407	TATONGA7	345	15.86	587304	G16-045-SUB2	345	1.52
514799	SNRPMP 4	138	11.34	515412	DMNCRKT4	138	13.97	587380	G16-057-SUB1	345	1.53
514801	MINCO 7	345	17.40	515444	MCNOWND7	345	17.35	587384	G16-057-SUB2	345	1.47
514802	SOONER 4	138	31.97	515447	MORISNT4	138	14.11	587410	GEN-2016-061	345	16.47
514803	SOONER 7	345	25.66	515448	CRSRDSW7	345	11.07	587460	GEN-2016-068	345	6.89
514819	EL-RENO4	138	15.38	515461	RNDBARN4	138	39.98	587800	GEN-2016-100	345	12.24
514820	JENSENT4	138	15.31	515465	LGARBER4	138	21.21	587804	G16-100-TAP	345	16.49
514825	KAYWIND7	345	12.26	515466	MITCHSB4	138	21.49	587950	GEN-2016-119	345	10.31
514827	CTNWOOD4	138	17.93	515476	HUNTERS7	345	17.43	587955	GEN2016-119B	345	8.89
514828	KETCHTP4	138	26.57	515477	CHSHLMV7	345	17.3935				

Table 4-14
Short Circuit Analysis for Study Project GEN-2016-127 (26SP)

Study Generator GEN-2016-127											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
301369	4REMNGTON	138	10.41	514760	KILDARE4	138	11.33	515542	CWBOYHT4	138	8.19
510376	WEBBTAP4	138	10.42	514761	WHEAGLE4	138	16.43	520213	HARDY 4	138	5.57
510377	FAIRFXT4	138	10.48	514763	CONBLKS2	69	16.24	520214	SHIDWFC4	138	7.43
510382	WPAWHSK4	138	6.50	514764	NWKRKAT4	138	11.01	520215	WEBBCTY4	138	5.97
510403	SHIDLER4	138	11.11	514770	MARLNDT4	138	11.29	521007	MARLAND_138	138	7.61
510412	WESTERNWALL4	138	6.42	514798	SNRPMPT4	138	20.68	529241	OMMORANT	69	12.64
514704	MILLERT4	138	20.61	514799	SNRPMP 4	138	11.34	529242	OMHUFFYT	69	12.83
514707	PERRY 4	138	11.11	514802	SOONER 4	138	31.97	529248	OMPECANT	69	12.07
514742	OSGE 2	69	18.62	514803	SOONER 7	345	25.66	529249	OMWW	69	13.88
514743	OSAGE 4	138	17.55	515400	DMANCRK4	138	8.13	587070	GEN-2016-009	69	17.36
514745	CHERPLT2	69	13.01	515402	CONBLKT2	69	16.37	588030	GEN-2016-127	138	5.41
514748	CONTEMP4	138	14.07	515403	FNTANTP4	138	6.93	588230	GEN-2016-148	138	5.22
514753	CONORTH4	138	14.13	515412	DMNCRKT4	138	13.97	588314	ASGI1708-TAP	138	10.71
514757	CHIKASI4	138	9.29	515447	MORISNT4	138	14.11	588315	ASGI1708MAIN	138	7.13
514758	STDBEAR4	138	14.52	515541	COWBOYH4	138	7.59				

Table 4-15
Short Circuit Analysis for Study Project GEN-2016-128 (26SP)

Study Generator GEN-2016-128

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
509852	T.NO.--7	345	25.73	514863	HAYMAKR4	138	26.33	515610	FSHRTAP7	345	16.77
511425	TUTCONT4	138	10.63	514864	PIEDMNT4	138	22.49	515621	OPENSKY7	345	12.29
512694	CLEVLND7	345	15.26	514873	LNEOAK 4	138	27.07	515641	PLNSMEN4	138	14.22
512729	CLEVLND 4	138	16.85	514879	NORTWST4	138	44.55	515646	GRNTWD 7	345	12.39
514642	BRCKWND4	138	7.50	514880	NORTWST7	345	33.70	515688	FRNTWND7	345	10.54
514701	BUNCHCK4	138	6.66	514881	SPRNGCK7	345	26.68	515800	GRACMNT7	345	16.88
514704	MILLERT4	138	20.61	514894	CZECHAL4	138	27.79	515875	REDNGTN7	345	24.05
514705	COWCRK 2	69	4.06	514895	SARA 4	138	18.70	515877	REDDIRT7	345	23.47
514706	COWCRK 4	138	11.42	514898	CIMARON4	138	43.12	515894	THUNDER7	345	10.60
514707	PERRY 4	138	11.11	514901	CIMARON7	345	33.26	520409	RENFROW4	138	10.42
514708	OTTER 4	138	9.74	514907	ARCADIA4	138	42.10	520882	DOVERSW4	138	9.65
514709	FRMNTAP4	138	18.78	514908	ARCADIA7	345	26.67	521006	MARSHAL4	138	8.36
514710	WAUKOMI4	138	10.40	514909	REDBUD 7	345	25.87	521100	WARREN 4	138	8.78
514711	WAUKOTP4	138	16.07	514933	DRAPER 4	138	39.10	529200	OMCDLEC7	345	13.18
514712	FAIRMON4	138	14.38	514934	DRAPER 7	345	20.90	532796	WICHITA7	345	26.23
514713	WRVALLY4	138	8.78	515006	MORRISN4	138	14.07	532798	VIOLA 7	345	14.67
514714	WOODRNG4	138	20.17	515011	STILWTR4	138	14.53	533075	VIOLA 4	138	20.64
514715	WOODRNG7	345	22.99	515045	SEMINOL7	345	26.56	539801	THISTLE7	345	16.22
514718	VANCE 2	69	7.04	515373	LBRTYLK4	138	14.03	560053	G15-052T	345	13.09
514721	IMO 2	69	12.01	515375	WWRDEHV7	345	18.94	560056	G15-066T	345	18.49
514722	CLEVETP2	69	11.79	515376	WWRDEHV4	138	22.70	560071	G16-003-TAP	345	14.69
514727	ENID 2	69	10.94	515377	CRESENT4	138	7.97	560077	G16-032-TAP	345	4.16
514730	SO4TH 2	69	13.87	515383	ENIDINT4	138	13.26	560084	G16-061-TAP	345	16.84
514731	SO4TH 4	138	15.76	515407	TATONGA7	345	15.86	560086	G16-072-TAP	345	15.00
514733	MARSHL 4	138	8.41	515412	DMNCRKT4	138	13.97	584170	GEN-2014-064	138	9.66
514734	GLENWD 4	138	10.45	515444	MCNOWND7	345	17.35	584690	GEN-2015-030	345	19.34
514737	OTOE 4	138	16.40	515447	MORISNT4	138	14.11	584700	GEN-2015-029	345	9.58
514743	OSAGE 4	138	17.55	515448	CRSRDSW7	345	11.07	584770	GEN-2015-034	345	11.20
514774	HENESEY4	138	8.75	515456	CHSTNTT2	69	11.60	585040	GEN-2015-066	345	18.32
514789	MENOTAP4	138	7.15	515458	BORDER 7	345	5.30	587160	GEN-2016-022	345	10.66
514790	IMO 4	138	12.13	515476	HUNTERS7	345	17.43	587210	GEN-2016-032	138	8.80
514798	SNRPMPT4	138	20.68	515477	CHSHLMV7	345	17.39	587300	G16-045-SUB1	345	1.56
514799	SNRPMP 4	138	11.34	515497	MATHWSN7	345	32.60	587304	G16-045-SUB2	345	1.52
514801	MINCO 7	345	17.40	515543	RENFROW7	345	14.40	587380	G16-057-SUB1	345	1.53
514802	SOONER 4	138	31.97	515544	RENFROW4	138	14.50	587384	G16-057-SUB2	345	1.47
514803	SOONER 7	345	25.66	515546	GRANTCO4	138	6.45	587410	GEN-2016-061	345	16.47
514815	BRECKNR4	138	14.19	515549	MNCWND37	345	11.83	587460	GEN-2016-068	345	6.89
514819	EL-RENO4	138	15.38	515569	MDFRDTP4	138	11.53	587490	GEN-2016-072	345	11.14
514820	JENSENT4	138	15.31	515576	RANCHRD7	345	13.21	587800	GEN-2016-100	345	12.24
514825	KAYWIND7	345	12.26	515582	SLNGWND7	345	7.22	587804	G16-100-TAP	345	16.49
514827	CTNWOOD4	138	17.93	515585	MAMTHPW7	345	12.54	587950	GEN-2016-119	345	10.31
514828	KETCHTP4	138	26.57	515599	G07621119-20	345	12.85	587955	GEN2016-119B	345	8.89
514829	PINE ST4	138	12.22	515600	KNGFSHR7	345	11.37	588190	GEN-2016-128	345	8.52
514854	BRADEN 4	138	31.61	515605	CANADN7	345	11.76	588364	G16-153-TAP	345	7.91

Table 4-16
Short Circuit Analysis for Study Project GEN-2016-133 through GEN-2016-146 (26SP)

Study Generator GEN-2016-133, GEN-2016-134, GEN-2016-135, GEN-2016-136, GEN-2016-137, GEN-2016-138, GEN-2016-139, GEN-2016-140, GEN-2016-141, GEN-2016-142, GEN-2016-143, GEN-2016-144, GEN-2016-145, and GEN-2016-146											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
300069	5CHOTEAU1	161	43.31	509769	BA101-N4	138	19.30	509889	E_121ST4	138	15.55
300131	4FISHERTP	138	14.59	509773	RSS T1 4	138	50.82	509891	BA_71ST4	138	24.86
300137	4BRISTOW	138	7.20	509782	R.S.S.-7	345	31.10	509895	T.NO.2-4	138	42.75
300138	4CLEVLND	138	16.85	509783	R.S.S.-4	138	61.25	510378	SCOFCTY4	138	8.53
300139	4FAIRFAX	138	8.65	509784	A.A.---4	138	17.32	510379	DELWARE4	138	10.86
300140	4SILVCTY	138	15.79	509785	BANNTAP4	138	18.41	510380	DELWARE7	345	10.98
300141	4STILWTR	138	12.20	509786	BA.N-ST4	138	23.79	510384	WATOVA 4	138	9.06
300145	4FISHER	138	12.33	509788	T.P.S.-4	138	39.29	510385	RICE CK4	138	11.35
300274	5LOCSTGV	161	13.42	509790	CATOOSA4	138	35.66	510388	BARNSAL4	138	6.77
300739	7BLACKBERRY	345	12.24	509801	MOHAWK 4	138	11.24	510391	BV-SE--4	138	12.22
300740	7SPORTSMAN	345	24.26	509802	MINGORD4	138	17.23	510396	N.E.S.-4	138	36.26
300741	5SPORTSMAN	161	41.06	509804	LLANETP4	138	27.04	510397	NOWATA-4	138	8.42
300795	4OOLOGAH	138	20.69	509805	PP----W4	138	8.36	510406	N.E.S.-7	345	16.36
300927	2CLEVLND	69	9.79	509806	ONETA--4	138	48.33	510410	CHELSA4	138	6.00
300943	2SILVCTY	69	10.19	509807	ONETA--7	345	27.47	510413	HAWTHRN4	138	20.44
300949	7JASPER	345	10.69	509812	SHEFFD-4	138	25.54	510433	BARNPMP4	138	6.72
300996	4JAVINE	138	6.56	509815	S.S.---4	138	28.31	512625	MAIDTP2	69	11.85
300997	5KETONVL	161	11.46	509816	S.S.---2	69	6.24	512626	MAID 2	69	14.51
301339	4SFORKKTP	138	6.85	509817	T.NO.--4	138	42.53	512629	DRYGULCH5	161	14.66
301348	5CHOTEAU2	161	43.31	509818	PP----E4	138	7.93	512635	KERR GR5	161	26.99
301425	4GLENCOE	138	9.61	509821	HWY20-T4	138	3.89	512638	CATSAGR5	161	23.65
301430	2CLEVLNDXFMR	69	9.80	509822	W.ED.-E4	138	8.32	512640	OKAYGR 5	161	9.56
505609	KEYSTON5	161	6.96	509823	WED-TAP4	138	19.05	512643	SILMCTY5	161	20.40
505610	KEYSTON4	138	21.56	509825	YARCH-N4	138	6.82	512648	MAID 5	161	42.28
506934	FLINTCR5	161	34.72	509832	W.ED.-W4	138	11.63	512650	GRDA1 7	345	26.76
506935	FLINTCR7	345	15.50	509834	COGENT 7	345	29.31	512651	CLARMR 5	161	13.05
506944	CHAMSPR5	161	24.69	509836	OEC 7	345	27.19	512656	GRDA1 5	161	42.01
506945	CHAMSPR7	345	10.71	509837	46ST--E4	138	15.18	512679	CLARMR 2	69	12.53
506959	TONTITN7	345	9.71	509839	CDC-ET 4	138	19.96	512694	CLEVLND7	345	15.26
506979	SHIPERD7	345	10.35	509840	WHIRLPO4	138	19.85	512697	WAGNOR 2	69	6.67
509714	CIP 4	138	14.07	509841	PCATSAT4	138	17.75	512700	WAGNOR 5	161	9.43
509715	CDC 4	138	14.05	509842	CDC-WT 4	138	21.07	512707	CLARMR 4	138	13.42
509721	BA.NO-S4	138	12.16	509843	OWASO2_4	138	13.99	512726	SILVCTYGR4	138	15.63
509726	OWASO1_4	138	14.50	509844	OWASOTP4	138	15.65	512727	GRDA1 2	69	12.17
509727	OAKS W4	138	15.46	509848	OAKSWTP4	138	24.70	512729	CLEVLND 4	138	16.85
509737	BA101 S4	138	17.80	509851	P&P WTP4	138	15.29	512734	FARML 4	138	8.29
509739	CARSN-T4	138	32.24	509852	T.NO.--7	345	25.73	512735	COFCTY2	69	9.69
509741	CARSN-N4	138	9.45	509854	VERDIGS4	138	13.68	512742	WMAIN ST5	161	26.23
509743	DENVR-E4	138	8.60	509860	OWAS1094	138	14.87	512749	PAWNSW4	138	10.29
509745	CLARKSV7	345	20.04	509862	YARCHT 4	138	8.96	512750	TONECE7	345	15.24
509746	DENVTAP4	138	10.10	509863	PPTAP 4	138	10.64	512751	TONECE5	161	15.29
509747	BA81---4	138	17.80	509864	CLARTOK4	138	13.67	512753	TONNEC2	69	4.74
509748	DENVR-W4	138	9.82	509865	CARSONT4	138	12.05	512757	NWMAID5	161	25.81
509753	116JENK4	138	42.63	509869	121LYNN4	138	17.41	512760	GERALDGAY4	161	26.87
509755	WEKIWA-7	345	19.06	509870	SAPLPRD7	345	21.37	512865	GREC TAP5	345	26.30
509757	WEKIWA-4	138	31.69	509871	SAPLPRD4	138	32.51	514704	MILLERT4	138	20.61
509758	PRATTV-4	138	20.10	509875	RSS T2 4	138	51.73	514707	PERRY 4	138	11.11
509759	JENKS--4	138	25.19	509884	SKIATOK4	138	10.93	514715	WOODRNG7	345	22.99
509767	B111---4	138	15.73	509887	OWAS88_4	138	17.36	514798	SNRPMPT4	138	20.68
509768	BA101ST4	138	18.47	509888	72ELWOD4	138	23.16	514802	SOONER 4	138	31.97

Table 4-16 (continued)
Short Circuit Analysis for Study Project GEN-2016-133 through GEN-2016-146 (26SP)

Study Generator GEN-2016-133, GEN-2016-134, GEN-2016-135, GEN-2016-136, GEN-2016-137, GEN-2016-138, GEN-2016-139, GEN-2016-140, GEN-2016-141, GEN-2016-142, GEN-2016-143, GEN-2016-144, GEN-2016-145, and GEN-2016-146

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
514803	SOONER 7	345	25.66	532781	CANEYWF7	345	9.69	560056	G15-066T	345	18.49
514881	SPRNGCK7	345	26.68	532793	NEOSHO 7	345	15.91	560084	G16-061-TAP	345	16.84
514908	ARCADIA7	345	26.67	532799	WAVERLY7	345	14.61	560389	GEN-2010-055	138	31.69
514909	REDBUD 7	345	25.87	532800	LATHAMS7	345	10.57	584690	GEN-2015-030	345	19.34
515045	SEMINOL7	345	26.56	532934	MARMTNE5	161	8.08	584770	GEN-2015-034	345	11.20
515224	MUSKOGE7	345	28.80	532937	NEOSHO 5	161	20.86	585040	GEN-2015-066	345	18.32
515234	PECANCK5	161	20.98	533020	NEOSHOS4	138	22.55	587160	GEN-2016-022	345	10.66
515235	PECANCK7	345	21.62	533021	NEOSHO 4	138	22.55	587410	GEN-2016-061	345	16.47
515302	FTSMITH7	345	9.60	533022	NEOSHON4	138	22.55	587800	GEN-2016-100	345	12.24
515422	C-RIVER7	345	9.63	533778	NEOSHOS2	69	22.08	587804	G16-100-TAP	345	16.49
515447	MORISNT4	138	14.11	542965	W.GRDNR7	345	26.44	587950	GEN-2016-119	345	10.31
515576	RANCHRD7	345	13.21	542968	STILWEL7	345	24.52	588040	G16133G16146	345	25.73
515621	OPENSKY7	345	12.29	542981	LACYGNE7	345	25.37	588041	G16133_765TN	765	7.87
515688	FRNTWND7	345	10.54	543629	LACYGNE11_7	345	24.73	588042	G16133_765R1	765	7.87
515894	THUNDER7	345	10.60	543632	LACYGNE22_7	345	24.70	588043	G16133_765R2	765	4.35
529200	OMCDLEC7	345	13.18	547469	RIV4525	161	23.42	588044	G16133_765R3	765	3.74
532780	CANEYRV7	345	9.96	549984	BROOKLINE 7	345	11.16				

Table 4-17
Short Circuit Analysis for Study Project GEN-2016-148 (26SP)

Study Generator GEN-2016-148

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
510376	WEBBTAP4	138	10.42	514758	STDBEAR4	138	14.52	520214	SHIDWFC4	138	7.43
510377	FAIRFXT4	138	10.48	514761	WHEAGLE4	138	16.43	520215	WEBBCTY4	138	5.97
510403	SHIDLER4	138	11.11	514770	MARLNDT4	138	11.29	588230	GEN-2016-148	138	5.22
514742	OSGE 2	69	18.62	514798	SNRPMPT4	138	20.68				
514743	OSAGE 4	138	17.55	520213	HARDY 4	138	5.57				

Table 4-18
Short Circuit Analysis for Study Project GEN-2016-153 (26SP)

Study Generator GEN-2016-153

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
514715	WOODRNG7	345	18.96	532800	LATHAMS7	345	10.57	533795	GILL E 2	69	32.66
515375	WWRDEHV7	345	18.88	532986	BENTON 4	138	29.04	533796	GILL W 2	69	32.66
515476	HUNTERS7	345	13.55	532988	BELAIRE4	138	19.15	539003	CLDWELL4	138	4.74
515477	CHSHLMV7	345	13.53	532990	MIDIAN 4	138	10.16	539004	MAYFLD 4	138	7.11
515543	RENFROW7	345	12.97	533015	BENTLEY4	138	10.06	539008	MILAN_GOAB	138	10.41
515544	RENFROW4	138	14.10	533024	29TH 4	138	19.95	539009	CONWAY	138	11.19
515546	GRANTCO4	138	6.38	533029	59TH ST4	138	18.58	539668	HARPER 4	138	6.91
515547	GRANTCO2	69	7.36	533035	CHISHLM4	138	22.66	539675	MILANTP4	138	9.05
515569	MDFRDTP4	138	11.30	533036	CLEARWT4	138	14.45	539676	MILAN 4	138	9.33
515646	GRNTWD 7	345	11.32	533040	EVANS N4	138	40.84	539801	THISTLE7	345	16.15
520205	WAKITA_138	138	5.53	533041	EVANS S4	138	40.84	539804	THISTLE4	138	17.35
520409	RENFROW4	138	10.23	533044	GILL E 4	138	26.00	560031	G15-015-TAP	138	8.31
522397	MDFRDJCT	138	7.34	533045	GILL W 4	138	26.00	560053	G15-052T	345	13.07
532768	EMPEC 7	345	17.35	533046	GILL S 4	138	26.00	560072	G16-005-TAP	345	12.74
532769	LANG 7	345	17.14	533047	GILL 4	138	26.00	560086	G16-072-TAP	345	13.08
532770	MORRIS 7	345	12.81	533053	LAKERDG4	138	18.98	562476	G14-001-TAP	345	11.14
532771	RENO 7	345	12.04	533054	MAIZE 4	138	23.32	578530	FR3HV	345	5.29
532774	SWISVAL7	345	16.44	533062	ROSEHIL4	138	32.10	583850	GEN-2014-001	345	7.59
532782	BUFFALO7	345	21.50	533065	SG12COL4	138	21.20	585100	GEN-2015-073	345	14.20
532783	KINGMAN7	345	6.86	533071	WACO S 4	138	21.97	587490	GEN-2016-072	345	10.12
532784	NINN1WF7	345	5.69	533074	45TH ST4	138	27.78	587500	GEN-2016-073	345	15.61
532791	BENTON 7	345	20.46	533075	VIOLA 4	138	18.66	587880	GEN-2016-111	345	6.98
532792	FR2EAST7	345	7.07	533390	MAIZEW 4	138	27.59	587884	G16-111-TAP	345	11.00
532794	ROSEHIL7	345	19.52	533413	CIRCLE 3	115	19.12	587894	G16-112-TAP	345	10.84
532795	FR2WEST7	345	5.74	533415	DAVIS 3	115	8.31	587910	GEN-2016-114	345	9.85
532796	WICHITA7	345	25.87	533416	RENO 3	115	23.10	588320	GEN-2016-162	345	9.93
532797	WOLFCRK7	345	15.93	533429	MOUNDRG3	115	7.11	588330	GEN-2016-163	345	8.76
532798	VIOLA 7	345	14.04	533438	WMCPHER3	115	12.24	588360	GEN-2016-153	345	7.43
532799	WAVERLY7	345	14.61	533653	WOLFCRK2	69	5.81	588364	G16-153-TAP	345	7.77

Table 4-19
Short Circuit Analysis for Study Project GEN-2016-162 and GEN-2016-163 (26SP)

Study Generator GEN-2016-162 and GEN-2016-163											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
300739	7BLACKBERRY	345	12.24	532986	BENTON 4	138	29.12	533074	45TH ST4	138	27.88
510380	DELWARE7	345	10.98	532987	BUTLER 4	138	9.99	533075	VIOLA 4	138	20.64
514803	SOONER 7	345	25.66	532988	BELAIRE4	138	19.19	533183	WM BROS3	115	4.57
514825	KAYWIND7	345	12.26	532989	BUTLERS4	138	9.99	533197	HARTLND3	115	4.65
515375	WWRDEHV7	345	18.94	532990	MIDIAN 4	138	10.18	533304	LANG 3	115	14.47
515376	WWRDEHV4	138	22.70	532991	WEAVER 4	138	22.52	533380	SPRGCRK3	115	3.62
515407	TATONGA7	345	15.86	532992	TIMBJCT4	138	5.96	533390	MAIZEW 4	138	27.68
515458	BORDER 7	345	5.30	532993	TALLGRS4	138	10.11	533391	MAIZEE 4	138	21.95
515476	HUNTERS7	345	17.43	532996	TIOGA 4	138	4.11	533394	CORONAD3	115	7.53
515543	RENFROW7	345	14.40	533001	ALTOONA4	138	7.63	533412	ARKVALJ3	115	10.52
515544	RENFROW4	138	14.50	533005	NEPARSN4	138	11.76	533413	CIRCLE 3	115	21.99
515546	GRANTCO4	138	6.45	533006	TAYLOR 4	138	6.46	533414	CITIES 3	115	8.75
515569	MDFRDTP4	138	11.53	533011	HALSTD 4	138	4.27	533415	DAVIS 3	115	8.69
515576	RANCHRD7	345	13.21	533013	MOUND 4	138	4.89	533416	RENO 3	115	25.42
515599	G07621119-20	345	12.85	533015	BENTLEY4	138	10.08	533419	HEC 3	115	20.50
515621	OPENSKY7	345	12.29	533016	WWUPLNT4	138	7.73	533421	HEC GT 3	115	21.34
515646	GRNTWD 7	345	12.39	533021	NEOSHO 4	138	22.55	533426	MANVILE3	115	11.25
515688	FRNTWND7	345	10.54	533024	29TH 4	138	20.00	533428	MCPHER 3	115	14.50
520409	RENFROW4	138	10.42	533026	ANDOVER4	138	18.11	533429	MOUNDRG3	115	7.21
529200	OMCDLEC7	345	13.18	533028	BEECHTP4	138	13.69	533438	WMCPHER3	115	14.69
532766	JEC N 7	345	23.77	533029	59TH ST4	138	18.62	533439	WHEATLD3	115	7.71
532768	EMPEC 7	345	17.38	533030	BOEINGE4	138	17.35	533506	DAVIS 2	69	7.52
532769	LANG 7	345	17.17	533032	BU11PON4	138	15.27	533583	BUTLER 2	69	12.55
532770	MORRIS 7	345	12.83	533033	CANAL 4	138	16.90	533585	BU10BEN2	69	10.49
532771	RENO 7	345	12.55	533035	CHISHLM4	138	22.71	533587	CHASJCT2	69	9.85
532773	SUMMIT 7	345	11.68	533036	CLEARWT4	138	14.70	533588	CHASE 2	69	7.40
532774	SWISVAL7	345	16.45	533037	COMOTAR4	138	18.94	533589	CHESNEY2	69	8.34
532780	CANEYRV7	345	9.96	533038	COWSKIN4	138	19.37	533593	FRNTIER2	69	11.00
532781	CANEYWF7	345	9.69	533039	ELPASO 4	138	25.83	533597	MIDIAN 2	69	12.26
532782	BUFFALO7	345	21.72	533040	EVANS N4	138	41.05	533600	PESTER 2	69	8.13
532783	KINGMAN7	345	6.87	533041	EVANS S4	138	41.05	533601	POTWIN 2	69	2.54
532784	NINN1WF7	345	5.70	533042	FARBER 4	138	16.58	533602	SKELLY 2	69	11.42
532791	BENTON 7	345	20.55	533043	FOWLER 4	138	16.62	533603	TOWANDA2	69	5.52
532792	FR2EAST7	345	7.18	533045	GILL W 4	138	26.22	533604	WEAVER 2	69	11.71
532793	NEOSHO 7	345	15.91	533046	GILL S 4	138	26.22	533605	WHITE J2	69	7.11
532794	ROSEHIL7	345	19.58	533047	GILL 4	138	26.22	533607	TOWTAPE2	69	5.67
532795	FR2WEST7	345	5.81	533049	HOOVERN4	138	18.86	533608	POTWNTP2	69	5.23
532796	WICHITA7	345	26.23	533053	LAKERDG4	138	19.03	533624	BURLING2	69	3.31
532797	WOLFCRK7	345	15.94	533054	MAIZE 4	138	23.38	533625	BURLIND2	69	2.96
532798	VIOLA 7	345	14.67	533055	BOEINGW4	138	17.35	533626	BURLJCT2	69	4.78
532799	WAVERLY7	345	14.61	533058	47TH ST4	138	16.52	533628	CC1BURL2	69	3.30
532800	LATHAMS7	345	10.57	533059	ELPASOE4	138	25.83	533629	CC2SHAR2	69	4.51
532801	ELKRVR17	345	9.32	533060	NOEASTE4	138	20.97	533630	CC3WEST2	69	4.39
532802	WAVERTX7	345	12.42	533061	NOEASTW4	138	20.97	533636	GREEN 2	69	3.79
532856	SWISVAL6	230	21.45	533062	ROSEHIL4	138	32.27	533653	WOLFCRK2	69	5.81
532863	MORRIS 6	230	13.91	533063	SC10BEL4	138	10.41	533673	ALTOO E2	69	4.01
532871	CIRCLE 6	230	9.70	533064	17TH 4	138	18.15	533674	ALTOO W2	69	2.94
532937	NEOSHO 5	161	20.86	533065	SG12COL4	138	21.26	533786	CHISHLM2	69	19.02
532982	OXFORD 4	138	9.63	533067	SPRNGDL4	138	14.65	533793	ELPASO 2	69	11.86
532984	SUMNER 4	138	10.57	533068	STEARMN4	138	20.08	533799	GRANT 2	69	10.82

Table 4-19 (continued)
Short Circuit Analysis for Study Project GEN-2016-162 and GEN-2016-163 (26SP)

Study Generator GEN-2016-162 and GEN-2016-163

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
533800	GRANT J2	69	9.56	539675	MILANTP4	138	9.39	585100	GEN-2015-073	345	14.20
533814	MASCOT 2	69	19.88	539676	MILAN 4	138	9.77	585250	GEN-2015-090	345	5.07
533815	MEAD 2	69	26.33	539800	CLARKCOUNTY7	345	13.51	587040	GEN-2016-005	345	10.51
533817	MINNEHA2	69	16.19	539801	THISTLE7	345	16.22	587100	GEN-2016-024	138	8.25
533820	MOSSMAN2	69	17.48	539804	THISTLE4	138	17.41	587160	GEN-2016-022	345	10.65
533822	NOEASTW2	69	25.69	541198	PECULR 7	345	20.18	587490	GEN-2016-072	345	10.12
533823	NOEASTE2	69	25.69	542965	W.GRDNR7	345	26.44	587500	GEN-2016-073	345	15.61
533831	RENEW 2	69	17.37	542966	WGARDNR5	161	27.64	587880	GEN-2016-111	345	6.98
533832	RIPLEYM2	69	22.37	542968	STILWEL7	345	24.52	587884	G16-111-TAP	345	11.00
533835	17TH TP2	69	25.46	542969	STILWEL5	161	38.60	587894	G16-112-TAP	345	10.84
533837	RH JCT 2	69	6.61	542977	CRAIG 7	345	22.69	587910	GEN-2016-114	345	9.85
533840	17TH 2	69	27.69	542981	LACYGNE7	345	25.37	587980	GEN-2016-122	345	5.39
533846	21ST 2	69	16.16	543629	LACYGNE11_7	345	24.73	588300	GEN-2016-157	345	4.94
533861	BU5FURL2	69	4.48	543632	LACYGNE22_7	345	24.70	588320	GEN-2016-162	345	9.93
539004	MAYFLD 4	138	7.34	560053	G15-052T	345	13.09	588330	GEN-2016-163	345	8.76
539008	MILAN_GOAB	138	10.96	560071	G16-003-TAP	345	14.69	588360	GEN-2016-153	345	7.43
539009	CONWAY	138	11.77	560072	G16-005-TAP	345	12.77	588364	G16-153-TAP	345	7.77
539638	FLATRDG4	138	15.44	560086	G16-072-TAP	345	15.00				

Table 4-20
Short Circuit Analysis for Study Project GEN-2016-173

Study Generator GEN-2016-173

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
514759	NEWKIRK4	138	9.62	533063	SC10BEL4	138	10.41	533558	TIMBJCT2	69	8.16
514764	NWKRKAT4	138	11.01	533070	SLATECRK4	138	6.76	533559	UDALL 2	69	7.05
514804	MIDLTNT4	138	9.08	533075	VIOLA 4	138	20.64	533560	WELLING2	69	4.26
515381	PECKHMT4	138	9.35	533540	ARKCTYW2	69	6.33	533561	WINFLD 2	69	6.04
521198	CHILOCCO4	138	6.32	533541	AKRON 2	69	6.73	533562	PRAIRIE2	69	6.22
529290	OMNUKRK4	138	9.51	533542	ARKCTYE2	69	6.33	533563	PRAIRIJ2	69	6.76
532798	VIOLA 7	345	14.67	533543	CRESWLN2	69	11.15	533573	CRESWLS2	69	11.15
532981	CRESWLN4	138	9.20	533547	OAK 2	69	7.61	533783	BELL 2	69	4.56
532982	OXFORD 4	138	9.63	533548	PARIS 2	69	6.66	533830	PECK 2	69	6.36
532984	SUMNER 4	138	10.57	533549	RAINBOW2	69	5.59	533866	SC9ANSN2	69	4.54
532985	TCROCK 4	138	5.56	533552	SC3MILL2	69	4.23	539008	MILAN_GOAB	138	10.96
532992	TIMBJCT4	138	5.96	533553	SC4ROME2	69	5.20	539009	CONWAY	138	11.77
533036	CLEARWT4	138	14.70	533554	SC5SILV2	69	6.24	585200	GEN-2015-083	138	7.19
533042	FARBER 4	138	16.58	533555	SC7CRES2	69	11.00	587480	GEN-2016-071	138	6.14
533047	GILL 4	138	26.22	533556	STROTHR2	69	5.77	588420	GEN-2016-173	69	11.01

SECTION 5: CONCLUSIONS

Summary of Stability Analysis

The Stability Analysis determined that there were multiple contingencies across all seasons that resulted in system/voltage instability, generation tripping offline, and poor post-fault voltage recovery when all generation interconnection requests were at 100% output.

To mitigate the voltage instability, voltage violations, generation tripping offline, and poor post-fault steady-state voltages, the following upgrades were provided by SPP and implemented in each season:

- Redington to Woodring 345 kV circuit #2
- Hunter to Woodring 345 kV circuit #2
- Redington to Spring Creek 345 kV circuit #1
- Tulsa North 345/138 kV transformer #2
- Benton 138 kV capacitor bank initialized at 153.6 Mvar (an existing capacitor bank)
- GEN-2016-045 34.5 kV reactor: 175 Mvar (an existing reactor)
- GEN-2016-057 34.5 kV reactor #1 and #2: 175 Mvar each (existing reactors)
- Static Var Compensators (SVC)
  - +300 Mvar SVC at Tulsa North 345 kV bus (wind plant side of 765 kV line)
  - +300 Mvar SVC at Tulsa North 345 kV bus (transmission side of 765 kV line)

It was observed that the SVC solutions at Tulsa North mitigated a portion of the contingencies around the Tulsa North 345 kV substation. For various contingencies, a reasonable solution was not identified due to 2,500 MW of generation being interconnected to the Tulsa North 345 kV line through a 360 mile 765 kV transmission line which results in the project's turbines tripping offline due to overvoltage protection. It is recommended that the interconnection customer(s) for GEN-2016-133 through GEN-2016-146 re-examine the design of the interconnection request(s).

For FLT29-PO, which is a prior outage of G16-072-Tap to Hunters 345 kV line, followed by a three phase fault on the Renfrow to Viola 345 kV line, voltage and generator instability of GEN-2016-072 exists. In order to mitigate this violation, it is recommended GEN-2016-072 be curtailed to 210 MW (reduction of 90 MW) following the prior outage condition for the 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak condition.

Similarly, FLT33-PO is a prior outage of the Renfrow to Viola 345 kV line followed by a three phase fault on the G16-072-Tap to Hunters 345 kV line which also requires GEN-2016-072 be curtailed to 210 MW (reduction of 90 MW) following the prior outage condition for the 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak condition.

Note for GEN-2016-173, for a three-phase fault at the point of interconnection (Creswell 69 kV), the Power Electronics HEC-US V1500 inverter model tripped offline due to over frequency protection. For this study, the over frequency protection was set to 75 Hz and 1.8 p.u., respectively, to avoid instantaneous tripping. It is recommended the supplier of the Power Electronic inverter model examine this model for three-phase faults that cause the model to trip on over frequency protection.

For FLT186, which is a three phase fault on the Waverly to LaCygne 345 kV line near Waverly, it was determined the system response of area generators and voltage did not meet SPP disturbance requirements following the fault until the power output at Waverly Wind Farm and Wolf Creek Generating Station were reduced.

After implementing the above upgrades, the contingency analysis was re-simulated for all contingencies. With the upgrades, the Stability Analysis determined that there was no generation tripping or system instability observed as a result of interconnecting all study projects at 100% output except for several contingencies near Tulsa North. It is recommended that the interconnection customer(s) for GEN-2016-133 through GEN-2016-146 re-examine the design of the interconnection request(s).

Summary of the Short Circuit Analysis

The short circuit analysis was performed on the 2018 Summer Peak and 2026 Summer Peak power flows for all study projects. Refer to Table 5-1 and Table 5-2 for a list of maximum fault currents observed for each study project for the 2018 Summer Peak and 2026 Summer Peak cases, respectively.

Table 5-1
2018SP: List of Maximum Fault Currents Observed for Each Study Project

Study Project	Fault Current at POI (kA)	Maximum Fault Current (kA)	Fault Location	Bus Voltage (kV)
GEN-2016-024	10.16	40.84	EVANS N4	138
GEN-2016-072	13.08	44.84	EVANS N4	138
GEN-2016-100 GEN-2016-101 GEN-2016-119	16.29	44.32	NORTHWEST 7	138
GEN-2016-127	7.41	31.56	SOONER 4	138
GEN-2016-128	18.96	44.32	NORTHWEST 4	138
GEN-2016-133 to GEN-2016-146	25.91	59	RSS T2 4	138
GEN-2016-148	5.56	20.41	SNRPMPT4	138
GEN-2016-153	7.77	44.84	EVANS N4	138
GEN-2016-162 GEN-2016-163	20.46	44.84	EVANS N4	138
GEN-2016-173	10.63	16.07	FARBER 4	138

Table 5-2
2026SP: List of Maximum Fault Currents Observed for Each Study Project

Study Project	Fault Current at POI (kA)	Maximum Fault Current (kA)	Fault Location	Bus Voltage (kV)
GEN-2016-024	10.18	41.05	EVANS N4	138
GEN-2016-072	15.00	44.05	EVANS N4	138
GEN-2016-100 GEN-2016-101 GEN-2016-119	16.49	44.55	NORTHWEST 7	138
GEN-2016-127	7.43	31.97	SOONER 4	138
GEN-2016-128	22.99	44.55	NORTHWEST 4	138
GEN-2016-133 to GEN-2016-146	25.73	61.25	RSS T2 4	138
GEN-2016-148	5.57	20.60	SNRPMPT4	138
GEN-2016-153	7.77	41.05	EVANS N4	138
GEN-2016-162 GEN-2016-163	20.55	41.05	EVANS N4	138
GEN-2016-173	11.15	26.22	GILL 4	138

J9: GROUP 9 DYNAMIC STABILITY ANALYSIS REPORT

MITSUBISHI ELECTRIC POWER PRODUCTS, INC.
POWER SYSTEMS ENGINEERING DIVISION
530 KEYSTONE DRIVE
WARRENDALE, PA 15086, U.S.A.

Phone: (724) 778-5111 Fax: (724) 778-5149
Home Page: www.meppi.com

Southwest Power Pool, Inc. (SPP)

DISIS-2016-002 (Group 09) Definitive Impact Study

Final Report

REP-0323
Revision #02

August 2018

Submitted By:
Mitsubishi Electric Power Products, Inc. (MEPPI)
Power Systems Engineering Division
Warrendale, PA

MITSUBISHI ELECTRIC POWER PRODUCTS, INC.
POWER SYSTEMS ENGINEERING DIVISION
530 KEYSTONE DRIVE
WARRENDALE, PA 15086, U.S.A.

Phone: (724) 778-5111 Fax: (724) 778-5149
Home Page: www.meppi.com

Report Revision Table

Revision	Reason for Revision	Date	Approved
1	Issue Final Report	8/10/2018	NWT
2	Add High GGS Sensitivity Analysis Results and Short Circuit Analysis Results	8/17/2018	NWT

Title: **DISIS-2016-002 (Group 09) Definitive Impact Study: Final Report REP-0323**
Date: August 2018
Author: Kathleen D. Lentijo; Senior Engineer, Power Systems Engineering Division *Kathleen D. Lentijo*
Reviewed: Nicholas W. Tenza; Senior Engineer, Power Systems Engineering Division *Nicholas W. Tenza*
Approved: Donald J. Shoup; General Manager, Power Systems Engineering Division *Donald J. Shoup*

EXECUTIVE SUMMARY

SPP requested a Definitive Interconnection System Impact Study (DISIS). The DISIS required a Stability Analysis and a Short Circuit Analysis detailing the impacts of the interconnecting projects as shown in Table ES-1.

Table ES-1
Interconnection Projects Evaluated

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2016-034	89.7	GE 2.3 MW (587223)	Tap Laramie River -Sidney 345kV (560090)
GEN-2016-074	200	Vestas 2.0 MW (587683)	Sweetwater 345kV (640374)
GEN-2016-096	227.7	Siemens 2.3 MW (587783, 587787)	Tap Pauline-Moore 345kV (587784)
GEN-2016-106	400	Vestas 2.0 MW (587853)	Gentleman Substation 345kV (640183)
GEN-2016-110	152	GE 2.0 MW (587873)	Tap Laramie River-Stegall 345kV (587874)
GEN-2016-147	40	GE PV Solar 2.0 MW (588223)	Sidney 115kV Sub (653572)
GEN-2016-159	427.8	Vestas 3.45 MW (588383, 588386)	Hoskins 345kV Substation (640226)
GEN-2016-165	202	GE 2.0 MW (588343)	Grand Prairie 345kV (652532)

SUMMARY OF STABILITY ANALYSIS

The Stability Analysis determined that there were multiple contingencies across all seasons that resulted in system/voltage instability, generation tripping offline, and poor post-fault voltage recovery when all generation interconnection requests were at 100% output. To mitigate the system/voltage instability, voltage violations, generation tripping offline, and poor post-fault steady-state voltages, the following upgrades were provided by SPP and implemented (upgrades provided here are required for the 17W season and thus, implemented in remaining years):

- Keystone to Red Willow 345 kV circuit #1
- Red Willow to Post Rock 345 kV circuit #1
- Grand Prairie to Antelope 345 kV circuit #1
- Reroute Laramie River Station (GEN-2016-110-Tap) to Stegall 345kV circuit #1 through the GEN-2016-023-Tap substation

The following three single phase stuck breaker faults required additional mitigation:

- FLT58-SB: Single phase stuck breaker fault at Gentleman 230 kV resulting in the loss of Gentleman to Ogalala 230 kV circuit #1 and Gentleman 345/230 kV transformer.
- FLT60-SB: Single phase stuck breaker fault at Gentleman 345 kV resulting in the loss of Gentleman to Sweetwater 345 kV circuit #1 and Gentleman 345 kV to Red Willow 345 kV circuit #1.
- FLT63-SB: Single phase stuck breaker fault at Gentleman 345 kV resulting in the loss of the Gentleman to Red Willow 345 kV circuit #1 and Gentleman 345/230 kV transformer.

It was identified that an SVC injection of +100 Mvar at Keystone 345 kV would mitigate the voltage instability observed in the region. Note for any prior outage in the Gentleman area, generation curtailment may be required by operations due to the limit from the stuck breaker faults above.

After implementing the above upgrades, the contingency analysis was re-simulated for all contingencies. With the upgrades, the Stability Analysis determined that there was no generation tripping or system instability observed as a result of interconnecting all study projects at 100% output.

High GGS Sensitivity Scenario

The High GGS Scenario Stability Analysis determined that no additional voltage instability, generation tripping offline, or poor post-fault voltage recovery existed with the mitigation applied from the normal dispatch scenario (mitigation above). The system recovers with SPP Performance Criteria for all contingencies when all generation interconnection requests were at 100% output.

SUMMARY OF THE SHORT CIRCUIT ANALYSIS

The Short Circuit Analysis was performed on the 2018 Summer Peak and 2026 Summer Peak power flows for all study projects. Refer to Table ES-2 and Table ES-3 for a list of maximum fault currents observed for each study project for the 18S and 26S cases, respectively.

Table ES-2
2018SP: List of Maximum Fault Currents Observed for Each Study Project

Study Project	Fault Current at POI (kA)	Maximum Fault Current (kA)	Fault Location
GEN-2016-034	6.35	20.00	Gentleman 230 kV
GEN-2016-074	10.87	31.63	Sheldon 115 kV
GEN-2016-096	9.22	31.63	Sheldon 115 kV
GEN-2016-106	18.27	31.63	Sheldon 115 kV
GEN-2016-110	6.82	20.00	Gentleman 230 kV
GEN-2016-147	4.20	28.99	NB West 230 kV
GEN-2016-159	14.27	40.00	S 1206 161 kV
GEN-2016-165	9.98	28.44	S 1251 161 kV

Table ES-3
2026SP: List of Maximum Fault Currents Observed for Each Study Project.

Study Project	Fault Current at POI (kA)	Maximum Fault Current (kA)	Fault Location
GEN-2016-034	6.36	20.10	Gentleman 230 kV
GEN-2016-074	10.93	32.48	Sheldon 115 kV
GEN-2016-096	9.26	32.48	Sheldon 115 kV
GEN-2016-106	18.42	32.48	Sheldon 115 kV
GEN-2016-110	6.82	20.10	Gentleman 230 kV
GEN-2016-147	4.21	28.99	NB West 230 kV
GEN-2016-159	14.30	40.84	S 1209 161 kV
GEN-2016-165	9.99	29.17	S 1251 161 kV

Table of Contents

SECTION 1: OBJECTIVES

The objective of this report is to provide Southwest Power Pool, Inc. (SPP) with the deliverables for the "DISIS-2016-002 (Group 09) Definitive Impact Study." SPP requested an Interconnection System Impact Study for eight (8) generation interconnections for 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak, which requires a Stability Analysis, Short Circuit Analysis, and an Impact Study Report.

SECTION 2: BACKGROUND

The Siemens Power Technologies International PSS/E power system simulation program Version 33.10.0 was used for this study. SPP provided the stability database cases for 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak conditions and a list of contingencies to be examined. Additionally, SPP provided stability database cases for a sensitivity of the Gentleman Generation Station for the three stability databases (referred to as High GGS Sensitivity Scenario). The models provided include the study projects shown in Table 2-1 and the previously queued projects listed in Table 2-2. Refer to Appendix A for the steady-state and dynamic model data for the study projects. A power flow one-line diagram for each generation interconnection project is shown in Figures 2-1 through 2-8. Note that the one-line diagrams represent the 2017 Winter Peak case.

The Stability Analysis determined the impacts of the new interconnecting projects on the stability and voltage recovery of the nearby system and the ability of the interconnecting projects to meet FERC Order 661A. If problems with stability or voltage recovery are identified, the need for reactive compensation or system upgrades were investigated. Three-phase faults and single line-to-ground faults were examined as listed in Table 2-3.

A Short Circuit Analysis was performed on the 2018 Summer Peak and 2026 Summer Peak study years for each study generator. The study was performed five buses out from the study generator's point of interconnection and results were documented.

Table 2-1
Interconnection Projects Evaluated

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2016-034	89.7	GE 2.3 MW (587223)	Tap Laramie River -Sidney 345kV (560090)
GEN-2016-074	200	Vestas 2.0 MW (587683)	Sweetwater 345kV (640374)
GEN-2016-096	227.7	Siemens 2.3 MW (587783, 587787)	Tap Pauline-Moore 345kV (587784)
GEN-2016-106	400	Vestas 2.0 MW (587853)	Gentleman Substation 345kV (640183)
GEN-2016-110	152	GE 2.0 MW (587873)	Tap Laramie River-Stegall 345kV (587874)
GEN-2016-147	40	GE PV Solar 2.0 MW (588223)	Sidney 115kV Sub (653572)
GEN-2016-159	427.8	Vestas 3.45 MW (588383, 588386)	Hoskins 345kV Substation (640226)
GEN-2016-165	202	GE 2.0 MW (588343)	Grand Prairie 345kV (652532)

Table 2-2
Previously Queued Nearby Interconnection Projects Included

Request	Size (MW)	Generator Model	Point of Interconnection
J041	90	Vestas V110 VCSS 2.0MW	Wellsburg 161 kV Substation (631008)
J438	170	Vestas V110 VCSS 2.0MW	Parnell to Poweshiek 161kV (51113)
J475	200	Vestas V110 VCSS 2.0MW	Montezuma 345kV (635730)
J495	200	Vestas V110 VCSS 2.0MW	Ledyard to Colby 345kV (61529)
J498	340	Vestas V110 VCSS 2.0MW	Grimes to Lehigh 345kV (636003)
J499	340	Vestas V110 VCSS 2.0MW	Fallow to Grimes 345kV (635580)
J500	500	Vestas V110 VCSS 2.0MW	Boone-Atchison and MEC Rolling Hills-Madison County 345 kV (635570)
J504	50	Solar	Vinton to Arnold 161kV (71088)
J506	200	Vestas V110 VCSS 2.0MW	Raun to Highland 345kV (65400)
J524	100	SMA SC 2.5 MVA	Webster 161kV (636001)
J527	250	GE 2.50 MW	Booneville Cooper 345kV (65200)
J528	200	GE 2.50 MW	Rolling Hills - Madison 345kV (65300)
J530	250	GE 2.50 MW	Montezuma - Hills 345kV (75730)
J534	250	GE 2.50 MW	Kossuth to Webster 345kV (66000)
J535	210	GE 2.50 MW	J411 to Lehigh 345kV (66201)
J555	140	Vestas V110 VCSS 2.0MW	Montezuma 345kV (635730)
J583	200	GE 2.50 MW	Fallow Avenue 345kV (635590)
J615	70	Vestas V110 VCSS 2.0MW	Electric Farms- Shaulis 161kV (86151)
Beatrice Power Station	250	Thermal 80/90MW	Beatrice 115kV (640088)
Broken Arrow	7.3		Broken Bow 115kV (640089)

Request	Size (MW)	Generator Model	Point of Interconnection
Buffalo County Solar	10		Kearney Northeast (640249)
Burt County Wind	12		Tekamah & Oakland 115kV (640300)
Burwell	3.3		Ord 115kV (640308)
Columbus Hydro	45	Hydro 15MW	Columbus 115kV (640136)
North Platte - Lexington	66.7	Hydro 21.6/23.5MW	Multiple: Jeffrey 115kV, John_1 115kV, John_2 115kV (640238, 640240, 640242)
Ord	10.8		Ord 115kV (640308)
Stuart	1.8		Ainsworth 115kV (640051)
Ft Randle Hydro	356	Hydro 44/45MW	Ft Randle (WAPA) 230kV & 115kV (652510)
Gavins Pt Hydro	102	Hydro 34MW	Gavins Point (WAPA) 115kV (652511)
Spirit Mound Heat	120	Thermal 60MW	Spirit Mound (WAPA) 115kV (659121)
GEN-2003-021N	74.25	Vestas V82 1.65MW	Ainsworth Wind Tap 115kV (640050)
GEN-2004-023N	75	Thermal 75MW	Columbus 115kV (640119)
GEN-2006-020N	42.3	Vestas V190 VCUS 1.815MW, Vestas V90 VCRS 3.0MW	Bloomfield 115kV (640084)
GEN-2006-037N1	73.1	GE 1.7MW	Broken Bow North 115kV (640445)
GEN-2006-038N005	80	GE 1.6MW	Broken Bow North 115kV (640445)
GEN-2006-038N019	81	GE 1.5MW	Petersburg 115kV (640444)
GEN-2006-044N	40.5	GE 1.5MW	Petersburg 115kV (640444)
GEN-2007-011N08	81	Vestas V90 VCRS 3.0MW	Bloomfield 115kV (640084)
GEN-2007-017IS/GEN-2007-018IS	400	Vestas V110 VCSS 2.0MW	Tap Ft. Thompson-Hope County 345 kV (Grand Prarie, 652532)

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2008-086N02/GEN-2014-032	211.22	GE 100m 1.79MW	Meadow Grove 230kV (640540)
GEN-2008-119O	60	GE 1.5MW	S1399 161kV (646399)
GEN-2008-123N	89.7	GE 103m 1.79/2/2.3MW	Tap Pauline - Guide Rock (Rosemont) 115kV (560134)
GEN-2009-040	72	Vestas V110 VCSS 2.0MW	Marshall 115kV (533303)
GEN-2010-041	10.5	GE 1.5MW	S1399 161kV (646399)
GEN-2010-051	198.9	GE 100m 1.7MW	Tap on the Twin Church – Hoskins 230kV line (560347)
GEN-2011-018/GEN-2013-008/GEN-2014-004	78.76	GE 100m 1.79MW, GE 97.4m 1.79MW	Steele County 115kV (640426)
GEN-2011-027	120.25	GE 1.85MW	Tap Twin Church-Hoskins 230kV (560347)
GEN-2011-056	3.6 MW increase (Pmax=21.6MW)	Hydro 21.6MW	Jeffrey 115kV (640238)
GEN-2011-056A	3.6 MW increase (Pmax=21.6MW)	Hydro 21.6MW	Johnson 1 115kV (640240)
GEN-2011-056B	4.5 MW increase (Pmax=23.5MW)	Hydro 23.5MW	Johnson 2 115kV (640242)
GEN-2012-021	4.8 MW increase	Thermal 4.8MW	Terry Bundy Generating Station 115kV (650275)
GEN-2013-002	50.6	Siemens 108m 2.3MW	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2 (560746)
GEN-2013-019	73.6	Siemens 108m 2.3MW	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2 (560746)
GEN-2013-032	204	GE 97.4m 1.7MW	Antelope 115kV (640521)
GEN-2014-013	73.39	GE 100m 1.79MW	Meadow Grove (GEN-2008-086N2 Sub) 230kV (640540)
GEN-2014-031	35.8	GE 1.79MW	Meadow Grove 230kV (GEN-2008-086N02 POI) (640540)

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2014-039	73.34	Vestas V110 VCSS 1.905/2.0MW	Friend 115kV (640174)
GEN-2015-007	160	GE 116m 2.0MW	Hoskins 345kV (640226)
GEN-2015-023	300.72	GE 100m 1.79MW	Holt County 345kV (640510)
GEN-2015-053	50.12	GE 1.79 MW	Antelope 115kV (640521)
GEN-2015-076	158.4	Vestas V117 GridStreamer 3.3MW	Belden 115kV (640080)
GEN-2015-087	66	Vestas V100 VCSS 2.0MW	Tap on Fairbury(640169) to Hebron (640218) 115kV (560061)
GEN-2015-088	300	Vestas V100 VCSS 2.0MW	Tap on Moore (640277) to Pauline (640312) 345kV (560062)
GEN-2015-089	200	GE 2.0MW	Utica 230kV (652526)
GEN-2016-021	300	Vestas V110 VCSS 2.0MW	Hoskins 345kV (640226)
GEN-2016-023	150.53	GE 1.79/2.0MW	Tap Sidney (659426) - Laramie River (659131) 345kV (560075)
GEN-2016-029	150.53	GE 1.79/2.0MW	Tap Sidney (659426) - Laramie River (659131) 345kV (560075)
GEN-2016-043	226.8	Vestas V136 3.6MW	Hoskins 345kV (640226)
GEN-2016-050	250.7	GE 2.3MW	Axtell (640065)-Post Rock (530583) 345 kV (560082)
GEN-2016-075	50	Vestas V110 VCSS 2.0MW	Tap Ft. Thompson-Hope County 345 kV (Grand Prarie, 652532)

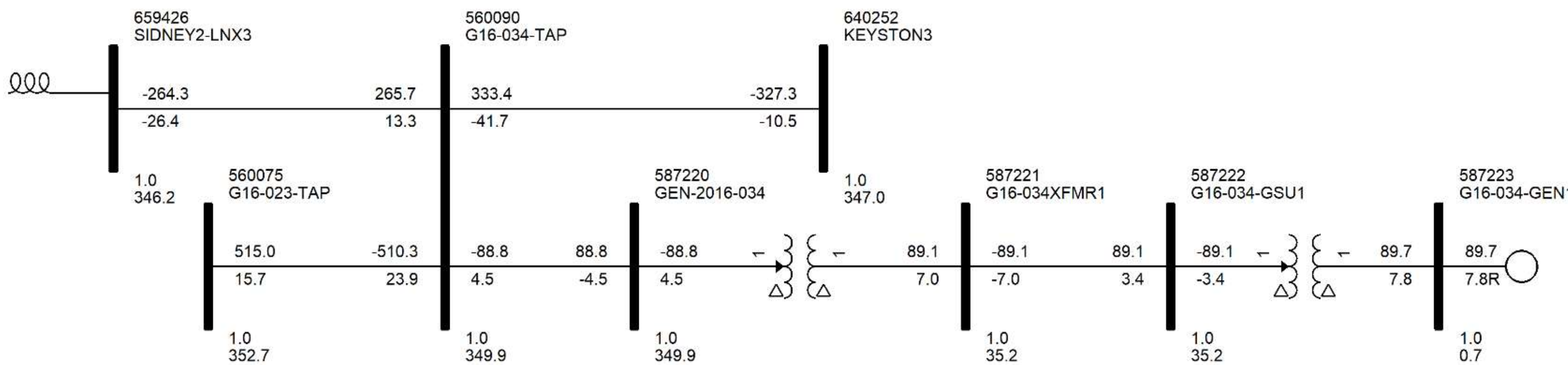


Figure 2-1. Power flow one-line diagram for interconnection project at Laramie River-Sidney Tap 345kV (GEN-2016-034).

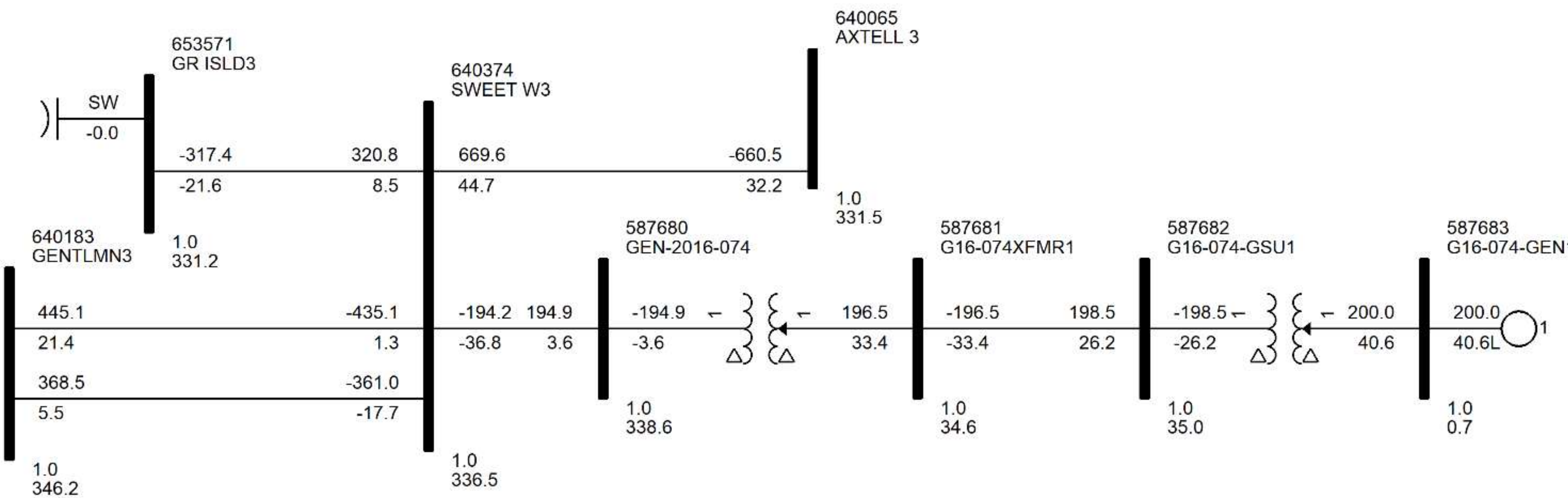


Figure 2-2. Power flow one-line diagram for interconnection project at Sweetwater 345 kV (GEN-2016-074).

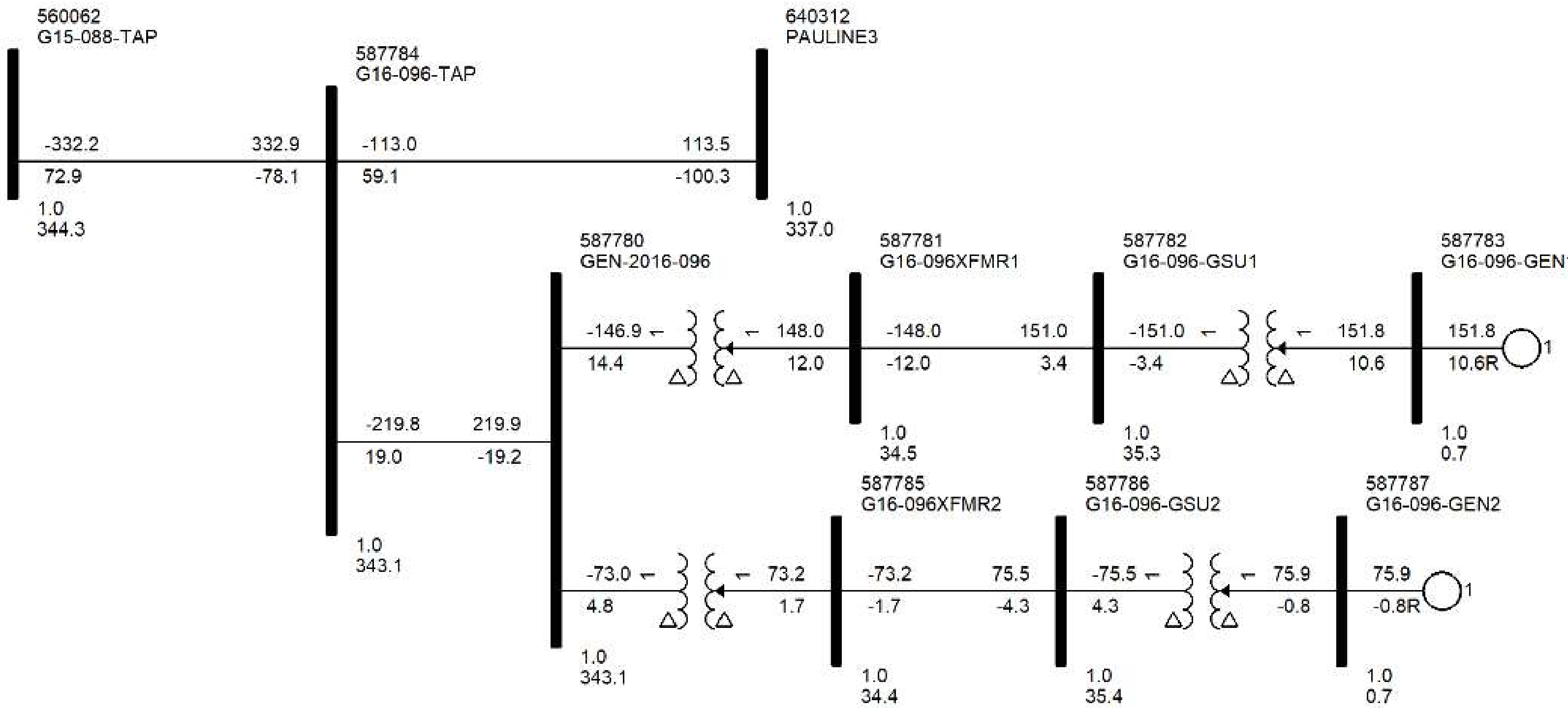


Figure 2-3. Power flow one-line diagram for interconnection project at Pauline-Moore 3450 kV (GEN-2016-096).

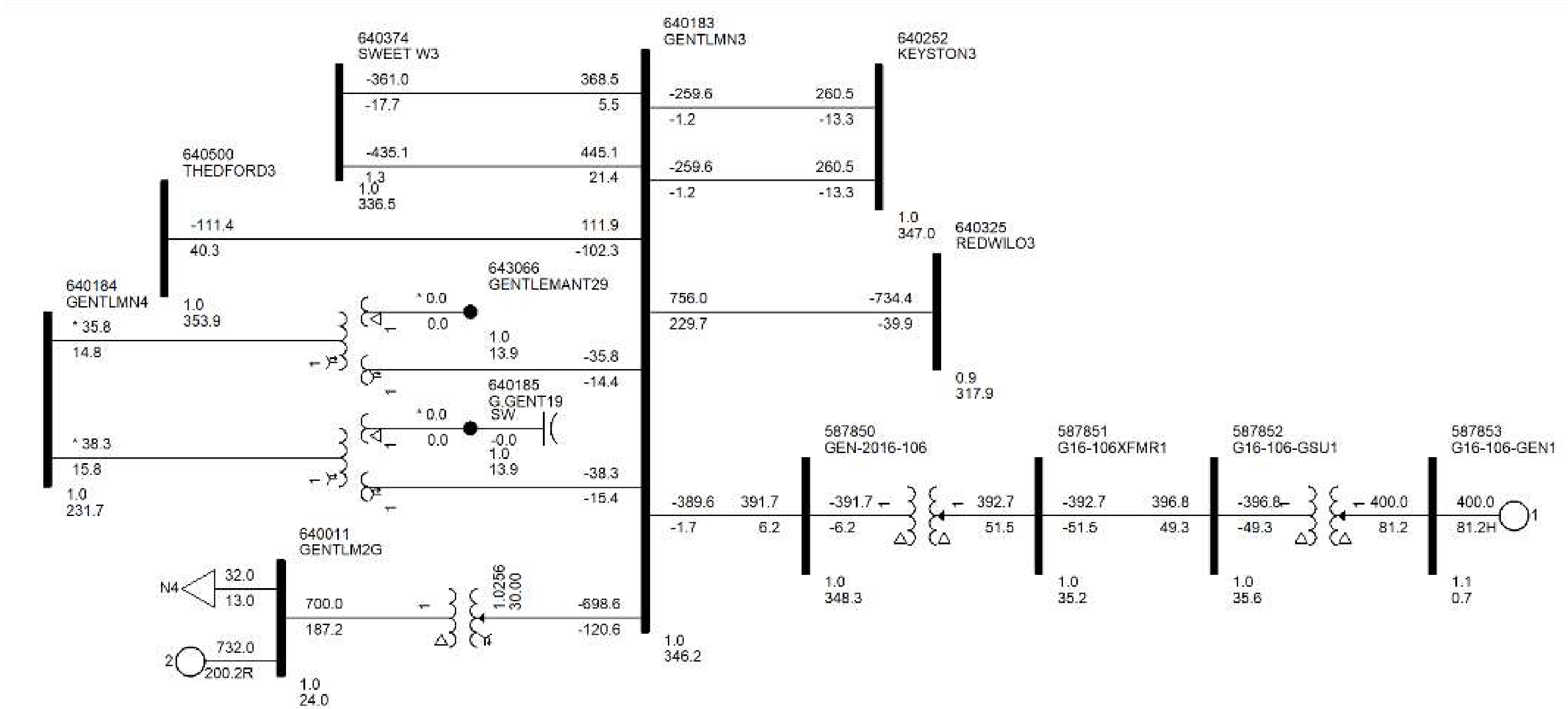


Figure 2-4. Power flow one-line diagram for interconnection project at Gentleman Substation 345kV (GEN-2016-106).

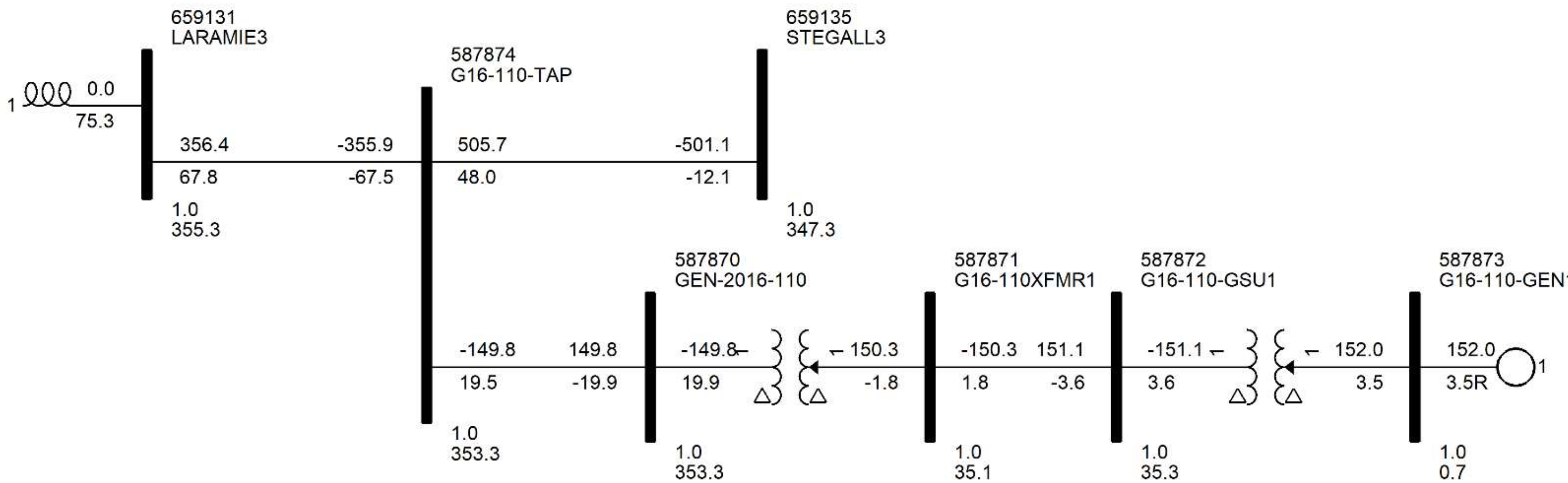


Figure 2-5. Power flow one-line diagram for interconnection project at River-Stegall Tap 345 kV (GEN-2016-110).

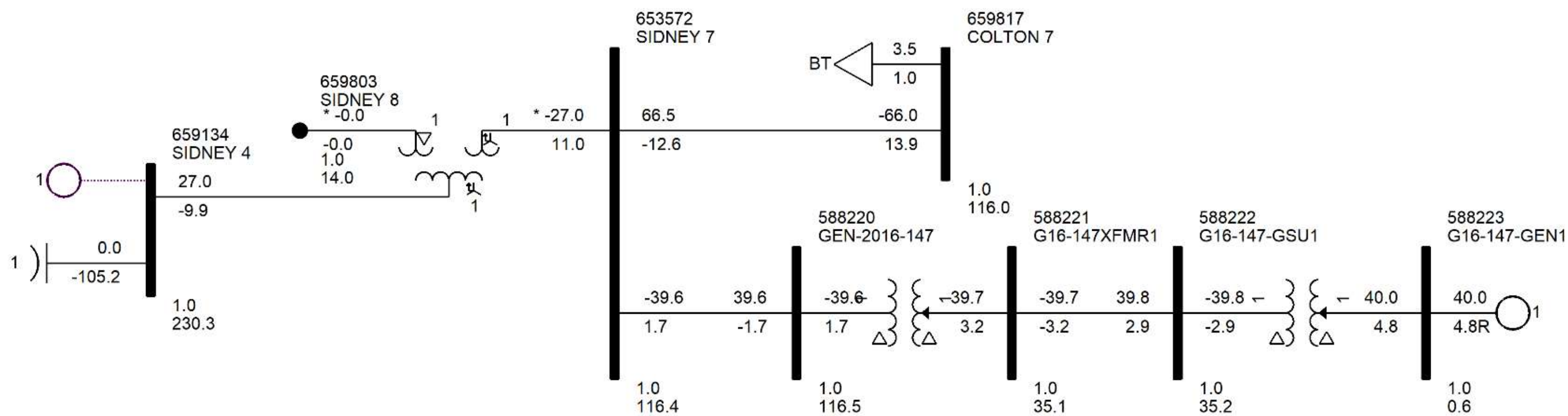


Figure 2-6. Power flow one-line diagram for interconnection project at Sidney 115 kV (GEN-2016-147).

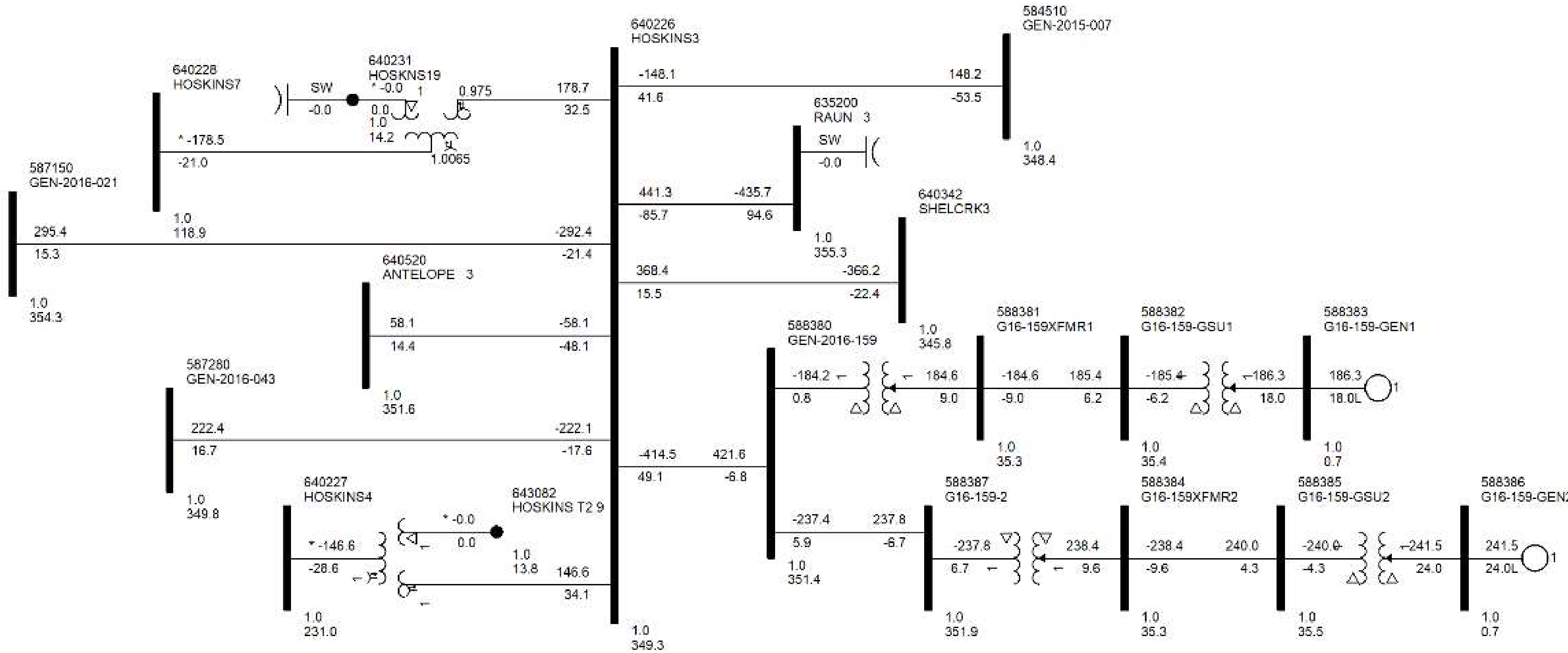


Figure 2-7. Power flow one-line diagram for interconnection project at Hoskins Substation 345 kV (GEN-2016-159).

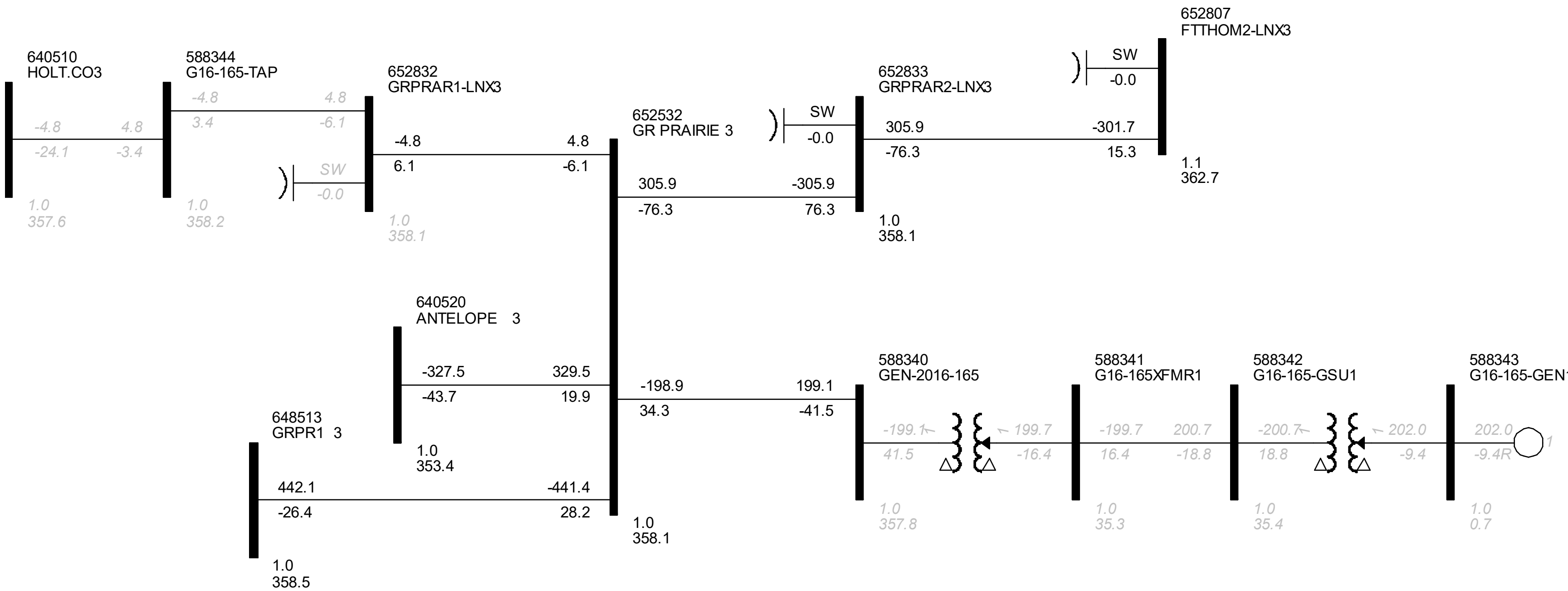


Figure 2-8. Power flow one-line diagram for interconnection project at Fort Johnson-Grand Island Tap 345 kV Tap (GEN-2016-165).

Table 2-3
Case List with Contingency Description

	Cont. Name	Description
1	FLT01-3PH	3 phase fault on the G16-034-Tap (560090) to Sidney2-LNX3 (659426) to Sidney (659133) 345kV line circuit 1, near G16-034-Tap. a. Apply fault at the G16-034-Tap 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
2	FLT02-3PH	3 phase fault on the G16-034-Tap (560090) to G16-023-Tap (560075) 345kV line circuit 1, near G16-034-Tap. a. Apply fault at the G16-034-Tap 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
3	FLT03-3PH	3 phase fault on the G16-023-Tap (560075) to Laramie (659131) 345kV line circuit 1, near G16-023-Tap. a. Apply fault at the G16-023-Tap 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
4	FLT04-3PH	3 phase fault on the Laramie (659131) to G16-110-TAP (587874) 345kV line circuit 1, near Laramie. a. Apply fault at the Laramie 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
5	FLT05-3PH	3 phase fault on the Sidney (659133) to SIDNEY1-LNX (659425) to Keystone (640252) 345kV line circuit 1, near Sidney. a. Apply fault at the Sidney 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
6	FLT06-3PH	3 phase fault on the Sidney 345/230/13.8kV (659133/659210/659168) Transformer, near Sidney. a. Apply fault at the Sidney 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
7	FLT07-3PH	3 phase fault on the Ogalala 230/115/13.8kV (640302/640304/643115) Transformer circuit 1, near Ogalala 230 kV. a. Apply fault at the Ogalala 230 kV bus. b. Clear fault after 6 cycles and trip the faulted transformer.
8	FLT08-3PH	3 phase fault on the Ogalala (640302) to Gentleman (640184) 230 kV line circuit 1, near Ogalala. a. Apply fault at the Ogalala 230kV bus. b. Clear fault after 6 cycles and trip the faulted line and remove fault.
9	FLT09-3PH	3 phase fault on the Sidney (659134) to Sidney West (652584) 230kV line circuit 1, near Sidney. a. Apply fault at the Sidney 230 kV bus. b. Clear fault after 6 cycles, trip the faulted line, and remove the fault. c. Block the DC tie at SIDNEY 4.

	Cont. Name	Description
10	FLT10-SB	**Sidney 230 kV Stuck Breaker Scenario 1** a. Apply single phase fault at the G16-034-TAP (560090) 230kV bus. b. Wait 16 cycles and remove fault. c. Trip G16-034-TAP (560090) to SIDNEY2-LNX3 (659426) to Sidney (659133) 230kV line circuit 1. d. Trip G16-034-TAP (560090) to GEN-2016-034 (587220) 230kV line circuit 1.
11	FLT11-SB	**Sidney 230 kV Stuck Breaker Scenario 2** a. Apply single phase fault at the Sidney (659134) 230kV bus. b. Wait 16 cycles and remove fault. c. Trip Sidney (659134) to Sidney Xfmr (659210) 230kV line circuit 1. d. Trip Sidney (659134) to Ogalala (640302) 230kV line circuit 1.
12	FLT12-SB	**Sidney 230 kV Stuck Breaker Scenario 3** a. Apply single phase fault at the Sidney (659134) 230 kV bus. b. Wait 16 cycles and remove fault. c. Trip Sidney (659134) to Sidney Xfmr (659210) 230 kV line circuit 1. d. Trip Sidney (659134) 230 kV / (652572) 115 kV / (659803) 13.8 kV transformer circuit 1.
13	FLT13-SB (pre-mitigation)	**Stegall 345 kV Stuck Breaker Scenario 1** a. Apply single phase fault at the Stegall (659135) 345kV bus. b. Wait 16 cycles and remove fault. c. Trip Stegall (659135) to G16-110-TAP (587874) 345kV line circuit 1. d. Trip Stegall (659135) to Sidney (659133) 345kV line circuit 1
13	FLT13-SB (post mitigation)	**Stegall 345 kV Stuck Breaker Scenario 1** a. Apply single phase fault at the Stegall (659135) 345kV bus. b. Wait 16 cycles and remove fault. c. Trip Stegall (659135) to G16-023-TAP (560075) 345kV line circuit 1. d. Trip Stegall (659135) to Sidney (659133) 345kV line circuit 1
14	FLT14-PO	**Prior outage on the G16-034-TAP (560090) – Sidney (659133) 230 kV line circuit 1** 3 phase fault on the Sidney (659133) to Stegall (659135) 345kV line circuit 1, near Sydney. a. Apply fault at the Sidney 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
15	FLT15-PO	**Prior outage on the G16-034-TAP (560090) – Sidney (659133) 230 kV line circuit 1** 3 phase fault on the G16-034-TAP (560090) to G16-023-TAP (560075) 345kV line circuit 1, near Sydney. a. Apply fault at the Sidney 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

	Cont. Name	Description
16	FLT16-PO	**Prior outage on the Sidney (659134) – Sidney Xfmr (659210) 230 kV line circuit 1** 3 phase fault on the Sidney (659133) to Stegall (659135) 345kV line circuit 1, near Sydney. a. Apply fault at the Sidney 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
17	FLT17-PO	**Prior outage on the Sidney (659134) – Sidney Xfmr (659210) 230 kV line circuit 1** 3 phase fault on the Sidney (659133) to Sidney2-LNX3 (659426) to G16-034-TAP (560090) 345kV line circuit 1, near Sydney. a. Apply fault at the Sidney 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
18	FLT18-3PH	3 phase fault on the Sweetwater (640374) to Axtell (640065) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Sweetwater 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
19	FLT19-3PH	3 phase fault on the Sweetwater (640374) to Grand Island (653571) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Sweetwater 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
20	FLT20-3PH	3 phase fault on the Sweetwater (640374) to Gentleman (640183) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Sweetwater 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
21	FLT21-3PH	3 phase fault on the Axtell (640065) to Pauline (640312) 345kV line circuit 1, near Axtell. a. Apply fault at the Axtell 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
22	FLT22-3PH	3 phase fault on the Axtell 345/115/13.8kV (640065/640066/640067) Transformer, near Axtell. a. Apply fault at the Axtell 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
23	FLT23-3PH	3 phase fault on the Grand Island (653571) to Mccool 3 (640271) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Grand Island 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
24	FLT24-3PH	3 phase fault on the Gentleman (640183) to Keystone (640252) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

	Cont. Name	Description
25	FLT25-3PH	3 phase fault on the Gentleman 345/230/13.8kV (640183/640184/643066) Transformer, near Gentleman. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
26	FLT25-3PH	3 phase fault on the Gentleman 345/230/13.8kV (640183/640184/640185) Transformer, near Gentleman. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
27	FLT27-3PH	3 phase fault on the Gentleman (640183) to Red Willow (640325) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
28	FLT28-SB	**Sweetwater 345 kV Stuck Breaker Scenario 1** a. Apply single phase fault at the Sweetwater (640374) 345kV bus. b. Wait 16 cycles and remove fault. c. Trip Sweetwater (640374) to Gentleman (640183) 345kV line circuit 1. d. Trip Sweetwater (640374) to Axtell (640065) 345kV line circuit 1.
29	FLT29-SB	**Sweetwater 345 kV Stuck Breaker Scenario 2** a. Apply single phase fault at the Sweetwater (640374) 345kV bus. b. Wait 16 cycles and remove fault. c. Trip Sweetwater (640374) to Gentleman (640183) 345kV line circuit 1. d. Trip Sweetwater (640374) to Grand Island (653571) 345kV line circuit 1.
30	FLT30-SB	**Sweetwater 345 kV Stuck Breaker Scenario 3** a. Apply single phase fault at the Sweetwater (640374) 345kV bus. b. Wait 16 cycles and remove fault. c. Trip Sweetwater (640374) to Axtell (640065) 345kV line circuit 1. d. Trip Sweetwater (640374) to Gentleman (640183) 345kV line circuit 1.
31	FLT31-SB	**Keystone 345 kV Stuck Breaker Scenario 1** a. Apply single phase fault at the Keystone (640252) 345kV b. Run 16 cycles, remove fault. c. Trip line from Keystone (640252) to Sidney (659133) 345kV. d. Trip line from Keystone (640252) to Gentleman (640183) 345kV.
32	FLT32-SB	**Keystone 345 kV Stuck Breaker Scenario 2** a. Apply single phase fault at the Keystone (640252) 345kV b. Run 16 cycles, remove fault. c. Trip line from Keystone (640252) to Gentleman (640183) 345kV. d. Disconnect three winding transformer at bus 640252/640253/640254.

	Cont. Name	Description
33	FLT33-PO	**Prior outage on the Sweetwater (640374) – Axtell (640065) 345 kV line circuit 1** 3 phase fault on the Sweetwater (640374) to Grand Island (653571) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Sweetwater 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
34	FLT34-PO	**Prior outage on the Sweetwater (640374) – Gentleman (640183) 345 kV line circuit 1** 3 phase fault on the Sweetwater (640374) to Grand Island (653571) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Sweetwater 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
35	FLT35-PO	**Prior outage on the Sweetwater (640374) – Axtell (640065) 345 kV line circuit 1** 3 phase fault on the Sweetwater (640374) to Gentleman (640183) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Sweetwater 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
36	FLT36-PO	**Prior outage on the Axtell (640065/640066/640067) 345/115/13.8 kV transformer** 3 phase fault on the Pauline (640312) to Axtell (640065) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Axtell 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
37	FLT37-PO	**Prior outage on the Gentleman (640183/640184/640067) 345/230/13.8kV transformer** 3 phase fault on the Keystone (640252) to Gentleman (640183) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
38	FLT38-PO	**Prior outage on the Gentleman (640183/640185/640067) 345/230/13.8kV transformer** 3 phase fault on the Red Willow (640325) to Gentleman (640183) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
39	FLT39-PO	**Prior outage on the Gentleman (640183/640185/640067) 345/230/13.8kV transformer** 3 phase fault on the Sweetwater (640325) to Gentleman (640183) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

	Cont. Name	Description
40	FLT40-3PH	3 phase fault on the G16-096-TAP (587784) to Pauline (640312) 345kV line circuit 1, near G16-096-TAP. a. Apply fault at the G16-096-TAP 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
41	FLT41-3PH	3 phase fault on the G16-096-TAP (587784) to G15-088-TAP (560062) 345kV line circuit 1, near G16-096-TAP. a. Apply fault at the G16-096-TAP 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
42	FLT43-3PH	3 phase fault on the Pauline 345/115/13.8kV (640312/640313/640315) Transformer, near Pauline. a. Apply fault at the Pauline45kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
43	FLT44-3PH	3 phase fault on the G15-088-TAP (560062) to Moore (640277) 345kV line circuit 1, near G16-088-TAP. a. Apply fault at the G16-088-TAP 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
44	FLT45-SB	**Pauline 345 kV Stuck Breaker Scenario 1** a. Apply single phase fault at the Pauline (640312) 345kV bus. b. Wait 16 cycles and remove fault. c. Trip Pauline 345/115/13.8kV (640312/640313/640315) transformer. d. Trip Pauline (640312) to Axtell (640065) 345kV line circuit 1.
45	FLT45-SB	**Pauline 345 kV Stuck Breaker Scenario 2** a. Apply single phase fault at the Pauline (640312) 345kV bus. b. Wait 16 cycles and remove fault. c. Trip Pauline 345/115/13.8kV (640312/640313/640315) transformer. d. Trip Pauline (640312) to G16-096-TAP (587784) 345kV line circuit 1.
46	FLT46-SB	**Moore 345 kV Stuck Breaker Scenario 1** a. Apply single phase fault at the Moore (640277) 345kV bus. b. Wait 16 cycles and remove fault. c. Trip Moore 345/115/13.8kV (640277/640278/640280) transformer. d. Trip Moore (640277) to Mccool 3 (640271) 345kV line circuit 1.
47	FLT47-SB	**Moore 345 kV Stuck Breaker Scenario 2** a. Apply single phase fault at the Moore (640277) 345kV bus. b. Wait 16 cycles and remove fault. c. Trip Moore (640277) to NW68HOLDRG3 (650114) 345kV line circuit 1. d. Trip Moore (640277) to 103&ROKEBY3 (650189) 345kV line circuit 1.

	Cont. Name	Description
48	FLT48-SB	**Moore 345 kV Stuck Breaker Scenario 3** a. Apply single phase fault at the Moore (640277) 345kV bus. b. Wait 16 cycles and remove fault. c. Trip Moore (640277) to COOPER 3 (640139) 345kV line circuit 1. d. Trip Moore (640277) to G15-088-TAP (560062) 345kV line circuit 1.
49	FLT49-SB	**Axtell 345 kV Stuck Breaker** a. Apply single phase fault at the Axtell (640065) 345kV bus. b. Wait 16 cycles and remove fault. c. Trip Axtell (640065) to Pauline (640312) 345kV line circuit 1. d. Trip Axtell (640065) to SWEET 3 (640374) 345kV line circuit 1.
50	FLT50-PO	**Prior outage on the Pauline 345/115/13.8kV (640312/640313/640315) transformer** 3 phase fault on the Pauline (640312) to Axtell (640065) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Axtell 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
51	FLT51-PO	**Prior outage on the Axtell 345/115/13.8 kV (640065/640066/640067) transformer** 3 phase fault on the Pauline (640312) to Axtell (640065) 345kV line circuit 1, near Sweetwater. a. Apply fault at the Axtell 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
52	FLT52-PO	**Prior outage on the Moore 345/115/13.8kV (640277/640278/640280) transformer** 3 phase fault on the Moore (640277) to COOPER 3 (640139) 345kV line circuit 1, near Moore. a. Apply fault at the Moore 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
53	FLT53-PO	**Prior outage on the Moore (640277) - COOPER 3 (640139) 345kV kV line circuit 1** 3 phase fault on the Moore (640277) to 103&ROKEBY3 (650189) 345kV line circuit 1, near Moore. a. Apply fault at the Moore 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
54	FLT54-PO	**Prior outage on the Moore (640277) - COOPER 3 (640139) 345kV kV line circuit 1** 3 phase fault on the Moore (640277) to NW68HOLDRG3 (650114) 345kV line circuit 1, near Moore. a. Apply fault at the Moore 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

	Cont. Name	Description
55	FLT55-PO	**Prior outage on the Moore (640277) - NW68HOLDRG3 (650114) 345kV kV line circuit 1** 3 phase fault Pauline (640312) to Axtell (640065) 345kV line circuit 1 a. Apply fault at the Moore 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
56	FLT56-PO	**Prior outage on the G16-096-TAP (587784) - G15-088-TAP (560062) 345kV kV line circuit 1** 3 phase fault Pauline (640312) to Axtell (640065) 345kV line circuit 1 a. Apply fault at the Moore 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
57		Deleted
58	FLT58-SB	**Gentleman 230 kV Stuck Breaker Scenario 2** a. Apply single phase fault at the Gentleman (640184) 230kV bus. b. Wait 15.5 cycles and remove fault. c. Trip Gentleman (640184) to OGALALA (640302) 230kV line circuit 1. d. Trip Gentleman 345/230/13.8kV (640183/640184/640185) Transformer.
59		Deleted
60	FLT60-SB	**Gentleman 345 kV Stuck Breaker Scenario 4** a. Apply single phase fault at the Gentleman (640183) 345kV bus. b. Wait 13.5 cycles and remove fault. c. Trip Sweetwater (640374) to Gentleman (640183) 345kV line circuit 1. d. Trip Red Willow (640325) to Gentleman (640183) 345kV line circuit 1.
61		Deleted
62		Deleted
63	FLT63-SB	**Gentleman 345 kV Stuck Breaker Scenario 7** a. Apply single phase fault at the Gentleman (640183) 345kV bus. b. Wait 13.5 cycles and remove fault. c. Trip Red Willow (640325) to Gentleman (640183) 345kV line circuit 1. d. Trip Gentleman 345/230/13.8kV (640183/640184/640185) Transformer.
64	FLT64-PO	**Prior outage on the Sidney (659134) – Sidney Xfmr (659210) 230 kV line circuit 1** 3 phase fault on the Sidney (659133) to Stegall (659135) 345kV line circuit 1, near Sidney. a. Apply fault at the Sidney 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

	Cont. Name	Description
65	FLT65-3PH	3 phase fault on the G16-110-TAP (587874) to Laramie 3 (659131) 345kV line circuit 1, near G16-110-TAP. a. Apply fault at the G16-110-TAP 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
66	FLT66-3PH	3 phase fault on the G16-110-TAP (587874) to G16-023-Tap (560075) 345kV line circuit 1, near G16-110-TAP. a. Apply fault at the G16-110-TAP 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
66a	FLT66a-3PH	3 phase fault on the G16-023-TAP (560075) to Stegall 3 (659135) 345kV line circuit 1, near Stegall 3. a. Apply fault at the Stegall 3 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
67	FLT67-3PH	3 phase fault on the G16-023-Tap (560075) to Laramie3 (659131) 345kV line circuit 1, near G16-023-Tap. a. Apply fault at the G16-023-Tap 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
68	FLT68-3PH	3 phase fault on the Stegall 3 (659135) to Sidney (659133) 345kV line circuit 1, near Stegall 3. a. Apply fault at the Stegall 3 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
69	FLT69-3PH	3 phase fault on the Stegall 345/230/13.8kV (659135/659206/659167) Transformer, near Stegall3. a. Apply fault at the Stegall 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
70	FLT70-3PH	3 phase fault on the Sidney (659133) to Sidney2-LNX3 (659426) to G16-034-TAP (560090) 345kV line circuit 1, near Sidney. a. Apply fault at the Sidney 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
71	FLT71-SB	**Stegall 345 kV Stuck Breaker Scenario 2** a. Apply single phase fault at the Stegall (659135) 345kV bus. b. Wait 16 cycles and remove fault. c. Trip Trip Stegall 345/230/13.8kV (659135/659206/659167) Transformer d. Trip Stegall (659135) to Sidney (659133) 345kV line circuit 1
72	FLT72-SB	**Stegall 345 kV Stuck Breaker Scenario 3** a. Apply single phase fault at the Stegall (659135) 345kV bus. b. Wait 16 cycles and remove fault. c. Trip Stegall 345/230/13.8kV (659135/659206/659167) Transformer d. Trip Stegall 345/115/13.8kV (659135/640530/640531) Transformer

	Cont. Name	Description
73	FLT73-PO	**Prior outage on the Sidney (659134) – Sidney Xfmr (659210) 230 kV line circuit 1** 3 phase fault on the Sidney (659133) to Sidney2-LNX (659426) to G16-034-Tap (560090) 345kV line circuit 1, near Sydney. a. Apply fault at the Sidney 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
74	FLT74-PO	**Prior outage on the Sidney (659134) – Sidney Xfmr (659210) 230 kV line circuit 1** 3 phase fault on the Sidney (659133) to Stegall (659135) 345kV line circuit 1, near Sidney. a. Apply fault at the Sidney 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
75	FLT75-PO	**Prior outage on the G16-034-TAP (560090) – Sidney (659133) 230 kV line circuit 1** 3 phase fault on the G16-034-TAP (560090) to G16-023-TAP (560075) 345kV line circuit 1, near Sydney. a. Apply fault at the Sidney 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
76	FLT76-3PH	3 phase fault on the Sidney (653572) to Colton (659817) 115kV line circuit 1, near Sidney. a. Apply fault at the Sidney 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
77	FLT77-3PH	3 phase fault on the Sidney (653572/659134/659803) 115/230/13.8kV transformer, near Sidney. a. Apply fault at the Sidney 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
78	FLT78-3PH	3 phase fault on the Colton (659817) to Chappel (65330) 115kV line circuit 1, near Colton. a. Apply fault at the Colton 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
79	FLT79-3PH	3 phase fault on the Sidney (659134) to Sidxfmr (659210) 230kV line circuit 1, near Sidney. a. Apply fault at the Sidney 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
80	FLT80-3PH	3 phase fault on the Sidney (659134) to Sidney West (6452584) 230kV line circuit 1, near Sidney. a. Apply fault at the Sidney 230kV bus. b. Clear fault after 6 cycles, trip the faulted line, and remove the fault. c. Block the DC tie at SIDNEY 4.
81	FLT81-3PH	3 phase fault on the Chappel (65330) to JULSTAP7 (640246) 115kV line circuit 1, near Colton. a. Apply fault at the Chappel 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.

	Cont. Name	Description
82		Deleted
83	FLT83-SB	**Sidney 230 kV Stuck Breaker Scenario 4** a. Apply single phase fault at the Sidney (659134) 230kV bus. b. Wait 16 cycles and remove fault. c. Trip Sidney (659134) to Sidney Xfmr (659210) 230kV line circuit 1. d. Trip Sidney (659134) to Ogalala (640302) 230kV line circuit 1. e. Block the DC tie at SIDNEY 4 f. Drop shunt at SIDNEY 4
84		Deleted
85	FLT85-SB	**JULSTAP7 115 kV Stuck Breaker** a. Apply single phase fault at the JULSTAP7 (640246) 115kV bus. b. Wait 16 cycles and remove fault. c. Trip JULSTAP7 (640246) to Highline (653303) 115kV line circuit 1. d. Trip JULSTAP7 (640246) to CHAPPEL7 (653300) 115kV line circuit 1.
86		Deleted
87	FLT87-PO	**Prior outage on the Sidney (659134) – Sidney Xfmr (659210) 230 kV line circuit 1;** 3 phase fault on the Sidney (659134) to Ogalala (640302) 230kV line circuit 1, near Sidney. a. Apply fault at the Sidney 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line. c. Block the DC tie at SIDNEY 4 d. Drop shunt at SIDNEY 4
88	FLT88-PO	**Prior outage on the Sidney (659134) – Sidney Xfmr (659210) 230 kV line circuit 1;** 3 phase fault on the Sidney (659134) to Sidney West (6452584) 230kV line circuit 1, near Sidney. a. Apply fault at the Sidney 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
89	FLT89-3PH	3 phase fault on the Hoskins (640226) to Antelope (640520) 345kV line circuit 1, near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
90	FLT90-3PH	3 phase fault on the Hoskins (640226) to Shell Creek (640342) 345kV line circuit 1, near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

	Cont. Name	Description
91	FLT91-3PH	3 phase fault on the Hoskins (640226) to Raun (635200) 345kV line circuit 1, near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
92	FLT92-3PH	3 phase fault on the Hoskins 345/230/13.8kV (640226/640227/643082) transformer, near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
93	FLT93-3PH	3 phase fault on the Hoskins 345/115/13.8kV (640226/640228/640231) transformer, near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
94	FLT94-3PH	3 phase fault on the Raun (635200) to Sioux City (652564) 345kV line circuit 1, near Raun. a. Apply fault at the Raun 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
95	FLT95-3PH	3 phase fault on the Raun (635200) to Lehigh (636010) 345kV line circuit 1, near Raun. a. Apply fault at the Raun 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
96	FLT96-3PH	3 phase fault on the Raun (635200) to S3451 (645451) 345kV line circuit 1, near Raun. a. Apply fault at the Raun 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
97	FLT97-3PH	3 phase fault on the Raun (635200) to Highland (635400) 345kV line circuit 1, near Raun. a. Apply fault at the Raun 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
98	FLT98-3PH	3 phase fault on the Raun 345/161kV (635200/635201) transformer, near Raun. a. Apply fault at the Raun 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
99	FLT99-3PH	3 phase fault on the Raun (635200) to Highland (635400) 345kV line circuit 1, near Raun. a. Apply fault at the Raun 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
100	FLT100-3PH	3 phase fault on the Shell Creek (640342) to Columbus (640125) 345kV line circuit 1, near Shell Creek. a. Apply fault at the Shell Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

	Cont. Name	Description
101	FLT101-3PH	3 phase fault on the Shell Creek 345/230/13.8kV (640342/640343/643136) transformer, near Shell Creek. a. Apply fault at the Shell Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
102	FLT102-3PH	3 phase fault on the Antelope 345/115/13.8kV (640520/640521/640524) transformer, near Antelope. a. Apply fault at the Antelope 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
103	FLT103-3PH	3 phase fault on the Hoskins 230/115/13.8kV (640227/640228/643083) transformer, near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
104	FLT104-3PH	3 phase fault on the Hoskins (640227) to G10-051-Tap (560347) 230kV line circuit 1, near Hoskins. a. Apply fault at the Hoskins 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
105	FLT105-3PH	3 phase fault on the Hoskins (640228) to Norfolk (640298) 115kV line circuit 1, near Hoskins. a. Apply fault at the Hoskins 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
106	FLT106-3PH	3 phase fault on the Hoskins (640228) to Belden (640080) 115kV line circuit 1, near Hoskins. a. Apply fault at the Hoskins 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
107	FLT107-3PH	3 phase fault on the Hoskins (640228) to Norfolk North (640296) 115kV line circuit 1, near Hoskins. a. Apply fault at the Hoskins 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
108	FLT108-3PH	3 phase fault on the Hoskins (640228) to Stanton West (640363) 115kV line circuit 1, near Hoskins. a. Apply fault at the Hoskins 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
109	FLT109-SB	**Hoskins 345 kV Stuck Breaker Scenario 1** a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 16 cycles and trip the following elements c. Hoskins (640226) – Shell Creek (640342) 345kV d. Hoskins 345/230/13.8kV (640226/640227/643082) transformer

	Cont. Name	Description
110	FLT110-SB	**Hoskins 345 kV Stuck Breaker Scenario 2** a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 16 cycles and trip the following elements c. Hoskins (640226) – Shell Creek (640342) 345kV d. Hoskins (640226) – Antelope (640520) 345kV
111	FLT111-SB	**Hoskins 345 kV Stuck Breaker Scenario 3** a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 16 cycles and trip the following elements c. Hoskins 345/230/13.8kV (640226/640227/643082) transformer d. Hoskins 345/115/13.8kV (640226/640228/640231) transformer
112	FLT112-PO	**Prior Outage of Hoskins 345 kV (640226) to Raun 345 kV (635200) CKT 1;** 3 phase fault on Hoskins 345kV (640226) to Antelope 345kV (640520), near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
113	FLT113-PO	**Prior Outage of Hoskins 345 kV (640226) to Raun 345 kV (635200) CKT 1;** 3 phase fault on Hoskins 345kV (640226) to Shell Creek 345kV (640342), near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
114	FLT114-PO	**Prior Outage of Hoskins 345 kV (640226) to Raun 345 kV (635200) CKT 1;** 3 phase fault on Hoskins 345/115/13.8kV (640226/640228/640231) transformer, near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
115	FLT115-PO	**Prior Outage of Hoskins 345 kV (640226) to Antelope 345 kV (640520) CKT 1;** 3 phase fault on Hoskins 345kV (640226) to Raun 345kV (635200), near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
116	FLT116-PO	**Prior Outage of Hoskins 345 kV (640226) to Antelope 345 kV (640520) CKT 1;** 3 phase fault on Hoskins 345kV (640226) to Shell Creek 345kV (640342), near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
117	FLT117-PO	**Prior Outage of Hoskins 345 kV (640226) to Antelope 345 kV (640520) CKT 1;** 3 phase fault on Hoskins 345/115/13.8kV (640226/640228/640298) transformer, near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

	Cont. Name	Description
118	FLT118-PO	**Prior Outage of Hoskins 345/230/13.8 kV (640226/640227/643082) Transformer;** 3 phase fault on Hoskins 345kV (640226) to Antelope 345kV (640520), near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
119	FLT119-PO	**Prior Outage of Hoskins 345/230/13.8 kV (640226/640227/643082) Transformer;** 3 phase fault on Hoskins 345kV (640226) to Shell Creek 345kV (640342), near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
120	FLT120-PO	**Prior Outage of Hoskins 345/230/13.8 kV (640226/640227/643082) Transformer;** 3 phase fault on Hoskins 345kV (640226) to Raun 345kV (635200), near Hoskins. a. Apply fault at the Hoskins 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
121	FLT121-3PH	3 phase fault on the G16-165-TAP (588344) to Holt County (640510) 345kV line circuit 1, near G16-165-TAP. a. Apply fault at the G16-165-TAP 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
122	FLT122-3PH	3 phase fault on the Holt County (640510) to GR ISLD-LNX3 (653871) to Grand Island (653571) 345kV line circuit 1, near Holt County. a. Apply fault at the Holt County 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
123	FLT123-3PH	3 phase fault on the Grand Prairie (652532) to GRPRAR1-LNX3 (652832) to G16-126-TAP (588344) 345kV line circuit 1, near Grand Prairie. a. Apply fault at the Grand Prairie 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
124	FLT124-3PH	3 phase fault on the Grand Prairie (652532) to Grand Prairie (648513) 345kV line circuit 1, near Grand Prairie. a. Apply fault at the Grand Prairie 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
125	FLT125-3PH	3 phase fault on the Grand Prairie (652532) to GRPRAR1-LNX2 (652833) to G16-126-TAP (588344) 345kV line circuit 1, near Grand Prairie. a. Apply fault at the Grand Prairie 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
126	FLT126-3PH	3 phase fault on the Holt County (640510) to GR ISLD-LNX3 (653871) to Grand Island (652871) 345kV line circuit 1, near Holt County. a. Apply fault at the Holt County 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.

	Cont. Name	Description
127	FLT127-3PH	**G16-126-TAP 345 kV Stuck Breaker** a. Apply fault at the G16-126-TAP 345kV bus. b. Clear fault after 16 cycles and trip the following elements c. G16-126-TAP (588344) to Holt County (640510) 345kV d. Grand Prairie (652532) to GRPRAR1-LNX2 (652833) to G16-126-TAP (588344)
128	FLT128-SB	**Grand Island 345 kV Stuck Breaker Scenario** a. Apply fault at the Grand Island 345kV bus. b. Clear fault after 16 cycles and trip the following elements c. Holt County (640510) to GR ISLD-LNX3 (653871) to Grand Island (653571) 345kV d. SWEET 3 (640374) to Grand Island (653571) 345kV
129	FLT129-PO	**Prior Outage of Grand Prairie 345 kV (652532) to GRPRAR1-LNX3 (652832) to G16-165-TAP (588344) 345 kV CKT 1;** 3 phase fault on the Grand Prairie 345 kV (652532) to GRPRAR2-LNX3 (652833) to FTTHOM2-LNX3 (652807) to Ft Thompson (652506) 345kV line circuit 1, near Ft Thompson. a. Apply fault at the Ft Thompson 345kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
130	FLT130-PO	**Prior Outage of Grand Prairie 345 kV (652532) to GRPRAR1-LNX3 (652832) to G16-165-TAP (588344) 345 kV CKT 1;** 3 phase fault on the Ft Thompson 345/230/14.8kV (652506/652507/652273) transformer, near Ft Thompson. a. Apply fault at the Ft Thompson 345kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
131	FLT131-3PH	3 phase fault on the Keystone (640252) to Red Willow (640325) 345kV line circuit 1, near Keystone. a. Apply fault at the Keystone 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
132	FLT132-3PH	3 phase fault on the Red Willow (640325) to Post Rock (530583) 345kV line circuit 1, near Red Willow. a. Apply fault at the Red Willow 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
133	FLT133-3PH	3 phase fault on the Grand Prairie (652532) to Antelope (640520) 345kV line circuit 1, near Grand Prairie. a. Apply fault at the Grand Prairie 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
134	FLT134-PO	**Prior outage on the Red Willow (640325) - Gentleman (640183) 345kV kV line** 3 phase fault on the Red Willow (640325) to Post Rock (530583) 345kV line circuit 1, near Red Willow. a. Apply fault at the Red Willow 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

	Cont. Name	Description
135	FLT135-PO	**Prior outage on the Red Willow (640325) - Mingo (531451) 345kV kV line** 3 phase fault on the Red Willow (640325) to Post Rock (530583) 345kV line circuit 1, near Red Willow. a. Apply fault at the Red Willow 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
136	FLT136-PO	**Prior outage on the Red Willow (640325) - Gentleman (640183) 345kV kV line** 3 phase fault on the Keystone (640252) to Red Willow (640325) 345kV line circuit 1, near Keystone. a. Apply fault at the Keystone 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
137	FLT137-PO	**Prior outage on the Red Willow (640325) - Mingo (531451) 345kV kV line** 3 phase fault on the Keystone (640252) to Red Willow (640325) 345kV line circuit 1, near Keystone. a. Apply fault at the Keystone 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
138	FLT138-PO	**Prior Outage of Grand Prairie 345 kV (652532) to GRPRAR1-LNX3 (652832) to G16-165-TAP (588344) 345 kV CKT 1;** 3 phase fault on the Grand Prairie (652532) to Antelope (640520) 345kV line circuit 1, near Grand Prairie.. a. Apply fault at the Grand Prairie 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
139	FLT139-PO	**Prior Outage of Grand Prairie 345 kV (652532) to GRPRAR2-LNX3 (652833) to FTTHOM2-LNX3 (652807) to Ft Thompson (652506) 345 kV CKT 1;** 3 phase fault on the Grand Prairie (652532) to Antelope (640520) 345kV line circuit 1, near Grand Prairie. a. Apply fault at the Grand Prairie 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

SECTION 3: STABILITY ANALYSIS

The objective of the Stability Analysis was to determine the impacts of the generator interconnections on the stability and voltage recovery on the SPP transmission system. If problems with stability or voltage recovery were identified, the need for reactive compensation or system upgrades was investigated.

3.1 Approach

SPP provided MEPPI with the following three power flow cases:

- MDWG16-17W_DIS1602_G09
- MDWG16-18S_DIS1602_G09
- MDWG16-26S_DIS1602_G09

Each case was examined prior to the Stability Analysis to ensure the case contained the proposed study projects and any previously queued projects listed in Tables 2-1 and 2-2 respectively. There was no suspect power flow data in the study area. The dynamic datasets were also verified and stable initial system conditions (i.e., "flat lines") were achieved. Three-phase and single phase-to-ground faults listed in Table 2-3 were examined. Single-phase fault impedances were calculated for each season to result in a voltage of approximately 60% of the pre-fault voltage. Refer to Table 3-1 for a list of the calculated single-phase fault impedances utilized.

Table 3-1
Calculated Single-Phase Fault Impedances

Cont. No.*	Cont. Name	Single-Phase Fault Impedance (MVA)		
		2017 Winter	2018 Summer	2026 Summer
10	FLT10-SB	-2304.7	-2304.7	-2406.3
11	FLT11-SB	-1500.0	-1500.0	-1500.0
12	FLT12-SB	-1500.0	-1500.0	-1500.0
13	FLT13-SB	-1875.0	-1875.0	-1875.0
28	FLT28-SB	-3625.0	-3625.0	-3828.1
29	FLT29-SB	-3625.0	-3625.0	-3828.1
30	FLT30-SB	-3625.0	-3625.0	-3828.1
31	FLT31-SB	-4031.3	-4031.3	-4437.5
32	FLT32-SB	-4031.3	-4031.3	-4437.5
44	FLT44-SB	-2812.5	-2812.5	-3015.6
45	FLT45-SB	-2812.5	-2812.5	-3015.6
46	FLT46-SB	-7687.5	-7687.5	-8093.8
47	FLT47-SB	-7687.5	-7687.5	-8093.8
48	FLT48-SB	-7687.5	-7687.5	-8093.8
49	FLT49-SB	-3218.8	-3218.8	-3218.8
57	FLT57-SB	-6062.5	-6062.5	-6062.5
58	FLT58-SB	-6062.5	-6062.5	-6062.5
59	FLT59-SB	-6062.5	-6062.5	-6062.5
60	FLT60-SB	-6062.5	-6062.5	-6062.5
61	FLT61-SB	-6062.5	-6062.5	-6062.5
62	FLT62-SB	-6062.5	-6062.5	-6062.5
63	FLT63-SB	-6062.5	-6062.5	-6062.5
71	FLT71-SB	-1875.0	-1875.0	-1875.0
72	FLT72-SB	-1875.0	-1875.0	-1875.0
82	FLT82-SB	-562.5	-562.5	-562.5
83	FLT83-SB	-1500.0	-1500.0	-1500.0
84	FLT84-SB	-1500.0	-1500.0	-1500.0
85	FLT85-SB	-500.0	-500.0	-500.0
109	FLT109-SB	-4843.8	-4843.8	-4843.8
110	FLT110-SB	-4843.8	-4843.8	-4843.8
111	FLT111-SB	-4843.8	-4843.8	-4843.8
127	FLT127-SB	-4031.3	-4031.3	-4437.5
128	FLT128-SB	-4031.3	-4031.3	-4437.5

*Refer to Table 2-3 for a description of the contingency scenerio

Bus voltages, machine rotor angles, and previously queued generation in the study area were monitored in addition to bus voltages and machine rotor angles in the following areas:

- 534 SUNC
- 536 WERE
- 540 GMO

- 541 KCPL
- 635 MEC
- 640 NPPD
- 645 OPPD
- 650 LES
- 652 WAPA

Requested and previously queued generation outside the above study area was also monitored.

The results of the analysis determined if reactive compensation or system upgrades were required to obtain acceptable system performance. If additional reactive compensation was required, the size, type, and location were determined. The proposed reactive reinforcements would ensure the wind or solar farm meets FERC Order 661A low voltage requirements and return the wind or solar farm to its pre-disturbance operating voltage. If the results indicated the need for fast responding reactive support, dynamic support such as an SVC or STATCOM was investigated.

3.2 Stability Analysis Results

The Stability Analysis determined that there were multiple contingencies across all seasons that resulted in system/voltage instability, generation tripping offline, and poor post-fault voltage recovery when all generation interconnection requests were at 100% output. The 2017 Winter Peak ("17W") case was observed to have many non-damped voltage oscillations for faults throughout the SPP study area. It can be observed that the 2018 Summer Peak ("18S") and 2026 Summer Peak ("26S") case, which have additional projects implemented from 17W, have improved voltage responses.

Refer to Table 3-2 for a summary of the Stability Analysis results for the contingencies listed in Table 2-3. Table 3-2 is a summary of the stability results for the 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak conditions and states whether the system remained stable or generation tripped offline, if acceptable voltage recovery was observed after the fault was cleared, and if the voltage recovered to above 0.9 p.u. and below 1.1 p.u. post fault steady-state conditions. Voltage recovery criteria includes ensuring that the transient voltage recovery is between 0.7 p.u. and 1.2 p.u. and ending in a steady-state voltage (for N-1 contingencies) at the pre-contingent level or at least above 0.9 p.u. and below 1.1. p.u.

Refer to Appendix B, Appendix C, and Appendix D for a complete set of plots for all contingencies for 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak conditions, respectively.

Table 3-2
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
1	FLT01-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
2	FLT02-3PH	System Instability				-	-	Compliant	Stable	-	-	Compliant	Stable
3	FLT03-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
4	FLT04-3PH	-	-	Compliant	Stable	-	-	V < 0.9 p.u.	Stable	-	-	Compliant	Stable
5	FLT05-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
6	FLT06-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
7	FLT07-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
8	FLT08-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
9	FLT09-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
10	FLT10-SB	System Instability				System Instability				System Instability			
11	FLT11-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
12	FLT12-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
13	FLT13-SB	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable
14	FLT14-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
15	FLT15-PO	System Instability				System Instability				System Instability			
16	FLT16-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
17	FLT17-PO	-	-	Compliant	Stable	-	-	V < 0.9 p.u.	Stable	-	-	Compliant	Stable
18	FLT18-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	V < 0.9 p.u.	Stable
19	FLT19-3PH	-	-	Compliant	Stable	-	-	V < 0.9 p.u.	Stable	-	-	Compliant	Stable
20	FLT20-3PH	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable	-	-	Compliant	Stable
21	FLT21-3PH	-	-	Compliant	Stable	-	-	V < 0.9 p.u.	Stable	-	-	Compliant	Stable
22	FLT22-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
23	FLT23-3PH	-	-	Compliant	Stable	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable
24	FLT24-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
25	FLT25-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
27	FLT27-3PH	-	-	Compliant	Stable	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable
28	FLT28-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
29	FLT29-SB	-	-	Compliant	Stable	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable
30	FLT30-SB	System Instability				-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable
31	FLT31-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
32	FLT32-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
33	FLT33-PO	Steady-State Divergence				Steady-State Divergence				-	-	Compliant	Gen Trip
34	FLT34-PO	Steady-State Divergence				Steady-State Divergence				-	-	Compliant	Stable
35	FLT35-PO	Steady-State Divergence				Steady-State Divergence				-	-	Compliant	Stable
36	FLT36-PO	-	-	Compliant	Stable	-	-	V < 0.9 p.u.	Stable	-	-	Compliant	Stable

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
37	FLT37-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
38	FLT38-PO	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable
39	FLT39-PO	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable
40	FLT40-3PH	-	-	Compliant	Stable	-	-	V < 0.9 p.u.	Stable	-	-	Compliant	Stable
41	FLT41-3PH	-	-	Compliant	Stable	-	-	V < 0.9 p.u.	Stable	-	-	Compliant	Stable
42	FLT42-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
43	FLT43-3PH	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable
44	FLT44-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
45	FLT45-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
46	FLT46-SB	-	-	Compliant	Stable	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable
47	FLT47-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
48	FLT48-SB	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable
49	FLT49-SB	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable
50	FLT50-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
51	FLT51-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
52	FLT52-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
53	FLT53-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
54	FLT54-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
55	FLT55-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
56	FLT56-PO	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable	-	-	Compliant	Stable
58	FLT58-SB	System Instability				System Instability				System Instability			
60	FLT60-SB	System Instability				System Instability				System Instability			
63	FLT63-SB	System Instability				System Instability				System Instability			
64	FLT64-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
65	FLT65-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
66	FLT66-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
66a	FLT66a-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
67	FLT67-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
68	FLT68-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
69	FLT69-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
70	FLT70-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
71	FLT71-SB	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable	-	-	Compliant	Stable
72	FLT72-SB	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable	-	-	Compliant	Stable
73	FLT73-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
74	FLT74-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
75	FLT75-PO	System Instability				System Instability				System Instability			

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
76	FLT76-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
77	FLT77-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
78	FLT78-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
79	FLT79-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
80	FLT80-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
81	FLT81-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
83	FLT83-SB	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
85	FLT85-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
87	FLT87-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
88	FLT88-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
89	FLT89-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
90	FLT90-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
91	FLT91-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
92	FLT92-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
93	FLT93-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
94	FLT94-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
95	FLT95-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
96	FLT96-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
97	FLT97-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
98	FLT98-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
99	FLT99-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
100	FLT100-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
101	FLT101-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
102	FLT102-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
103	FLT103-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
104	FLT104-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
105	FLT105-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
106	FLT106-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
107	FLT107-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
108	FLT108-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
109	FLT109-SB	System Instability				System Instability				System Instability			
110	FLT110-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
111	FLT111-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
112	FLT112-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
113	FLT113-PO	System Instability				System Instability				System Instability			

Table 3-2 (continued)
Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
114	FLT114-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
115	FLT115-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
116	FLT116-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
117	FLT117-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
118	FLT118-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
119	FLT119-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
120	FLT120-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
121	FLT121-3PH	-	-	Compliant	Gen Trip	System Instability				System Instability			
122	FLT122-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
123	FLT123-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
124	FLT124-3PH	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip
125	FLT125-3PH	-	-	V < 0.9 p.u.	Stable	-	-	Compliant	Stable	-	-	V < 0.9 p.u.	Stable
126	FLT126-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
127	FLT127-3PH	-	-	Compliant	Stable	System Instability				System Instability			
128	FLT128-SB	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable	-	-	V < 0.9 p.u.	Stable
129	FLT129-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Stable
130	FLT130-PO	-	-	Compliant	Gen Trip	-	-	Compliant	Gen Trip	-	-	Compliant	Stable
131*	FLT131-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
132*	FLT132-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
133*	FLT133-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
134*	FLT134-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
135*	FLT135-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
136*	FLT136-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
137*	FLT137-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
138*	FLT138-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
139*	FLT139-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable

*Added post mitigation

To mitigate the system/voltage instability, voltage violations, generation tripping offline, and poor post-fault steady-state voltages, the following upgrades were provided by SPP and implemented (upgrades provided here are required for 17W season and thus, implemented in remaining years):

- Keystone to Red Willow 345 kV circuit #1
- Red Willow to Post Rock 345 kV circuit #1
- Grand Prairie to Antelope 345 kV circuit #1
- Reroute Laramie River Station (GEN-2016-110-Tap) to Stegall 345kV circuit #1 through the GEN-2016-023-Tap substation

With the upgrades identified above, all single element contingencies recover within the expected requirements. However, the following three single phase stuck breaker faults required additional mitigation for the 17W and 18S seasons:

- FLT58-SB: Single phase stuck breaker fault at Gentleman 230 kV resulting in the loss of Gentleman to Ogalala 230 kV circuit #1 and Gentleman 345/230 kV transformer.
- FLT60-SB: Single phase stuck breaker fault at Gentleman 345 kV resulting in the loss of Gentleman to Sweetwater 345 kV circuit #1 and Gentleman 345 kV to Red Willow 345 kV circuit #1.
- FLT63-SB: Single phase stuck breaker fault at Gentleman 345 kV resulting in the loss of the Gentleman to Red Willow 345 kV circuit #1 and Gentleman 345/230 kV transformer.

It was identified that an SVC injection of +100 Mvar at Keystone 345 kV would mitigate the voltage instability observed in the region. The SVC solution was implemented in the 17W, 18S, and 26S seasons. Note for any prior outage in the Gentleman area, generation curtailment may be required by operations due to the limit from the stuck breaker faults above.

FLT13-3PH, a single phase fault with a stuck breaker (16 cycle clearing time) resulting in the loss of Stegall to G16-110-Tap 345 kV circuit #1 and Stegall to Sidney 345 kV circuit #1, was observed to have voltage recovery below 0.9 p.u. at Red Willow 345 kV. After the above mitigation was implemented, the topology of this fault changed from losing the Stegall to G16-110-Tap 345 kV circuit to losing the Stegall to G16-023-Tap 345 kV circuit. Refer to Figure 3-1 for a representative comparison plot of the Red Willow 345 kV bus voltage for the 17W case with and without system upgrades. It can be observed that the upgrades help improve the voltage at this bus. The system recovered within SPP criteria.

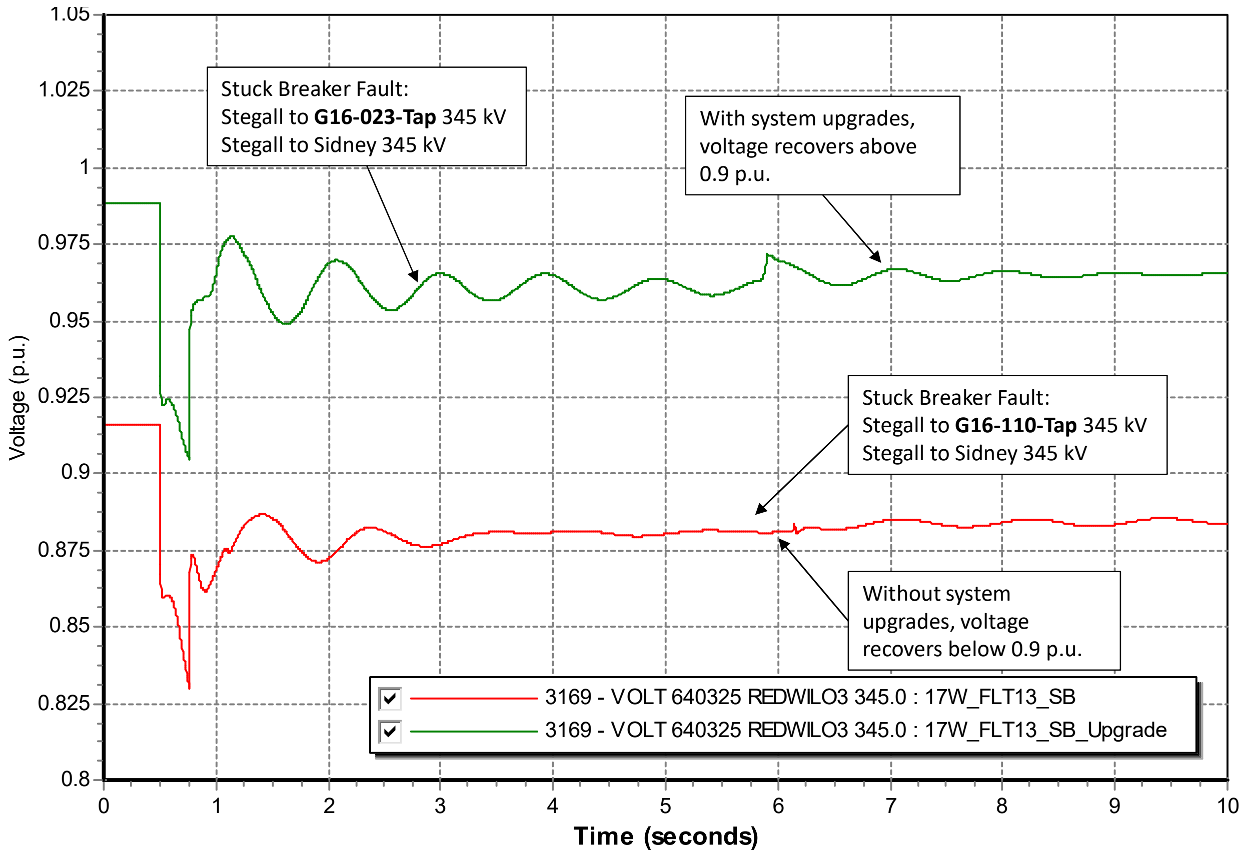


Figure 3-1: Representative plot of Red Willow 345 kV bus voltage for 17W conditions with and without system upgrades for FLT13-SB.

FLT35-PO, a prior outage of Sweetwater to Axtell 345 kV circuit #1 followed by a three-phase fault resulting in the loss of the Sweetwater to Gentleman 345 kV circuit #1, was observed to have steady-state divergence when simulated without any upgrades. After implementing the upgrades identified in this section, the system recovered within SPP criteria. Refer to Figure 3-2 for a representative voltage plot of the Gentleman and Sweetwater 345 kV area voltages for the 17W case with the above system upgrades.

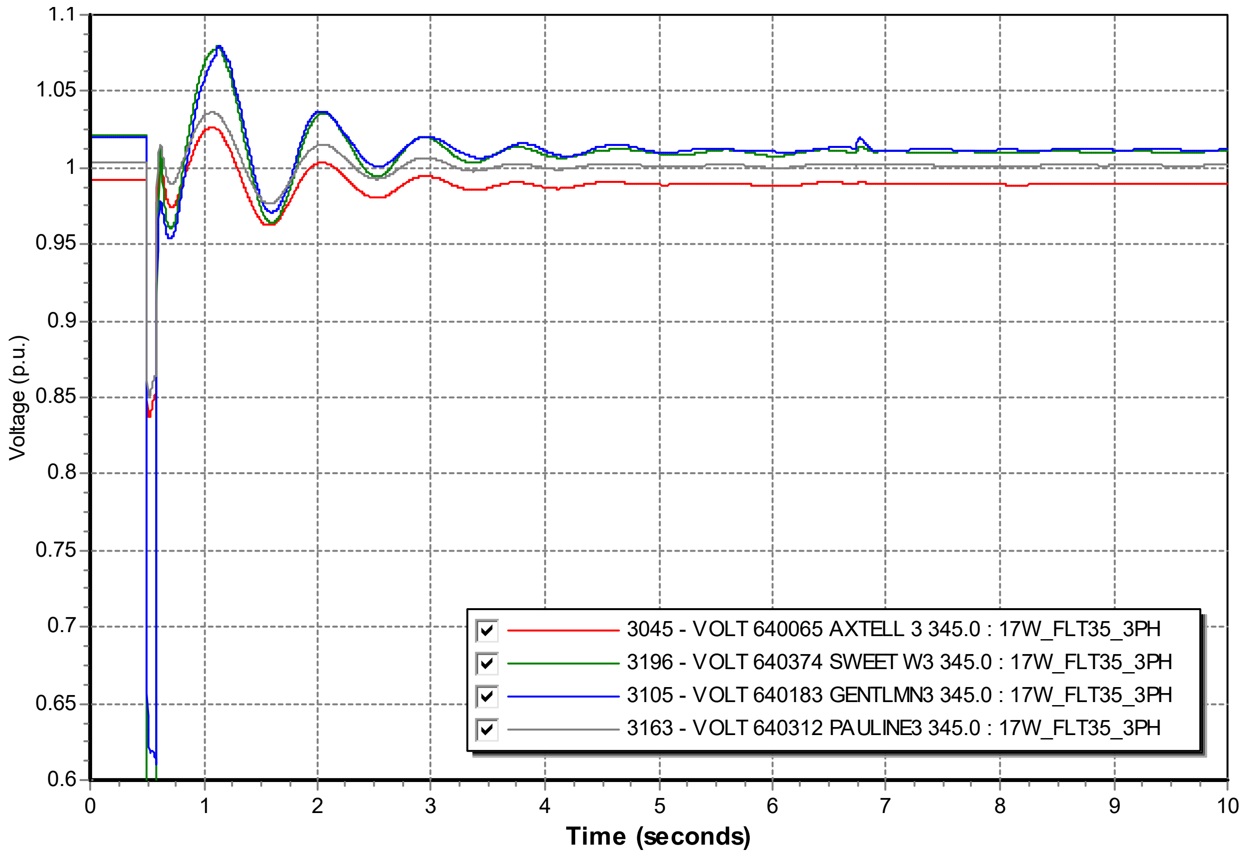


Figure 3-2: Representative plot of Gentleman 345 kV area bus voltages for 17W conditions with system upgrades for FLT35-PO.

FLT60-SB, a single phase fault with a stuck breaker (13.5 cycle clearing time) resulting in the loss of Gentleman to Sweetwater 345 kV and Gentleman to Red Willow 345 kV, was observed to have voltage collapse in the SPP system near the Gentleman and Red Willow areas which required additional mitigation. The additional upgrade that was implemented to mitigate the voltage collapse was a SVC with +100 Mvar injection at Keystone 345 kV. Refer to Figure 3-3 for a representative voltage plot of several area buses for the 17W case without system upgrades and Figure 3-4 which includes system upgrades for the same contingency. It can be observed that the upgrades in the study area and the addition of the SVC help the system recover within SPP Performance Criteria.

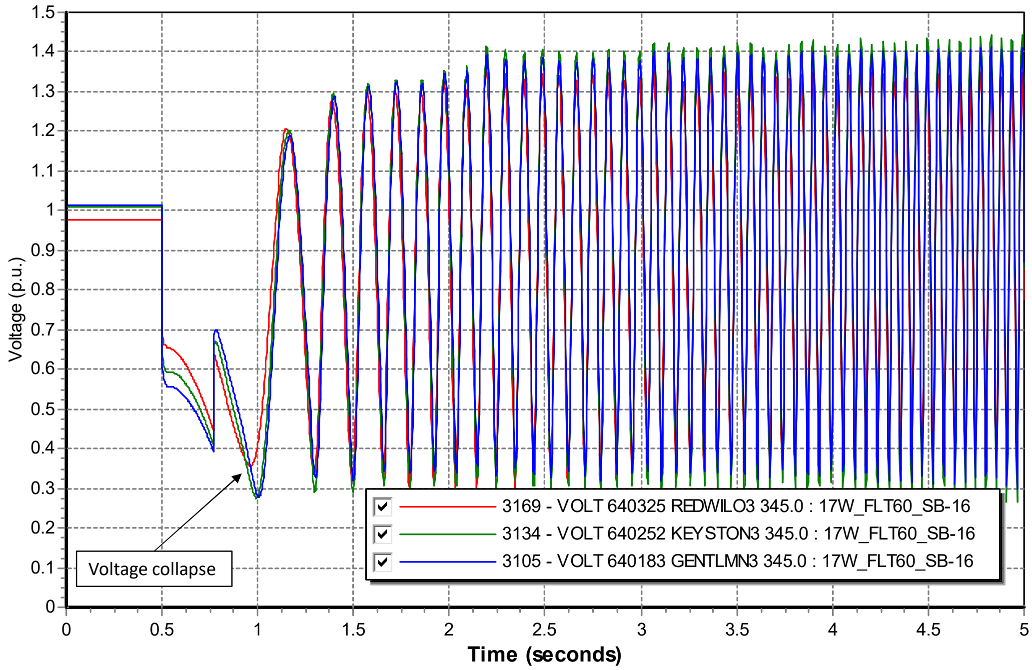


Figure 3-3: Representative plot of area voltages for 17W conditions without system upgrades for FLT60-SB.

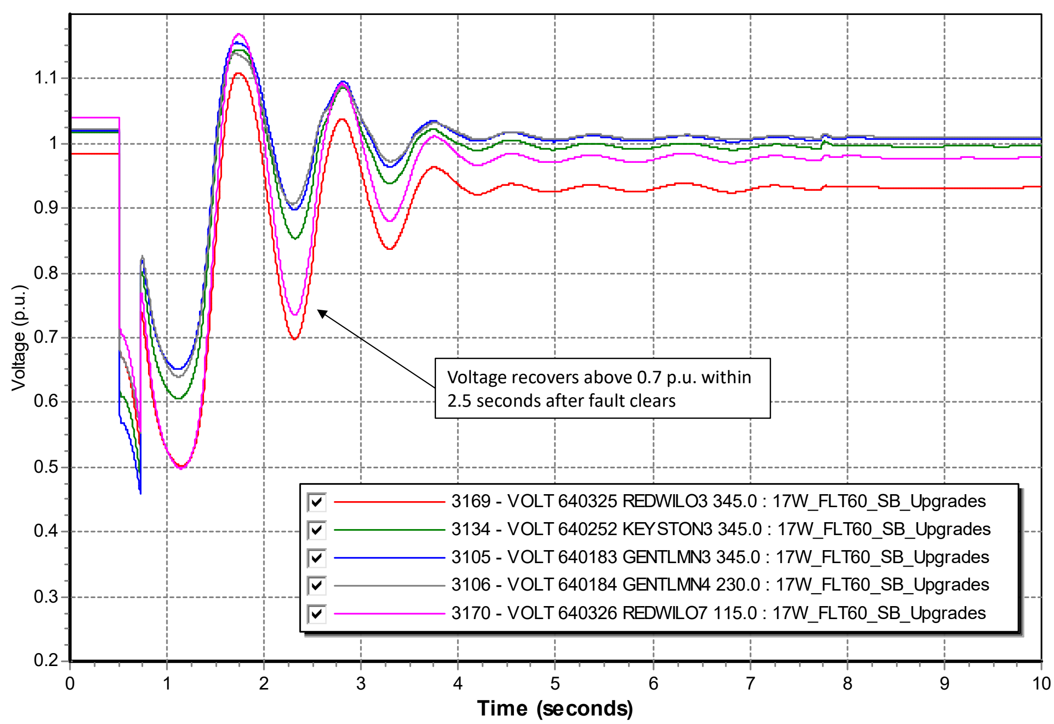


Figure 3-4: Representative plot of area voltages for 17W conditions with system upgrades for FLT60-SB.

After the upgrades and system adjustments listed in this section were implemented, the Stability Analysis was re-simulated to determine system stability. With the required upgrades and system adjustments, the Stability Analysis determined that there was no wind turbine tripping or system instability as a result of interconnected all study projects at 100% output.

3.3 High GGS Sensitivity Stability Analysis Results

The High GGS Scenario Stability Analysis was performed on the three seasons as identified previously: 17W, 18S, and 26S. The upgrades identified in the previous section were implemented in to the three seasons before any simulations were completed. With the upgrades implemented in the three seasons, it was determined that there was no additional mitigation required for the dispatch sensitivity. That is, there was no system/voltage instability, generation tripping offline, or poor voltage recovery when all generation interconnection requests were at 100% output.

Refer to Table 3-3 for a summary of the Stability Analysis results for the contingencies listed in Table 2-3 with the upgrades identified in the previous section identified. Table 3-3 is a summary of the stability results for the 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak High GGS conditions and states whether the system remained stable or generation tripped offline, if acceptable voltage recovery was observed after the fault was cleared, and if the voltage recovered to above 0.9 p.u. and below 1.1 p.u. post fault steady-state conditions. Voltage recovery criteria includes ensuring that the transient voltage recovery is between 0.7 p.u. within 2.5 seconds after the fault is cleared and 1.2 p.u. at any point after the fault is cleared and ending in a steady-state voltage (for N-1 contingencies) at the pre-contingent level or at least above 0.9 p.u. and below 1.1. p.u.

Refer to Appendix E, Appendix F, and Appendix G for a complete set of plots for all contingencies for 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak High GGS conditions, respectively.

Table 3-3
High GGS Sensitivity Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
1	FLT01-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
2	FLT02-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
3	FLT03-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
4	FLT04-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
5	FLT05-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
6	FLT06-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
7	FLT07-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
8	FLT08-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
9	FLT09-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
10	FLT10-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
11	FLT11-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
12	FLT12-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
13	FLT13-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
14	FLT14-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
15	FLT15-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
16	FLT16-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
17	FLT17-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
18	FLT18-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
19	FLT19-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
20	FLT20-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
21	FLT21-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
22	FLT22-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
23	FLT23-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
24	FLT24-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
25	FLT25-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
27	FLT27-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
28	FLT28-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
29	FLT29-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
30	FLT30-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
31	FLT31-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
32	FLT32-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
33	FLT33-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
34	FLT34-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
35	FLT35-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
36	FLT36-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
37	FLT37-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
38	FLT38-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
39	FLT39-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
40	FLT40-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
41	FLT41-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
42	FLT42-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
43	FLT43-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
44	FLT44-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
45	FLT45-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
46	FLT46-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
47	FLT47-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
48	FLT48-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
49	FLT49-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
50	FLT50-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
51	FLT51-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
52	FLT52-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
53	FLT53-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
54	FLT54-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
55	FLT55-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
56	FLT56-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
58	FLT58-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
60	FLT60-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable

*Previously identified upgrades implemented in all cases

Table 3-3 (continued)
High GGS Sensitivity Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
63	FLT63-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
64	FLT64-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
65	FLT65-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
66a	FLT66a-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
67	FLT67-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
68	FLT68-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
69	FLT69-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
70	FLT70-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
71	FLT71-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
72	FLT72-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
73	FLT73-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
74	FLT74-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
75	FLT75-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
76	FLT76-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
77	FLT77-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
78	FLT78-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
79	FLT79-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
80	FLT80-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
81	FLT81-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
83	FLT83-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
85	FLT85-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
87	FLT87-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
88	FLT88-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
89	FLT89-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
90	FLT90-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
91	FLT91-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
92	FLT92-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
93	FLT93-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
94	FLT94-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
95	FLT95-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
96	FLT96-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
97	FLT97-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
98	FLT98-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
99	FLT99-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
100	FLT100-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
101	FLT101-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
102	FLT102-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
103	FLT103-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
104	FLT104-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
105	FLT105-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
106	FLT106-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
107	FLT107-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
108	FLT108-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
109	FLT109-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
110	FLT110-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
111	FLT111-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
112	FLT112-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
113	FLT113-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
114	FLT114-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
115	FLT115-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
116	FLT116-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
117	FLT117-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
118	FLT118-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
119	FLT119-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
120	FLT120-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
121	FLT121-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
122	FLT122-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable

*Previously identified upgrades implemented in all cases

Table 3-3 (continued)
High GGS Sensitivity Stability Analysis Summary of Results for 2017 Winter, 2018 Summer, and 2026 Summer Peak Conditions

Cont. No.	Cont. Name	2017 Winter Peak				2018 Summer Peak				2026 Summer Peak			
		Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability	Voltage Recovery		Post Fault Steady-State Voltage	System Stability
		Less than 0.70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.			Less than .70 p.u.	Greater than 1.20 p.u.		
123	FLT123-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
124	FLT124-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
125	FLT125-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
126	FLT126-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
127	FLT127-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
128	FLT128-SB	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
129	FLT129-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
130	FLT130-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
131**	FLT131-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
132**	FLT132-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
133**	FLT133-3PH	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
134**	FLT134-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
135**	FLT135-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
136**	FLT136-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
137**	FLT137-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
138**	FLT138-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable
139**	FLT139-PO	-	-	Compliant	Stable	-	-	Compliant	Stable	-	-	Compliant	Stable

*Previously identified upgrades implemented in all cases
**Added post mitigation

FLT60-SB, a single phase fault with a stuck breaker (13.5 cycle clearing time) resulting in the loss of Gentleman to Sweetwater 345 kV and Gentleman to Red Willow 345 kV, was observed to recover within SPP Performance Criteria with the mitigation identified in Section 3.2 implemented in the three power flow databases. Refer to Figure 3-5 for a representative voltage plot of several area buses for the 17W High GGS Sensitivity case with the upgrades implemented. It can be observed that the upgrades in the study area and the addition of the SVC help the system recover within SPP Performance Criteria.

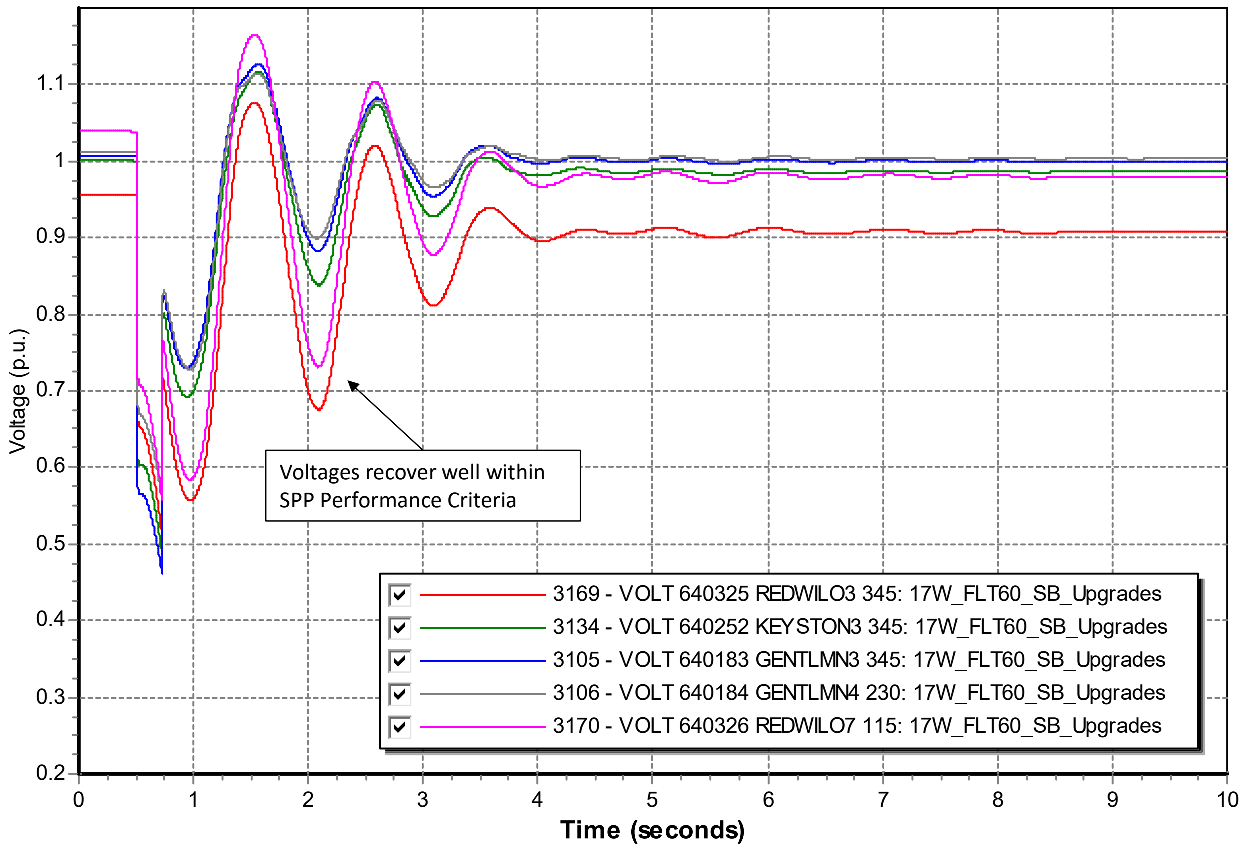


Figure 3-5: Representative plot of area voltages for 17W high GGS sensitivity conditions with system upgrades for FLT60-SB.

SECTION 4: SHORT CIRCUIT ANALYSIS

The objective of this task is to quantify the three-phase to ground fault currents for the 2018 Summer Peak and 2026 Summer Peak seasons for each interconnecting generator.

4.1 Approach

The Short Circuit Analysis will assess breaker adequacy and fault duties for the generator interconnection bus and five buses away from the point of interconnection. MEPPI will assume no outages to find maximum short-circuit currents that flow through the breaker. The Automatic Sequencing Fault Calculation (ASCC) function in PSS/E was utilized to perform this task. FLAT conditions were applied to pre-fault conditions and the following adjustments were utilized:

- All synchronous and asynchronous machine P and Q output was set to zero
- All transformer tap ratios were set to 1.0 p.u. and all phase shift angles were set to zero
- All generator reactance's were fixed to the subtransient reactance
- All line charging was set to zero
- All shunts were set to zero
- All loads were set to zero
- All pre-fault bus voltages were set to 1.0 p.u. and a phase shift angle of zero

Note upgrades found to be necessary for the Stability Analysis were included in the Short Circuit Analysis.

4.2 Short Circuit Results: 2018 Summer Peak

The maximum fault current for each bus is provided for the 2018 Summer Peak conditions. The following tables show the short circuit results for the study generators for the 2018 Summer Peak condition:

- Table 4-1: Short-circuit Analysis for GEN-2016-034
- Table 4-2: Short-circuit Analysis for GEN-2016-074
- Table 4-3: Short-circuit Analysis for GEN-2016-096
- Table 4-4: Short-circuit Analysis for GEN-2016-106
- Table 4-5: Short-circuit Analysis for GEN-2016-110
- Table 4-6: Short-circuit Analysis for GEN-2016-147
- Table 4-7: Short-circuit Analysis for GEN-2016-159
- Table 4-8: Short-circuit Analysis for GEN-2016-165

Table 4-1
18S Short-Circuit Analysis for Study Project GEN-2016-034

Study Generator GEN-2016-034											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
530555	COLBY 3	115	6.15	587874	G16-110-TAP	345	6.82	640366	STOCKVL8	69	3.27
530558	KNOLL 6	230	11.61	588344	G16-165-TAP	345	9.69	640374	SWEET W3	345	10.87
530559	PH RUN 3	115	4.55	640065	AXTELL 3	345	9.42	640381	THEDFRD7	115	9.22
530582	S HAYS6	230	8.96	640066	AXTELL 7	115	14.10	640396	VICTRYH4	230	3.85
530583	POSTROCK7	345	9.33	640082	BEVERLY7	115	4.76	640397	VICTRYH7	115	6.10
530584	POSTROCK6	230	11.83	640083	BEVERLY8	69	4.30	640500	THEDFORD3	345	5.86
530702	BUCKEYE_230	230	8.32	640091	BRULE 7	115	5.42	640510	HOLT.CO3	345	8.76
531351	BREWSTR3	115	3.12	640093	C.CREEK4	230	7.03	640530	STEGALL7	115	8.54
531429	MINGO 3	115	12.98	640096	CALAMS 7	115	3.40	652573	STEGALL4	230	5.74
531449	HOLCOMB7	345	10.39	640100	CAMBRIG7	115	4.09	652584	SIDNEYW4	230	3.30
531451	MINGO 7	345	6.75	640167	ENDERS 7	115	3.73	652873	STEGALL-LNX3	230	5.74
531464	SETAB 3	115	10.63	640183	GENTLMN3	345	18.27	653571	GR ISLD3	345	12.29
531465	SETAB 7	345	7.25	640184	GENTLMN4	230	20.00	653572	SIDNEY 7	115	4.20
531469	SPERVIL7	345	13.95	640200	GR ISLD4	230	16.47	653871	GR ISLD-LNX3	345	12.29
560075	G16-023-TAP	345	7.42	640252	KEYSTON3	345	12.87	659131	LARAMIE3	345	7.42
560082	G16-050-TAP	345	7.09	640253	KEYSTON7	115	15.59	659133	SIDNEY 3	345	6.74
560090	G16-034-TAP	345	6.35	640255	KINGSLY7	115	9.33	659134	SIDNEY 4	230	6.52
562334	G13-010-TAP	345	8.38	640269	MCCOOK 7	115	8.15	659135	STEGALL3	345	5.85
583600	GEN-2013-010	345	8.38	640270	MCCOOK 8	69	4.35	659170	STEGALDC	230	5.76
584650	GEN-2015-023	345	7.91	640271	MCCOOL 3	345	10.27	659206	STGXFMR4	230	6.07
585020	GEN-2015-064	115	10.13	640286	N.PLATT4	230	13.29	659210	SIDXFMR4	230	7.06
585030	GEN-2015-065	345	6.12	640287	N.PLATT7	115	18.48	659425	SIDNEY1-LNX3	345	6.74
587090	GEN-2016-023	345	5.96	640302	OGALALA4	230	7.85	659426	SIDNEY2-LNX3	345	6.74
587190	GEN-2016-029	345	5.96	640304	OGALALANPPD7	115	15.04	659800	GRANTNB7	115	6.29
587220	GEN-2016-034	345	6.35	640312	PAULINE3	345	8.03	659801	OGALALA7	115	15.04
587350	GEN-2016-050	345	6.36	640325	REDWILO3	345	9.15	659809	ROSCOE 7	115	6.37
587450	GEN-2016-067	345	6.12	640326	REDWILO7	115	11.65	659810	SPCREEK7	115	4.36
587680	GEN-2016-074	345	6.44	640338	SCOTBLF7	115	5.98	659821	GERINGT7	115	5.42
587850	GEN-2016-106	345	8.82	640359	STAPLETON 7	115	4.14	659824	MCONGHY7	115	5.40
587870	GEN-2016-110	345	6.75	640365	STOCKVL7	115	4.51				

Table 4-2
18S Short-Circuit Analysis for Study Project GEN-2016-074

Study Generator GEN-2016-074											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
300039	7FAIRPT	345	12.25	640126	E.COL. 4	230	9.55	640325	REDWILO3	345	9.15
530555	COLBY 3	115	6.15	640131	COLMB.W4	230	9.66	640326	REDWILO7	115	11.65
530558	KNOLL 6	230	11.61	640133	COLMBUS4	230	11.23	640330	RIVERDL4	230	6.99
530559	PH RUN 3	115	4.55	640134	KELLY 7	115	17.65	640331	RIVERDL7	115	11.82
530582	S HAYS6	230	8.96	640139	COOPER 3	345	26.66	640332	RIVERDL8	69	6.25
530583	POSTROCK7	345	9.33	640140	COOPER 5	161	17.47	640343	SHELCRK4	230	10.73
530584	POSTROCK6	230	11.83	640153	CRETE__7	115	8.05	640345	SILVRCK7	115	4.55
530702	BUCKEYE_230	230	8.32	640159	DONIPHN7	115	11.01	640353	ST.LIB 7	115	9.50
531351	BREWSTR3	115	3.12	640161	ELMCRK_7	115	5.89	640355	ST.PAUL7	115	3.80
531429	MINGO 3	115	12.98	640167	ENDERS 7	115	3.73	640359	STAPLETON 7	115	4.14
531449	HOLCOMB7	345	10.39	640174	FRIEND 7	115	6.31	640360	STAPLETON 8	69	3.17
531451	MINGO 7	345	6.75	640178	GENEVA 7	115	9.71	640365	STOCKVL7	115	4.51
531464	SETAB 3	115	10.63	640179	GENEVA 8	69	4.13	640366	STOCKVL8	69	3.27
531465	SETAB 7	345	7.25	640183	GENTLMN3	345	18.27	640372	SUTTON 7	115	6.27
531469	SPERVIL7	345	13.95	640184	GENTLMN4	230	20.00	640374	SWEET W3	345	10.87
541199	ST JOE 3	345	18.90	640194	GOSPER 7	115	4.29	640381	THEDFRD7	115	9.22
560062	G15-088-TAP	345	11.00	640200	GR ISLD4	230	16.47	640383	TOWER 7	115	8.72
560075	G16-023-TAP	345	7.42	640201	GR ISLD7	115	22.71	640407	WESTMIN7	115	7.84
560082	G16-050-TAP	345	7.09	640206	GUIDE R7	115	4.16	640411	YORK 7	115	7.47
560090	G16-034-TAP	345	6.35	640214	HASTING4	230	7.25	640413	YORK SW7	115	7.98
560134	ROSEMONT	115	6.27	640215	HASTING7	115	19.04	640416	AURORA_8	69	3.89
560746	G13-002-TAP	115	26.39	640222	HILDRTH7	115	4.19	640447	YORK.SW T2 8	69	2.41
562334	G13-010-TAP	345	8.38	640223	HILDRTH8	69	3.20	640448	HOLDREGE 8	69	3.65
572051	GEN2008-123N	115	5.02	640224	HOLDREG7	115	6.02	640500	THEDFORD3	345	5.86
583600	GEN-2013-010	345	8.38	640238	JEFFREY7	115	5.95	640510	HOLT.CO3	345	8.76
584650	GEN-2015-023	345	7.91	640242	JOHN.2 7	115	12.50	640540	MEADOWGROVE4	230	5.57
585020	GEN-2015-064	115	10.13	640244	JOHN.LK7	115	8.62	640591	MONOLITH7	115	26.69
585030	GEN-2015-065	345	6.12	640248	KEAR.NE7	115	9.02	641085	E7THST 7	115	17.96
585240	GEN-2015-088	345	10.58	640250	KEARNEY7	115	11.56	641087	EGYCNTR7	115	17.83
587090	GEN-2016-023	345	5.96	640252	KEYSTON3	345	12.87	641088	HASTCTY7	115	19.04
587190	GEN-2016-029	345	5.96	640253	KEYSTON7	115	15.59	642066	SUB-H G	115	15.16
587220	GEN-2016-034	345	6.35	640255	KINGSLY7	115	9.33	642070	SUB-C 7	115	12.09
587350	GEN-2016-050	345	6.36	640256	LXNGTN 7	115	6.94	642071	SUB-D 7	115	16.97
587450	GEN-2016-067	345	6.12	640259	LOUPCTY7	115	4.18	642072	SUB-E 7	115	16.48
587680	GEN-2016-074	345	6.44	640261	LOWELL 7	115	7.98	642073	SUB-F 7	115	12.31
587780	GEN-2016-096	345	9.20	640262	LOWELL 8	69	4.01	642076	SUB-J 7	115	15.98
587784	G16-096-TAP	345	9.22	640265	MALONEY7	115	11.22	645458	S3458 3	345	28.51
587850	GEN-2016-106	345	8.82	640267	MAXWELS7	115	6.63	650114	NW68HOLDRG3	345	16.37
587874	G16-110-TAP	345	6.82	640269	MCCOOK 7	115	8.15	650185	WAGENER 3	345	19.52
588344	G16-165-TAP	345	9.69	640270	MCCOOK 8	69	4.35	650189	103&ROKEBY3	345	19.59
635017	ATCHSN 3	345	16.94	640271	MCCOOL 3	345	10.27	650214	NW68HOLDRG7	115	23.87
640050	AINSWND7	115	3.70	640272	MCCOOL 7	115	13.93	650246	SW7&BENNET7	115	20.38
640063	AURORA_7	115	6.93	640273	MCCOOL 8	69	5.45	652584	SIDNEYW4	230	3.30
640065	AXTELL 3	345	9.42	640275	MINDEN 7	115	7.08	652832	GRPRAR1-LNX3	345	9.98
640066	AXTELL 7	115	14.10	640277	MOORE 3	345	21.16	653571	GR ISLD3	345	12.29
640082	BEVERLY7	115	4.76	640278	SHELDON7	115	31.63	653572	SIDNEY 7	115	4.20
640083	BEVERLY8	69	4.30	640286	N.PLATT4	230	13.29	653871	GR ISLD-LNX3	345	12.29
640088	BPS SUB7	115	15.63	640287	N.PLATT7	115	18.48	659131	LARAMIE3	345	7.42
640093	C.CREEK4	230	7.03	640288	N.PLATT8	69	4.91	659133	SIDNEY 3	345	6.74
640094	C.CREEK7	115	7.15	640302	OGALALA4	230	7.85	659134	SIDNEY 4	230	6.52
640096	CALAMS 7	115	3.40	640304	OGALALANPPD7	115	15.04	659135	STEGALL3	345	5.85
640100	CAMBRIG7	115	4.09	640310	ORLEANS7	115	2.35	659210	SIDXFMR4	230	7.06
640102	CANADAY4	230	6.19	640311	ORLEANS8	69	2.35	659425	SIDNEY1-LNX3	345	6.74
640103	CANADAY7	115	13.70	640312	PAULINE3	345	8.03	659426	SIDNEY2-LNX3	345	6.74
640105	CARLJCT7	115	5.32	640313	PAULINE7	115	16.13	659800	GRANTNB7	115	6.29
640107	CENCITY7	115	5.04	640314	PAULINE8	69	4.71	659801	OGALALA7	115	15.04
640111	CLATONA7	115	10.14	640321	PROSSER7	115	6.64				
640125	COLMB.E3	345	10.19	640323	RAVENNA7	115	5.83				

Table 4-3
18S Short-Circuit Analysis for Study Project GEN-2016-096

Study Generator GEN-2016-096											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
84760	J476 POI	345	16.85	640140	COOPER 5	161	17.47	640342	SHELCRK3	345	10.53
300039	7FAIRPT	345	12.25	640153	CRETE__7	115	8.05	640368	SUPEROR7	115	3.28
300076	5FAIRPT	161	16.94	640161	ELMCRK_7	115	5.89	640372	SUTTON 7	115	6.27
530583	POSTROCK7	345	9.33	640171	FIRTH 7	115	6.10	640374	SWEET W3	345	10.87
530584	POSTROCK6	230	11.83	640174	FRIEND 7	115	6.31	640383	TOWER 7	115	8.72
541199	ST JOE 3	345	18.90	640178	GENEVA 7	115	9.71	640413	YORK SW7	115	7.98
541253	ST JOE 5	161	19.70	640183	GENTLMN3	345	18.27	640446	COOPER 8	69	4.56
541400	EASTOWN7	345	17.26	640184	GENTLMN4	230	20.00	640448	HOLDREGE 8	69	3.65
541510	HOLT 7	345	9.67	640200	GR ISLD4	230	16.47	640500	THEDFORD3	345	5.86
542980	NASHUA 7	345	21.03	640206	GUIDE R7	115	4.16	640591	MONOLITH7	115	26.69
560062	G15-088-TAP	345	11.00	640207	GUIDE R8	69	2.14	641085	E7THST 7	115	17.96
560082	G16-050-TAP	345	7.09	640214	HASTING4	230	7.25	641087	EGYCNTR7	115	17.83
560134	ROSEMONT	115	6.27	640215	HASTING7	115	19.04	641088	HASTCTY7	115	19.04
560746	G13-002-TAP	115	26.39	640222	HILDRTH7	115	4.19	641090	S. 281 7	115	11.04
562334	G13-010-TAP	345	8.38	640223	HILDRTH8	69	3.20	645454	S3454 3	345	23.77
572051	GEN2008-123N	115	5.02	640224	HOLDREG7	115	6.02	645456	S3456 3	345	30.29
583520	GEN-2013-002	115	26.39	640242	JOHN.2 7	115	12.50	645458	S3458 3	345	28.51
583700	GEN-2013-019	115	20.77	640248	KEAR.NE7	115	9.02	645740	S3740 3	345	17.23
585240	GEN-2015-088	345	10.58	640250	KEARNEY7	115	11.56	646280	S1280 5	161	10.07
587350	GEN-2016-050	345	6.36	640252	KEYSTON3	345	12.87	650114	NW68HOLDRG3	345	16.37
587680	GEN-2016-074	345	6.44	640261	LOWELL 7	115	7.98	650185	WAGENER 3	345	19.52
587780	GEN-2016-096	345	9.20	640271	MCCOOL 3	345	10.27	650189	103&ROKEBY3	345	19.59
587784	G16-096-TAP	345	9.22	640272	MCCOOL 7	115	13.93	650210	NW70FAIRFD7	115	20.01
587850	GEN-2016-106	345	8.82	640273	MCCOOL 8	69	5.45	650214	NW68HOLDRG7	115	23.87
635017	ATCHSN 3	345	16.94	640275	MINDEN 7	115	7.08	650216	SW27&F 7	115	20.58
640065	AXTELL 3	345	9.42	640277	MOORE 3	345	21.16	650242	FOLSM&PHIL7	115	24.66
640066	AXTELL 7	115	14.10	640278	SHELDON7	115	31.63	650246	SW7&BENNET7	115	20.38
640076	BEATRCE7	115	12.83	640310	ORLEANS7	115	2.35	650250	40&ROKEBY 7	115	19.24
640088	BPS SUB7	115	15.63	640312	PAULINE3	345	8.03	650285	WAGENER 7	115	29.90
640111	CLATONA7	115	10.14	640313	PAULINE7	115	16.13	650290	ROKEBY 7	115	22.71
640125	COLMB.E3	345	10.19	640314	PAULINE8	69	4.71	653571	GR ISLD3	345	12.29
640127	COLMB.E7	115	21.37	640316	PAWNEEL7	115	11.09	653871	GR ISLD-LNX3	345	12.29
640139	COOPER 3	345	26.66	640325	REDWILO3	345	9.15				

Table 4-4
18S Short-Circuit Analysis for Study Project GEN-2016-106

Study Generator GEN-2016-106

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
523853	FINNEY 7	345	10.30	588344	G16-165-TAP	345	9.69	640287	N.PLATT7	115	18.48
530553	S HAYS 3	115	8.93	640050	AINSWND7	115	3.70	640288	N.PLATT8	69	4.91
530554	ATWOOD 3	115	3.02	640051	AINSWRT7	115	3.40	640302	OGALALA4	230	7.85
530555	COLBY 3	115	6.15	640063	AURORA_7	115	6.93	640304	OGALALANPPD7	115	15.04
530558	KNOLL 6	230	11.61	640065	AXTELL 3	345	9.42	640310	ORLEANS7	115	2.35
530559	PH RUN 3	115	4.55	640066	AXTELL 7	115	14.10	640312	PAULINE3	345	8.03
530561	KNOLL 3	115	11.83	640082	BEVERLY7	115	4.76	640313	PAULINE7	115	16.13
530582	S HAYS6	230	8.96	640083	BEVERLY8	69	4.30	640314	PAULINE8	69	4.71
530583	POSTROCK7	345	9.33	640089	BROKENB7	115	5.50	640325	REDWILO3	345	9.15
530584	POSTROCK6	230	11.83	640091	BRULE 7	115	5.42	640326	REDWILO7	115	11.65
530592	SMOKYHL6	230	7.01	640093	C.CREEK4	230	7.03	640330	RIVERDL4	230	6.99
530610	SHAYS_230	230	3.43	640094	C.CREEK7	115	7.15	640331	RIVERDL7	115	11.82
530644	COLBY 2	69	3.97	640096	CALAMS 7	115	3.40	640353	ST.LIB 7	115	9.50
530682	SEGNTP 3	115	4.31	640098	CALAWAY7	115	3.85	640359	STAPLETON 7	115	4.14
530683	SEGUIN 3	115	4.10	640100	CAMBRIG7	115	4.09	640360	STAPLETON 8	69	3.17
530702	BUCKEYE_230	230	8.32	640101	CAMBRIG8	69	2.20	640365	STOCKVL7	115	4.51
531351	BREWSTR3	115	3.12	640102	CANADAY4	230	6.19	640366	STOCKVL8	69	3.27
531353	GOODLND3	115	2.67	640103	CANADAY7	115	13.70	640370	SUTHLND7	115	5.42
531412	GRINNEL3	115	3.72	640107	CENCITY7	115	5.04	640374	SWEET W3	345	10.87
531416	CTYSERT3	115	9.99	640131	COLMB.W4	230	9.66	640381	THEDFRD7	115	9.22
531429	MINGO 3	115	12.98	640133	COLMBUS4	230	11.23	640383	TOWER 7	115	8.72
531433	SCOTCTY3	115	8.97	640139	COOPER 3	345	26.66	640413	YORK SW7	115	7.98
531448	HOLCOMB3	115	21.59	640161	ELMCRK_7	115	5.89	640448	HOLDREGE 8	69	3.65
531449	HOLCOMB7	345	10.39	640167	ENDERS 7	115	3.73	640500	THEDFORD3	345	5.86
531451	MINGO 7	345	6.75	640168	ENDERS 8	69	3.02	640510	HOLT.CO3	345	8.76
531464	SETAB 3	115	10.63	640178	GENEVA 7	115	9.71	640530	STEGALL7	115	8.54
531465	SETAB 7	345	7.25	640183	GENTLMN3	345	18.27	641088	HASTCTY7	115	19.04
531469	SPERVIL7	345	13.95	640184	GENTLMN4	230	20.00	641244	ATHEY 7	115	3.04
531501	BUCKNER7	345	9.44	640194	GOSPER 7	115	4.29	642071	SUB-D 7	115	16.97
539679	GRTBEND6	230	8.26	640196	GOTHNBG7	115	4.28	642072	SUB-E 7	115	16.48
539695	SPEARVL6	230	12.70	640200	GR ISLD4	230	16.47	650114	NW68HOLDRG3	345	16.37
539759	SPRVL 3	115	11.63	640201	GR ISLD7	115	22.71	650189	103&ROKEBY3	345	19.59
539803	IRONWOOD7	345	13.33	640214	HASTING4	230	7.25	652532	GR PRAIRIE 3	345	9.98
560002	IRONWOOD2 7	345	13.50	640215	HASTING7	115	19.04	652584	SIDNEYW4	230	3.30
560062	G15-088-TAP	345	11.00	640222	HILDRTH7	115	4.19	652585	NB WEST4	230	28.99
560075	G16-023-TAP	345	7.42	640224	HOLDREG7	115	6.02	652832	GRPRAR1-LNX3	345	9.98
560082	G16-050-TAP	345	7.09	640238	JEFFREY7	115	5.95	653571	GR ISLD3	345	12.29
560090	G16-034-TAP	345	6.35	640240	JOHN.1 7	115	8.20	653572	SIDNEY 7	115	4.20
560134	ROSEMONT	115	6.27	640242	JOHN.2 7	115	12.50	653871	GR ISLD-LNX3	345	12.29
562334	G13-010-TAP	345	8.38	640248	KEAR.NE7	115	9.02	659131	LARAMIE3	345	7.42
583600	GEN-2013-010	345	8.38	640250	KEARNEY7	115	11.56	659133	SIDNEY 3	345	6.74
584650	GEN-2015-023	345	7.91	640252	KEYSTON3	345	12.87	659134	SIDNEY 4	230	6.52
585020	GEN-2015-064	115	10.13	640253	KEYSTON7	115	15.59	659135	STEGALL3	345	5.85
585030	GEN-2015-065	345	6.12	640255	KINGSLY7	115	9.33	659170	STEGALDC	230	5.76
587090	GEN-2016-023	345	5.96	640261	LOWELL 7	115	7.98	659206	STGXFMR4	230	6.07
587190	GEN-2016-029	345	5.96	640265	MALONEY7	115	11.22	659210	SIDXFMR4	230	7.06
587220	GEN-2016-034	345	6.35	640267	MAXWELS7	115	6.63	659425	SIDNEY1-LNX3	345	6.74
587350	GEN-2016-050	345	6.36	640269	MCCOOK 7	115	8.15	659426	SIDNEY2-LNX3	345	6.74
587450	GEN-2016-067	345	6.12	640270	MCCOOK 8	69	4.35	659800	GRANTNB7	115	6.29
587680	GEN-2016-074	345	6.44	640271	MCCOOL 3	345	10.27	659801	OGALALA7	115	15.04
587780	GEN-2016-096	345	9.20	640272	MCCOOL 7	115	13.93	659809	ROSCOE 7	115	6.37
587784	G16-096-TAP	345	9.22	640273	MCCOOL 8	69	5.45	659810	SPCREEK7	115	4.36
587850	GEN-2016-106	345	8.82	640275	MINDEN 7	115	7.08	659817	COLTON 7	115	3.68
587870	GEN-2016-110	345	6.75	640277	MOORE 3	345	21.16	659824	MCONGHY7	115	5.40
587874	G16-110-TAP	345	6.82	640278	SHELDON7	115	31.63				
588220	GEN-2016-147	115	4.10	640286	N.PLATT4	230	13.29				

Table 4-5
18S Short-Circuit Analysis for Study Project GEN-2016-110

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
Study Generator GEN-2016-110											
530583	POSTROCK7	345	9.33	640252	KEYSTON3	345	12.87	652573	STEGALL4	230	5.74
531451	MINGO 7	345	6.75	640253	KEYSTON7	115	15.59	652873	STEGALL-LNX3	230	5.74
560075	G16-023-TAP	345	7.42	640255	KINGSLY7	115	9.33	659131	LARAMIE3	345	7.42
560090	G16-034-TAP	345	6.35	640304	OGALALANPPD7	115	15.04	659133	SIDNEY 3	345	6.74
587090	GEN-2016-023	345	5.96	640325	REDWILO3	345	9.15	659134	SIDNEY 4	230	6.52
587190	GEN-2016-029	345	5.96	640326	REDWILO7	115	11.65	659135	STEGALL3	345	5.85
587220	GEN-2016-034	345	6.35	640338	SCOTBLF7	115	5.98	659170	STEGALDC	230	5.76
587850	GEN-2016-106	345	8.82	640374	SWEET W3	345	10.87	659206	STGXFMR4	230	6.07
587870	GEN-2016-110	345	6.75	640396	VICTRYH4	230	3.85	659210	SIDXFMR4	230	7.06
587874	G16-110-TAP	345	6.82	640397	VICTRYH7	115	6.10	659425	SIDNEY1-LNX3	345	6.74
640183	GENTLMN3	345	18.27	640500	THEDFORD3	345	5.86	659426	SIDNEY2-LNX3	345	6.74
640184	GENTLMN4	230	20.00	640530	STEGALL7	115	8.54	659821	GERINGT7	115	5.42

Table 4-6
18S Short-Circuit Analysis for Study Project GEN-2016-147

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
Study Generator GEN-2016-147											
560075	G16-023-TAP	345	7.42	640287	N.PLATT7	115	18.48	659133	SIDNEY 3	345	6.74
560090	G16-034-TAP	345	6.35	640302	OGALALA4	230	7.85	659134	SIDNEY 4	230	6.52
587850	GEN-2016-106	345	8.82	640304	OGALALANPPD7	115	15.04	659135	STEGALL3	345	5.85
588220	GEN-2016-147	115	4.10	640325	REDWILO3	345	9.15	659170	STEGALDC	230	5.76
640068	B.SPRGS7	115	4.39	640374	SWEET W3	345	10.87	659206	STGXFMR4	230	6.07
640086	BLUECK 7	115	2.50	640396	VICTRYH4	230	3.85	659210	SIDXFMR4	230	7.06
640091	BRULE 7	115	5.42	640500	THEDFORD3	345	5.86	659320	STEGALLWECCG	230	26.26
640093	C.CREEK4	230	7.03	640530	STEGALL7	115	8.54	659425	SIDNEY1-LNX3	345	6.74
640167	ENDERS 7	115	3.73	652573	STEGALL4	230	5.74	659426	SIDNEY2-LNX3	345	6.74
640183	GENTLMN3	345	18.27	652584	SIDNEYW4	230	3.30	659800	GRANTNB7	115	6.29
640184	GENTLMN4	230	20.00	652585	NB WEST4	230	28.99	659801	OGALALA7	115	15.04
640246	JULSTAP7	115	3.69	652873	STEGALL-LNX3	230	5.74	659809	ROSCOE 7	115	6.37
640252	KEYSTON3	345	12.87	653300	CHAPPEL7	115	3.33	659810	SPCREEK7	115	4.36
640253	KEYSTON7	115	15.59	653302	JULESBG7	115	2.62	659817	COLTON 7	115	3.68
640255	KINGSLY7	115	9.33	653303	HIGHLINE	115	3.07	659819	INTERST7	115	2.28
640286	N.PLATT4	230	13.29	653572	SIDNEY 7	115	4.20	659824	MCONGHY7	115	5.40

Table 4-7
18S Short-Circuit Analysis for Study Project GEN-2016-159

Study Generator GEN-2016-159											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
15010	A345	345	11.29	640122	COL.DRY7	115	16.20	645458	S3458 3	345	28.51
55201	J412 POI	345	9.75	640124	COL.SE 7	115	16.42	645459	S3459 3	345	21.24
55368	J455 POI	345	13.01	640125	COLMB.E3	345	10.19	645740	S3740 3	345	17.23
65400	J506 POI	345	12.37	640126	E.COL. 4	230	9.55	646206	S1206 5	161	40.00
66201	J535 POI	345	8.87	640127	COLMB.E7	115	21.37	646209	S1209 5	161	35.87
66202	J535	345	8.81	640131	COLMB.W4	230	9.66	646226	S1226 5	161	21.61
560062	G15-088-TAP	345	11.00	640133	COLMBUS4	230	11.23	646231	S1231 5	161	36.14
560347	G10-051-TAP	230	7.18	640134	KELLY 7	115	17.65	646237	S1237 5	161	16.42
579444	G06-044N-HV1	115	5.70	640136	COLMBUS7	115	19.04	646249	S1249 5	161	21.06
579450	GEN-2016-075	345	8.16	640139	COOPER 3	345	26.66	646250	S1250 5	161	30.75
580011	G10-051&1127	230	6.37	640149	CREITON7	115	4.82	646251	S1251 5	161	28.44
583780	GEN-2013-032	115	12.23	640150	CREITON8	69	3.32	646252	S1252 5	161	18.09
584510	GEN-2015-007	345	8.66	640151	CRESTON7	115	6.03	646254	S1254 5	161	25.87
584910	GEN-2015-053	115	15.12	640157	DAVIDCY7	115	5.34	646255	S1255 5	161	39.66
585130	GEN-2015-076	115	3.84	640163	EMERSON7	115	5.41	646281	S1281 5	161	23.46
587150	GEN-2016-021	345	5.93	640164	EMERSONG	69	3.74	646297	S1297 5	161	17.37
587280	GEN-2016-043	345	12.23	640181	GENOA 7	115	4.97	646298	S1298 5	161	25.97
588340	GEN-2016-165	345	7.83	640200	GR ISLD4	230	16.47	646305	S1305 5	161	24.82
588344	G16-165-TAP	345	9.69	640212	HARTGTN7	115	5.48	646341	S1341 5	161	24.23
588380	GEN-2016-159	345	3.90	640213	HARTGTN8	69	3.57	647909	S909 8	69	25.02
588387	G16-159-2	345	3.47	640226	HOSKINS3	345	14.27	648506	PR BRZ 4	230	4.21
601006	SPLT RK3	345	14.51	640227	HOSKINS4	230	10.28	648513	GRPR1 3	345	8.83
601034	NOBLES 3	345	11.68	640228	HOSKINS7	115	18.92	648520	GRPR2 3	345	8.16
603016	SPLT RK7	115	36.57	640263	MADISON7	115	6.23	650114	NW68HOLDRG3	345	16.37
631138	LAKEFLD3	345	19.85	640271	MCCOOL 3	345	10.27	650185	WAGENER 3	345	19.52
635000	CBLUFFS3	345	29.20	640277	MOORE 3	345	21.16	650189	103&ROKEBY3	345	19.59
635200	RAUN 3	345	25.66	640278	SHELDON7	115	31.63	650210	NW70FAIRFD7	115	20.01
635201	RAUN 5	161	26.38	640293	NELIGH 7	115	10.76	650214	NW68HOLDRG7	115	23.87
635202	NEAL 4 5	161	18.35	640294	NELIGH 8	69	6.06	650216	SW27&F 7	115	20.58
635203	NEAL N 5	161	24.97	640296	NORFK.N7	115	13.75	650285	WAGENER 7	115	29.90
635204	NEAL 8	69	9.83	640298	NORFOLK7	115	12.84	650290	ROKEBY 7	115	22.71
635206	IDA CO 3	345	9.37	640300	OAKLAND7	115	7.41	652287	RASMUSN8	69	3.16
635220	INTCHG 5	161	14.55	640305	ONEILL 7	115	3.92	652506	FTTHOMP3	345	9.69
635221	KELLOGG5	161	16.87	640316	PAWNEEL7	115	11.09	652507	FTTHOMP4	230	20.42
635222	KELLOGG8	69	17.54	640318	PETRSBG7	115	6.50	652509	FTRANDL4	230	11.02
635223	PLYMOTH5	161	19.77	640336	SCHUYLR7	115	5.74	652510	FTRANDL7	115	12.98
635225	MORNSD 5	161	10.15	640342	SHELCRK3	345	10.53	652511	GAVINS 7	115	8.75
635226	LEEDS 5	161	15.56	640343	SHELCRK4	230	10.73	652516	LAKPLAT4	230	5.61
635227	SBRIDGE T8	69	8.62	640345	SILVRCK7	115	4.55	652526	UTICAJC4	230	7.85
635228	AIRPORT 5	161	16.68	640357	STANTON7	115	5.14	652532	GR PRAIRIE 3	345	9.98
635230	LIBERTY5	161	24.31	640363	STNTN.N7	115	7.06	652536	RASMUSN4	230	6.59
635235	SALIX 5	161	15.86	640377	TEKAMAH5	161	8.55	652537	WHITE 3	345	21.59
635236	SALIX 8	69	13.26	640378	TEKAMAH7	115	8.00	652561	DENISON5	161	5.23
635300	MONONA 5	161	5.32	640386	TWIN CH4	230	8.53	652563	SPENCER5	161	8.85
635301	MONONA 8	69	4.47	640387	TWIN CH7	115	10.61	652564	SIOUXCY3	345	14.92
635330	CRWFRD 5	161	4.78	640388	TWIN CH8	69	7.73	652565	SIOUXCY4	230	19.44
635368	OBRIEN 3	345	14.29	640400	W.POINT7	115	4.94	652566	SIOUXCY5	161	20.22
635400	HIGHLND 3	345	13.69	640402	WAHOO 7	115	4.68	652567	DENISON4	230	4.28
636010	LEHIGH 3	345	13.32	640424	S.SIOUXCITY7	115	7.29	652574	SIOUXCY8	69	17.60
640070	BANCRFT7	115	5.00	640425	S.SIOUXCITY8	69	4.48	652578	PAHOJA 4	230	7.25
640072	BATTLCR7	115	7.85	640444	PETERSBRG.N7	115	6.51	652583	DENISON8	69	10.95
640073	BATTLCR8	69	3.98	640510	HOLT.CO3	345	8.76	652807	FTTHOM2-LNX3	345	9.69
640078	BEEMER 7	115	4.38	640520	ANTELOPE 3	345	9.54	652832	GRPRAR1-LNX3	345	9.98
640080	BELDEN 7	115	6.67	640521	ANTELOPE 7	115	15.39	652833	GRPRAR2-LNX3	345	9.98
640081	BELDEN 8	69	3.84	640540	MEADOWGROVE4	230	5.57	652864	SIOUXCY-LNX3	345	14.92
640084	BLMFLD 7	115	5.90	645100	FC1A 5	161	26.33	659121	SPIRITM7	115	3.30
640085	BLMFLD 8	69	3.67	645451	S3451 3	345	19.14	659900	EAGLE 4	230	7.10
640113	CLRWATR7	115	5.28	645454	S3454 3	345	23.77	659901	EAGLE 8	69	13.58
640115	CO.LINE7	115	8.12	645455	S3455 3	345	27.54	660006	YKNTJCT7	115	8.26
640119	COL.COG7	115	19.12	645456	S3456 3	345	30.29				

Table 4-8
18S Short-Circuit Analysis for Study Project GEN-2016-165

Study Generator GEN-2016-165											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
15010	A345	345	11.29	640084	BLMFLD 7	115	5.90	640520	ANTELOPE 3	345	9.54
55201	J412 POI	345	9.75	640085	BLMFLD 8	69	3.67	640521	ANTELOPE 7	115	15.39
65400	J506 POI	345	12.37	640113	CLRWATR7	115	5.28	645451	S3451 3	345	19.14
560074	G16-017-TAP	345	6.59	640115	CO.LINE7	115	8.12	645454	S3454 3	345	23.77
560347	G10-051-TAP	230	7.18	640125	COLMB.E3	345	10.19	645459	S3459 3	345	21.24
579444	G06-044N-HV1	115	5.70	640127	COLMB.E7	115	21.37	646251	S1251 5	161	28.44
579450	GEN-2016-075	345	8.16	640133	COLMBUS4	230	11.23	648513	GRPR1 3	345	8.83
580011	G10-051&1127	230	6.37	640149	CREITON7	115	4.82	648520	GRPR2 3	345	8.16
583780	GEN-2013-032	115	12.23	640150	CREITON8	69	3.32	650114	NW68HOLDRG3	345	16.37
584510	GEN-2015-007	345	8.66	640183	GENTLMN3	345	18.27	652276	FTTHOMP8	69	4.43
584650	GEN-2015-023	345	7.91	640212	HARTGTN7	115	5.48	652506	FTTHOMP3	345	9.69
584910	GEN-2015-053	115	15.12	640226	HOSKINS3	345	14.27	652507	FTTHOMP4	230	20.42
585130	GEN-2015-076	115	3.84	640227	HOSKINS4	230	10.28	652509	FTRANDL4	230	11.02
587150	GEN-2016-021	345	5.93	640228	HOSKINS7	115	18.92	652511	GAVINS 7	115	8.75
587280	GEN-2016-043	345	12.23	640263	MADISON7	115	6.23	652514	HURON 4	230	10.73
587764	G16-094-TAP	230	13.08	640293	NELIGH 7	115	10.76	652516	LAKPLAT4	230	5.61
588340	GEN-2016-165	345	7.83	640294	NELIGH 8	69	6.06	652519	OAHE 4	230	14.20
588344	G16-165-TAP	345	9.69	640296	NORFK.N7	115	13.75	652532	GR PRAIRIE 3	345	9.98
588380	GEN-2016-159	345	3.90	640298	NORFOLK7	115	12.84	652540	BIGBND14	230	11.79
588387	G16-159-2	345	3.47	640305	ONEILL 7	115	3.92	652541	BIGBND24	230	11.96
635200	RAUN 3	345	25.66	640318	PETRSBG7	115	6.50	652564	SIOUXCY3	345	14.92
635201	RAUN 5	161	26.38	640342	SHELCRK3	345	10.53	652565	SIOUXCY4	230	19.44
635202	NEAL 4 5	161	18.35	640343	SHELCRK4	230	10.73	652606	LETCHER4	230	4.73
635203	NEAL N 5	161	24.97	640357	STANTON7	115	5.14	652607	WESSINGTON 4	230	6.81
635206	IDA CO 3	345	9.37	640363	STNTN.N7	115	7.06	652806	FTTHOM1-LNX3	345	9.69
635220	INTCHG 5	161	14.55	640377	TEKAMAH5	161	8.55	652807	FTTHOM2-LNX3	345	9.69
635230	LIBERTY5	161	24.31	640381	THEDFRD7	115	9.22	652832	GRPRAR1-LNX3	345	9.98
635400	HIGHLND 3	345	13.69	640386	TWIN CH4	230	8.53	652833	GRPRAR2-LNX3	345	9.98
640072	BATTLCR7	115	7.85	640387	TWIN CH7	115	10.61	652864	SIOUXCY-LNX3	345	14.92
640073	BATTLCR8	69	3.98	640444	PETERSBRG.N7	115	6.51	653571	GR ISLD3	345	12.29
640080	BELDEN 7	115	6.67	640500	THEDFORD3	345	5.86	653871	GR ISLD-LNX3	345	12.29
640081	BELDEN 8	69	3.84	640510	HOLT.CO3	345	8.76				

4.3 Short Circuit Results: 2026 Summer Peak

The maximum fault current for each bus is provided for the 2026 Summer Peak conditions. The following tables show the short circuit results for the study generators for the 2026 Summer Peak condition:

- Table 4-9: Short-circuit Analysis for GEN-2016-034
- Table 4-10: Short-circuit Analysis for GEN-2016-074
- Table 4-11: Short-circuit Analysis for GEN-2016-096
- Table 4-12: Short-circuit Analysis for GEN-2016-106
- Table 4-13: Short-circuit Analysis for GEN-2016-110
- Table 4-14: Short-circuit Analysis for GEN-2016-147
- Table 4-15: Short-circuit Analysis for GEN-2016-159
- Table 4-16: Short-circuit Analysis for GEN-2016-165

Table 4-9
26S Short-Circuit Analysis for Study Project GEN-2016-034

Study Generator GEN-2016-034											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
530555	COLBY 3	115	6.16	587874	G16-110-TAP	345	6.82	640366	STOCKVL8	69	3.29
530558	KNOLL 6	230	11.65	588344	G16-165-TAP	345	9.70	640374	SWEET W3	345	10.93
530559	PH RUN 3	115	4.56	640065	AXTELL 3	345	9.47	640381	THEDFRD7	115	9.23
530582	S HAYS6	230	8.99	640066	AXTELL 7	115	14.14	640396	VICTRYH4	230	3.85
530583	POSTROCK7	345	9.37	640082	BEVERLY7	115	4.87	640397	VICTRYH7	115	6.10
530584	POSTROCK6	230	11.87	640083	BEVERLY8	69	4.36	640500	THEDFORD3	345	5.88
530702	BUCKEYE_230	230	8.34	640091	BRULE 7	115	5.42	640510	HOLT.CO3	345	8.78
531351	BREWSTR3	115	3.13	640093	C.CREEK4	230	7.06	640530	STEGALL7	115	8.55
531429	MINGO 3	115	13.03	640096	CALAMS 7	115	3.40	652573	STEGALL4	230	5.74
531449	HOLCOMB7	345	10.51	640100	CAMBRIG7	115	4.19	652584	SIDNEYW4	230	3.30
531451	MINGO 7	345	6.81	640167	ENDERS 7	115	3.75	652873	STEGALL-LNX3	230	5.74
531464	SETAB 3	115	10.71	640183	GENTLMN3	345	18.42	653571	GR ISLD3	345	12.48
531465	SETAB 7	345	7.32	640184	GENTLMN4	230	20.10	653572	SIDNEY 7	115	4.21
531469	SPERVIL7	345	14.00	640200	GR ISLD4	230	16.82	653871	GR ISLD-LNX3	345	12.48
560075	G16-023-TAP	345	7.42	640252	KEYSTON3	345	12.96	659131	LARAMIE3	345	7.42
560082	G16-050-TAP	345	7.11	640253	KEYSTON7	115	15.65	659133	SIDNEY 3	345	6.76
560090	G16-034-TAP	345	6.36	640255	KINGSLY7	115	9.35	659134	SIDNEY 4	230	6.54
562334	G13-010-TAP	345	8.40	640269	MCCOOK 7	115	9.32	659135	STEGALL3	345	5.85
583600	GEN-2013-010	345	8.40	640270	MCCOOK 8	69	4.53	659170	STEGALDC	230	5.76
584650	GEN-2015-023	345	7.92	640271	MCCOOL 3	345	10.37	659206	STGXFMR4	230	6.07
585020	GEN-2015-064	115	10.16	640286	N.PLATT4	230	13.35	659210	SIDXFMR4	230	7.07
585030	GEN-2015-065	345	6.16	640287	N.PLATT7	115	18.56	659425	SIDNEY1-LNX3	345	6.76
587090	GEN-2016-023	345	5.97	640302	OGALALA4	230	7.87	659426	SIDNEY2-LNX3	345	6.76
587190	GEN-2016-029	345	5.97	640304	OGALALANPPD7	115	15.10	659800	GRANTNB7	115	6.32
587220	GEN-2016-034	345	6.36	640312	PAULINE3	345	8.07	659801	OGALALA7	115	15.10
587350	GEN-2016-050	345	6.38	640325	REDWILO3	345	9.39	659809	ROSCOE 7	115	6.38
587450	GEN-2016-067	345	6.16	640326	REDWILO7	115	12.66	659810	SPCREEK7	115	4.37
587680	GEN-2016-074	345	6.46	640338	SCOTBLF7	115	5.98	659821	GERINGT7	115	5.42
587850	GEN-2016-106	345	8.85	640359	STAPLETON 7	115	4.14	659824	MCONGHY7	115	5.40
587870	GEN-2016-110	345	6.76	640365	STOCKVL7	115	4.59				

Table 4-10
26S Short-Circuit Analysis for Study Project GEN-2016-074

Study Generator GEN-2016-074											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
300039	7FAIRPT	345	12.35	640126	E.COL. 4	230	9.58	640325	REDWILO3	345	9.39
530555	COLBY 3	115	6.16	640131	COLMB.W4	230	9.69	640326	REDWILO7	115	12.66
530558	KNOLL 6	230	11.65	640133	COLMBUS4	230	11.27	640330	RIVERDL4	230	7.03
530559	PH RUN 3	115	4.56	640134	KELLY 7	115	17.71	640331	RIVERDL7	115	11.88
530582	S HAYS6	230	8.99	640139	COOPER 3	345	26.72	640332	RIVERDL8	69	6.26
530583	POSTROCK7	345	9.37	640140	COOPER 5	161	17.49	640343	SHELCRK4	230	10.76
530584	POSTROCK6	230	11.87	640153	CRETE__7	115	8.34	640345	SILVRCK7	115	4.56
530702	BUCKEYE_230	230	8.34	640159	DONIPHN7	115	11.18	640353	ST.LIB 7	115	9.69
531351	BREWSTR3	115	3.13	640161	ELMCRK_7	115	5.90	640355	ST.PAUL7	115	3.83
531429	MINGO 3	115	13.03	640167	ENDERS 7	115	3.75	640359	STAPLETON 7	115	4.14
531449	HOLCOMB7	345	10.51	640174	FRIEND 7	115	6.41	640360	STAPLETON 8	69	3.17
531451	MINGO 7	345	6.81	640178	GENEVA 7	115	10.00	640365	STOCKVL7	115	4.59
531464	SETAB 3	115	10.71	640179	GENEVA 8	69	4.16	640366	STOCKVL8	69	3.29
531465	SETAB 7	345	7.32	640183	GENTLMN3	345	18.42	640372	SUTTON 7	115	6.33
531469	SPERVIL7	345	14.00	640184	GENTLMN4	230	20.10	640374	SWEET W3	345	10.93
541199	ST JOE 3	345	18.63	640194	GOSPER 7	115	4.36	640381	THEDFRD7	115	9.23
560062	G15-088-TAP	345	11.06	640200	GR ISLD4	230	16.82	640383	TOWER 7	115	8.75
560075	G16-023-TAP	345	7.42	640201	GR ISLD7	115	23.61	640407	WESTMIN7	115	7.87
560082	G16-050-TAP	345	7.11	640206	GUIDE R7	115	4.23	640411	YORK 7	115	7.51
560090	G16-034-TAP	345	6.36	640214	HASTING4	230	7.31	640413	YORK SW7	115	8.03
560134	ROSEMONT	115	6.34	640215	HASTING7	115	19.20	640416	AURORA_8	69	3.90
560746	G13-002-TAP	115	27.02	640222	HILDRTH7	115	4.19	640447	YORK.SW T2 8	69	2.41
562334	G13-010-TAP	345	8.40	640223	HILDRTH8	69	3.20	640448	HOLDREGE 8	69	5.42
572051	GEN2008-123N	115	5.06	640224	HOLDREG7	115	6.03	640500	THEDFORD3	345	5.88
583600	GEN-2013-010	345	8.40	640238	JEFFREY7	115	5.96	640510	HOLT.CO3	345	8.78
584650	GEN-2015-023	345	7.92	640242	JOHN.2 7	115	12.56	640540	MEADOWGROVE4	230	5.57
585020	GEN-2015-064	115	10.16	640244	JOHN.LK7	115	8.65	640591	MONOLITH7	115	27.29
585030	GEN-2015-065	345	6.16	640248	KEAR.NE7	115	9.05	641085	E7THST 7	115	18.11
585240	GEN-2015-088	345	10.63	640250	KEARNEY7	115	11.61	641087	EGYCNTR7	115	17.96
587090	GEN-2016-023	345	5.97	640252	KEYSTON3	345	12.96	641088	HASTCTY7	115	19.20
587190	GEN-2016-029	345	5.97	640253	KEYSTON7	115	15.65	642066	SUB-H G	115	16.35
587220	GEN-2016-034	345	6.36	640255	KINGSLY7	115	9.35	642070	SUB-C 7	115	12.54
587350	GEN-2016-050	345	6.38	640256	LXNGTN 7	115	6.95	642071	SUB-D 7	115	17.62
587450	GEN-2016-067	345	6.16	640259	LOUPCTY7	115	4.19	642072	SUB-E 7	115	17.52
587680	GEN-2016-074	345	6.46	640261	LOWELL 7	115	8.01	642073	SUB-F 7	115	12.70
587780	GEN-2016-096	345	9.24	640262	LOWELL 8	69	4.01	642076	SUB-J 7	115	16.55
587784	G16-096-TAP	345	9.26	640265	MALONEY7	115	11.25	645458	S3458 3	345	28.62
587850	GEN-2016-106	345	8.85	640267	MAXWELS7	115	6.64	650114	NW68HOLDRG3	345	16.58
587874	G16-110-TAP	345	6.82	640269	MCCOOK 7	115	9.32	650185	WAGENER 3	345	19.81
588344	G16-165-TAP	345	9.70	640270	MCCOOK 8	69	4.53	650189	103&ROKEBY3	345	19.82
635017	ATCHSN 3	345	16.96	640271	MCCOOL 3	345	10.37	650214	NW68HOLDRG7	115	24.50
640050	AINSWND7	115	3.70	640272	MCCOOL 7	115	14.09	650246	SW7&BENNET7	115	21.82
640063	AURORA_7	115	6.98	640273	MCCOOL 8	69	5.46	652584	SIDNEYW4	230	3.30
640065	AXTELL 3	345	9.47	640275	MINDEN 7	115	7.09	652832	GRPRAR1-LNX3	345	9.99
640066	AXTELL 7	115	14.14	640277	MOORE 3	345	21.43	653571	GR ISLD3	345	12.48
640082	BEVERLY7	115	4.87	640278	SHELDON7	115	32.48	653572	SIDNEY 7	115	4.21
640083	BEVERLY8	69	4.36	640286	N.PLATT4	230	13.35	653871	GR ISLD-LNX3	345	12.48
640088	BPS SUB7	115	15.82	640287	N.PLATT7	115	18.56	659131	LARAMIE3	345	7.42
640093	C.CREEK4	230	7.06	640288	N.PLATT8	69	4.91	659133	SIDNEY 3	345	6.76
640094	C.CREEK7	115	7.17	640302	OGALALA4	230	7.87	659134	SIDNEY 4	230	6.54
640096	CALAMS 7	115	3.40	640304	OGALALANPPD7	115	15.10	659135	STEGALL3	345	5.85
640100	CAMBRIG7	115	4.19	640310	ORLEANS7	115	2.35	659210	SIDXFMR4	230	7.07
640102	CANADAY4	230	6.22	640311	ORLEANS8	69	2.35	659425	SIDNEY1-LNX3	345	6.76
640103	CANADAY7	115	13.76	640312	PAULINE3	345	8.07	659426	SIDNEY2-LNX3	345	6.76
640105	CARLJCT7	115	5.89	640313	PAULINE7	115	16.24	659800	GRANTNB7	115	6.32
640107	CENCITY7	115	5.07	640314	PAULINE8	69	4.71	659801	OGALALA7	115	15.10
640111	CLATONA7	115	10.21	640321	PROSSER7	115	6.66				
640125	COLMB.E3	345	10.23	640323	RAVENNA7	115	5.86				

Table 4-11
26S Short-Circuit Analysis for Study Project GEN-2016-096

Study Generator GEN-2016-096											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
84760	J476 POI	345	16.88	640140	COOPER 5	161	17.49	640342	SHELCRK3	345	10.56
300039	7FAIRPT	345	12.35	640153	CRETE__7	115	8.34	640368	SUPEROR7	115	3.41
300076	5FAIRPT	161	17.63	640161	ELMCRK_7	115	5.90	640372	SUTTON 7	115	6.33
530583	POSTROCK7	345	9.37	640171	FIRTH 7	115	6.13	640374	SWEET W3	345	10.93
530584	POSTROCK6	230	11.87	640174	FRIEND 7	115	6.41	640383	TOWER 7	115	8.75
541199	ST JOE 3	345	18.63	640178	GENEVA 7	115	10.00	640413	YORK SW7	115	8.03
541253	ST JOE 5	161	18.91	640183	GENTLMN3	345	18.42	640446	COOPER 8	69	4.56
541400	EASTOWN7	345	16.98	640184	GENTLMN4	230	20.10	640448	HOLDREGE 8	69	5.42
541510	HOLT 7	345	9.67	640200	GR ISLD4	230	16.82	640500	THEDFORD3	345	5.88
542980	NASHUA 7	345	21.14	640206	GUIDE R7	115	4.23	640591	MONOLITH7	115	27.29
560062	G15-088-TAP	345	11.06	640207	GUIDE R8	69	2.15	641085	E7THST 7	115	18.11
560082	G16-050-TAP	345	7.11	640214	HASTING4	230	7.31	641087	EGYCNTR7	115	17.96
560134	ROSEMONT	115	6.34	640215	HASTING7	115	19.20	641088	HASTCTY7	115	19.20
560746	G13-002-TAP	115	27.02	640222	HILDRTH7	115	4.19	641090	S. 281 7	115	11.10
562334	G13-010-TAP	345	8.40	640223	HILDRTH8	69	3.20	645454	S3454 3	345	24.01
572051	GEN2008-123N	115	5.06	640224	HOLDREG7	115	6.03	645456	S3456 3	345	30.70
583520	GEN-2013-002	115	27.02	640242	JOHN.2 7	115	12.56	645458	S3458 3	345	28.62
583700	GEN-2013-019	115	21.16	640248	KEAR.NE7	115	9.05	645740	S3740 3	345	17.30
585240	GEN-2015-088	345	10.63	640250	KEARNEY7	115	11.61	646280	S1280 5	161	10.08
587350	GEN-2016-050	345	6.38	640252	KEYSTON3	345	12.96	650114	NW68HOLDRG3	345	16.58
587680	GEN-2016-074	345	6.46	640261	LOWELL 7	115	8.01	650185	WAGENER 3	345	19.81
587780	GEN-2016-096	345	9.24	640271	MCCOOL 3	345	10.37	650189	103&ROKEBY3	345	19.82
587784	G16-096-TAP	345	9.26	640272	MCCOOL 7	115	14.09	650210	NW70FAIRFD7	115	20.45
587850	GEN-2016-106	345	8.85	640273	MCCOOL 8	69	5.46	650214	NW68HOLDRG7	115	24.50
635017	ATCHSN 3	345	16.96	640275	MINDEN 7	115	7.09	650216	SW27&F 7	115	21.12
640065	AXTELL 3	345	9.47	640277	MOORE 3	345	21.43	650242	FOLSM&PHIL7	115	26.05
640066	AXTELL 7	115	14.14	640278	SHELDON7	115	32.48	650246	SW7&BENNET7	115	21.82
640076	BEATRCE7	115	13.02	640310	ORLEANS7	115	2.35	650247	40&BENNET 7	115	20.60
640088	BPS SUB7	115	15.82	640312	PAULINE3	345	8.07	650285	WAGENER 7	115	30.86
640111	CLATONA7	115	10.21	640313	PAULINE7	115	16.24	650290	ROKEBY 7	115	24.23
640125	COLMB.E3	345	10.23	640314	PAULINE8	69	4.71	653571	GR ISLD3	345	12.48
640127	COLMB.E7	115	21.45	640316	PAWNEEL7	115	11.20	653871	GR ISLD-LNX3	345	12.48
640139	COOPER 3	345	26.72	640325	REDWILO3	345	9.39				

Table 4-12
26S Short-Circuit Analysis for Study Project GEN-2016-106

Study Generator GEN-2016-106											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
523853	FINNEY 7	345	10.42	588344	G16-165-TAP	345	9.70	640287	N.PLATT7	115	18.56
530553	S HAYS 3	115	8.95	640050	AINSWND7	115	3.70	640288	N.PLATT8	69	4.91
530554	ATWOOD 3	115	3.02	640051	AINSWRT7	115	3.40	640302	OGALALA4	230	7.87
530555	COLBY 3	115	6.16	640063	AURORA_7	115	6.98	640304	OGALALANPPD7	115	15.10
530558	KNOLL 6	230	11.65	640065	AXTELL 3	345	9.47	640310	ORLEANS7	115	2.35
530559	PH RUN 3	115	4.56	640066	AXTELL 7	115	14.14	640312	PAULINE3	345	8.07
530561	KNOLL 3	115	11.85	640082	BEVERLY7	115	4.87	640313	PAULINE7	115	16.24
530582	S HAYS6	230	8.99	640083	BEVERLY8	69	4.36	640314	PAULINE8	69	4.71
530583	POSTROCK7	345	9.37	640089	BROKENB7	115	5.51	640325	REDWILO3	345	9.39
530584	POSTROCK6	230	11.87	640091	BRULE 7	115	5.42	640326	REDWILO7	115	12.66
530592	SMOKYHL6	230	7.05	640093	C.CREEK4	230	7.06	640330	RIVERDL4	230	7.03
530610	SHAYS_230	230	3.44	640094	C.CREEK7	115	7.17	640331	RIVERDL7	115	11.88
530644	COLBY 2	69	3.97	640096	CALAMS 7	115	3.40	640353	ST.LIB 7	115	9.69
530682	SEGNTP 3	115	4.31	640098	CALAWAY7	115	3.85	640359	STAPLETON 7	115	4.14
530683	SEGUIN 3	115	4.10	640100	CAMBRIG7	115	4.19	640360	STAPLETON 8	69	3.17
530702	BUCKEYE_230	230	8.34	640101	CAMBRIG8	69	2.22	640365	STOCKVL7	115	4.59
531351	BREWSTR3	115	3.13	640102	CANADAY4	230	6.22	640366	STOCKVL8	69	3.29
531353	GOODLND3	115	2.67	640103	CANADAY7	115	13.76	640370	SUTHLND7	115	5.43
531412	GRINNEL3	115	3.72	640107	CENCITY7	115	5.07	640374	SWEET W3	345	10.93
531416	CTYSERT3	115	10.06	640131	COLMB.W4	230	9.69	640381	THEDFRD7	115	9.23
531429	MINGO 3	115	13.03	640133	COLMBUS4	230	11.27	640383	TOWER 7	115	8.75
531433	SCOTCTY3	115	9.05	640139	COOPER 3	345	26.72	640413	YORK SW7	115	8.03
531448	HOLCOMB3	115	22.46	640161	ELMCRK_7	115	5.90	640448	HOLDREGE 8	69	5.42
531449	HOLCOMB7	345	10.51	640167	ENDERS 7	115	3.75	640500	THEDFORD3	345	5.88
531451	MINGO 7	345	6.81	640168	ENDERS 8	69	3.03	640510	HOLT.CO3	345	8.78
531464	SETAB 3	115	10.71	640178	GENEVA 7	115	10.00	640530	STEGALL7	115	8.55
531465	SETAB 7	345	7.32	640183	GENTLMN3	345	18.42	641088	HASTCTY7	115	19.20
531469	SPERVIL7	345	14.00	640184	GENTLMN4	230	20.10	641244	ATHEY 7	115	3.06
531501	BUCKNER7	345	9.50	640194	GOSPER 7	115	4.36	642071	SUB-D 7	115	17.62
539679	GRTBEND6	230	8.34	640196	GOTHNBG7	115	4.28	642072	SUB-E 7	115	17.52
539695	SPEARVL6	230	12.73	640200	GR ISLD4	230	16.82	650114	NW68HOLDRG3	345	16.58
539759	SPRVL 3	115	11.64	640201	GR ISLD7	115	23.61	650189	103&ROKEBY3	345	19.82
539803	IRONWOOD7	345	13.38	640214	HASTING4	230	7.31	652532	GR PRAIRIE 3	345	9.99
560002	IRONWOOD2 7	345	13.55	640215	HASTING7	115	19.20	652584	SIDNEYW4	230	3.30
560062	G15-088-TAP	345	11.06	640222	HILDRTH7	115	4.19	652585	NB WEST4	230	28.99
560075	G16-023-TAP	345	7.42	640224	HOLDREG7	115	6.03	652832	GRPRAR1-LNX3	345	9.99
560082	G16-050-TAP	345	7.11	640238	JEFFREY7	115	5.96	653571	GR ISLD3	345	12.48
560090	G16-034-TAP	345	6.36	640240	JOHN.1 7	115	8.23	653572	SIDNEY 7	115	4.21
560134	ROSEMONT	115	6.34	640242	JOHN.2 7	115	12.56	653871	GR ISLD-LNX3	345	12.48
562334	G13-010-TAP	345	8.40	640248	KEAR.NE7	115	9.05	659131	LARAMIE3	345	7.42
583600	GEN-2013-010	345	8.40	640250	KEARNEY7	115	11.61	659133	SIDNEY 3	345	6.76
584650	GEN-2015-023	345	7.92	640252	KEYSTON3	345	12.96	659134	SIDNEY 4	230	6.54
585020	GEN-2015-064	115	10.16	640253	KEYSTON7	115	15.65	659135	STEGALL3	345	5.85
585030	GEN-2015-065	345	6.16	640255	KINGSLY7	115	9.35	659170	STEGALDC	230	5.76
587090	GEN-2016-023	345	5.97	640261	LOWELL 7	115	8.01	659206	STGXFMR4	230	6.07
587190	GEN-2016-029	345	5.97	640265	MALONEY7	115	11.25	659210	SIDXFMR4	230	7.07
587220	GEN-2016-034	345	6.36	640267	MAXWELS7	115	6.64	659425	SIDNEY1-LNX3	345	6.76
587350	GEN-2016-050	345	6.38	640269	MCCOOK 7	115	9.32	659426	SIDNEY2-LNX3	345	6.76
587450	GEN-2016-067	345	6.16	640270	MCCOOK 8	69	4.53	659800	GRANTNB7	115	6.32
587680	GEN-2016-074	345	6.46	640271	MCCOOL 3	345	10.37	659801	OGALALA7	115	15.10
587780	GEN-2016-096	345	9.24	640272	MCCOOL 7	115	14.09	659809	ROSCOE 7	115	6.38
587784	G16-096-TAP	345	9.26	640273	MCCOOL 8	69	5.46	659810	SPCREEK7	115	4.37
587850	GEN-2016-106	345	8.85	640275	MINDEN 7	115	7.09	659817	COLTON 7	115	3.68
587870	GEN-2016-110	345	6.76	640277	MOORE 3	345	21.43	659824	MCONGHY7	115	5.40
587874	G16-110-TAP	345	6.82	640278	SHELDON7	115	32.48				
588220	GEN-2016-147	115	4.10	640286	N.PLATT4	230	13.35				

Table 4-13
26S Short-Circuit Analysis for Study Project GEN-2016-110

Study Generator GEN-2016-110

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
530583	POSTROCK7	345	9.37	640252	KEYSTON3	345	12.96	652573	STEGALL4	230	5.74
531451	MINGO 7	345	6.81	640253	KEYSTON7	115	15.65	652873	STEGALL-LNX3	230	5.74
560075	G16-023-TAP	345	7.42	640255	KINGSLY7	115	9.35	659131	LARAMIE3	345	7.42
560090	G16-034-TAP	345	6.36	640304	OGALALANPPD7	115	15.10	659133	SIDNEY 3	345	6.76
587090	GEN-2016-023	345	5.97	640325	REDWILO3	345	9.39	659134	SIDNEY 4	230	6.54
587190	GEN-2016-029	345	5.97	640326	REDWILO7	115	12.66	659135	STEGALL3	345	5.85
587220	GEN-2016-034	345	6.36	640338	SCOTBLF7	115	5.98	659170	STEGALDC	230	5.76
587850	GEN-2016-106	345	8.85	640374	SWEET W3	345	10.93	659206	STGXFMR4	230	6.07
587870	GEN-2016-110	345	6.76	640396	VICTRYH4	230	3.85	659210	SIDXFMR4	230	7.07
587874	G16-110-TAP	345	6.82	640397	VICTRYH7	115	6.10	659425	SIDNEY1-LNX3	345	6.76
640183	GENTLMN3	345	18.42	640500	THEDFORD3	345	5.88	659426	SIDNEY2-LNX3	345	6.76
640184	GENTLMN4	230	20.10	640530	STEGALL7	115	8.55	659821	GERINGT7	115	5.42

Table 4-14
26S Short-Circuit Analysis for Study Project GEN-2016-147

Study Generator GEN-2016-147

Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
560075	G16-023-TAP	345	7.42	640287	N.PLATT7	115	18.56	659133	SIDNEY 3	345	6.76
560090	G16-034-TAP	345	6.36	640302	OGALALA4	230	7.87	659134	SIDNEY 4	230	6.54
587850	GEN-2016-106	345	8.85	640304	OGALALANPPD7	115	15.10	659135	STEGALL3	345	5.85
588220	GEN-2016-147	115	4.10	640325	REDWILO3	345	9.39	659170	STEGALDC	230	5.76
640068	B.SPRGS7	115	4.40	640374	SWEET W3	345	10.93	659206	STGXFMR4	230	6.07
640086	BLUECK 7	115	2.51	640396	VICTRYH4	230	3.85	659210	SIDXFMR4	230	7.07
640091	BRULE 7	115	5.42	640500	THEDFORD3	345	5.88	659320	STEGALLWECCG	230	26.26
640093	C.CREEK4	230	7.06	640530	STEGALL7	115	8.55	659425	SIDNEY1-LNX3	345	6.76
640167	ENDERS 7	115	3.75	652573	STEGALL4	230	5.74	659426	SIDNEY2-LNX3	345	6.76
640183	GENTLMN3	345	18.42	652584	SIDNEYW4	230	3.30	659800	GRANTNB7	115	6.32
640184	GENTLMN4	230	20.10	652585	NB WEST4	230	28.99	659801	OGALALA7	115	15.10
640246	JULSTAP7	115	3.69	652873	STEGALL-LNX3	230	5.74	659809	ROSCOE 7	115	6.38
640252	KEYSTON3	345	12.96	653300	CHAPPEL7	115	3.33	659810	SPCREEK7	115	4.37
640253	KEYSTON7	115	15.65	653302	JULESBG7	115	2.62	659817	COLTON 7	115	3.68
640255	KINGSLY7	115	9.35	653303	HIGHLINE	115	3.07	659819	INTERST7	115	2.28
640286	N.PLATT4	230	13.35	653572	SIDNEY 7	115	4.21	659824	MCONGHY7	115	5.40

Table 4-15
26S Short-Circuit Analysis for Study Project GEN-2016-159

Study Generator GEN-2016-159											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
15010	A345	345	11.30	640122	COL.DRY7	115	16.24	645458	S3458 3	345	28.62
55201	J412 POI	345	9.76	640124	COL.SE 7	115	16.47	645459	S3459 3	345	22.46
55368	J455 POI	345	13.02	640125	COLMB.E3	345	10.23	645740	S3740 3	345	17.30
65400	J506 POI	345	12.38	640126	E.COL. 4	230	9.58	646206	S1206 5	161	40.46
66201	J535 POI	345	8.89	640127	COLMB.E7	115	21.45	646209	S1209 5	161	40.84
66202	J535	345	8.82	640131	COLMB.W4	230	9.69	646226	S1226 5	161	22.82
560062	G15-088-TAP	345	11.06	640133	COLMBUS4	230	11.27	646231	S1231 5	161	38.51
560347	G10-051-TAP	230	7.19	640134	KELLY 7	115	17.71	646237	S1237 5	161	16.68
579444	G06-044N-HV1	115	5.70	640136	COLMBUS7	115	19.11	646249	S1249 5	161	21.22
579450	GEN-2016-075	345	8.16	640139	COOPER 3	345	26.72	646250	S1250 5	161	32.40
580011	G10-051&1127	230	6.38	640149	CREITON7	115	4.84	646251	S1251 5	161	29.17
583780	GEN-2013-032	115	12.24	640150	CREITON8	69	4.43	646252	S1252 5	161	18.99
584510	GEN-2015-007	345	8.67	640151	CRESTON7	115	6.03	646254	S1254 5	161	26.06
584910	GEN-2015-053	115	15.14	640157	DAVIDCY7	115	5.34	646255	S1255 5	161	40.17
585130	GEN-2015-076	115	3.85	640163	EMERSON7	115	5.42	646281	S1281 5	161	23.62
587150	GEN-2016-021	345	5.93	640164	EMERSONG	69	3.74	646297	S1297 5	161	17.65
587280	GEN-2016-043	345	12.25	640181	GENOA 7	115	4.98	646298	S1298 5	161	26.75
588340	GEN-2016-165	345	7.84	640200	GR ISLD4	230	16.82	646301	S1301 5	161	7.35
588344	G16-165-TAP	345	9.70	640212	HARTGTN7	115	5.53	646305	S1305 5	161	25.50
588380	GEN-2016-159	345	3.90	640213	HARTGTN8	69	3.59	646341	S1341 5	161	24.85
588387	G16-159-2	345	3.47	640226	HOSKINS3	345	14.30	647909	S909 8	69	25.39
601006	SPLT RK3	345	14.70	640227	HOSKINS4	230	10.30	648506	PR BRZ 4	230	4.21
601034	NOBLES 3	345	11.70	640228	HOSKINS7	115	18.95	648513	GRPR1 3	345	8.84
603016	SPLT RK7	115	37.04	640263	MADISON7	115	6.23	648520	GRPR2 3	345	8.16
631138	LAKEFLD3	345	19.77	640271	MCCOOL 3	345	10.37	650114	NW68HOLDRG3	345	16.58
635000	CBLUFFS3	345	29.41	640277	MOORE 3	345	21.43	650185	WAGENER 3	345	19.81
635200	RAUN 3	345	25.78	640278	SHELDON7	115	32.48	650189	103&ROKEBY3	345	19.82
635201	RAUN 5	161	26.49	640293	NELIGH 7	115	10.77	650210	NW70FAIRFD7	115	20.45
635202	NEAL 4 5	161	18.41	640294	NELIGH 8	69	6.06	650214	NW68HOLDRG7	115	24.50
635203	NEAL N 5	161	25.08	640296	NORFK.N7	115	13.77	650216	SW27&F 7	115	21.12
635204	NEAL 8	69	9.84	640298	NORFOLK7	115	12.86	650285	WAGENER 7	115	30.86
635206	IDA CO 3	345	9.39	640300	OAKLAND7	115	7.44	650290	ROKEBY 7	115	24.23
635220	INTCHG 5	161	14.60	640305	ONEILL 7	115	3.92	652287	RASMUSN8	69	3.16
635221	KELLOGG5	161	16.94	640316	PAWNEEL7	115	11.20	652506	FTTHOMP3	345	9.61
635222	KELLOGG8	69	17.57	640318	PETRSBG7	115	6.50	652507	FTTHOMP4	230	20.00
635223	PLYMOTH5	161	19.95	640336	SCHUYLR7	115	5.80	652509	FTRANDL4	230	11.03
635225	MORNSD 5	161	10.18	640342	SHELCRK3	345	10.56	652510	FTRANDL7	115	12.99
635226	LEEDS 5	161	15.64	640343	SHELCRK4	230	10.76	652511	GAVINS 7	115	9.14
635227	SBRIDGE T8	69	8.63	640345	SILVRCK7	115	4.56	652516	LAKPLAT4	230	5.60
635228	AIRPORT 5	161	16.74	640357	STANTON7	115	5.14	652526	UTICAJC4	230	7.89
635230	LIBERTY5	161	24.41	640363	STNTN.N7	115	7.06	652532	GR PRAIRIE 3	345	9.99
635235	SALIX 5	161	15.91	640377	TEKAMAH5	161	8.57	652536	RASMUSN4	230	6.61
635236	SALIX 8	69	13.28	640378	TEKAMAH7	115	8.01	652537	WHITE 3	345	23.73
635300	MONONA 5	161	5.33	640386	TWIN CH4	230	8.55	652561	DENISON5	161	5.24
635301	MONONA 8	69	4.47	640387	TWIN CH7	115	10.63	652563	SPENCER5	161	10.15
635330	CRWFRD 5	161	4.80	640388	TWIN CH8	69	7.74	652564	SIOUXCY3	345	15.00
635368	OBRIEN 3	345	14.30	640400	W.POINT7	115	4.95	652565	SIOUXCY4	230	19.59
635400	HIGHLND 3	345	13.70	640402	WAHOO 7	115	4.70	652566	SIOUXCY5	161	20.41
636010	LEHIGH 3	345	13.38	640424	S.SIOUXCITY7	115	7.30	652567	DENISON4	230	4.29
640070	BANCRFT7	115	5.01	640425	S.SIOUXCITY8	69	4.48	652574	SIOUXCY8	69	17.67
640072	BATTLCR7	115	7.86	640444	PETERSBRG.N7	115	6.51	652578	PAHOJA 4	230	7.31
640073	BATTLCR8	69	3.98	640510	HOLT.CO3	345	8.78	652583	DENISON8	69	10.98
640078	BEEMER 7	115	4.39	640520	ANTELOPE 3	345	9.55	652807	FTTHOM2-LNX3	345	9.61
640080	BELDEN 7	115	6.71	640521	ANTELOPE 7	115	15.41	652832	GRPRAR1-LNX3	345	9.99
640081	BELDEN 8	69	3.85	640540	MEADOWGROVE4	230	5.57	652833	GRPRAR2-LNX3	345	9.99
640084	BLMFLD 7	115	5.97	645100	FC1A 5	161	26.95	652864	SIOUXCY-LNX3	345	15.00
640085	BLMFLD 8	69	3.69	645451	S3451 3	345	19.52	659121	SPIRITM7	115	6.41
640113	CLRWATR7	115	5.28	645454	S3454 3	345	24.01	659900	EAGLE 4	230	7.15
640115	CO.LINE7	115	8.13	645455	S3455 3	345	27.80	659901	EAGLE 8	69	13.66
640119	COL.COG7	115	19.18	645456	S3456 3	345	30.70	660006	YKNTJCT7	115	8.51

Table 4-16
26S Short-Circuit Analysis for Study Project GEN-2016-165

Study Generator GEN-2016-165											
Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)	Bus Number	Bus Name	Bus Voltage (kV)	Fault Current 3-LG (kA)
15010	A345	345	11.30	640084	BLMFLD 7	115	5.97	640520	ANTELOPE 3	345	9.55
55201	J412 POI	345	9.76	640085	BLMFLD 8	69	3.69	640521	ANTELOPE 7	115	15.41
65400	J506 POI	345	12.38	640113	CLRWATR7	115	5.28	645451	S3451 3	345	19.52
560074	G16-017-TAP	345	6.56	640115	CO.LINE7	115	8.13	645454	S3454 3	345	24.01
560347	G10-051-TAP	230	7.19	640125	COLMB.E3	345	10.23	645459	S3459 3	345	22.46
579444	G06-044N-HV1	115	5.70	640127	COLMB.E7	115	21.45	646251	S1251 5	161	29.17
579450	GEN-2016-075	345	8.16	640133	COLMBUS4	230	11.27	648513	GRPR1 3	345	8.84
580011	G10-051&1127	230	6.38	640149	CREITON7	115	4.84	648520	GRPR2 3	345	8.16
583780	GEN-2013-032	115	12.24	640150	CREITON8	69	4.43	650114	NW68HOLDRG3	345	16.58
584510	GEN-2015-007	345	8.67	640183	GENTLMN3	345	18.42	652276	FTTHOMP8	69	4.42
584650	GEN-2015-023	345	7.92	640212	HARTGTN7	115	5.53	652506	FTTHOMP3	345	9.61
584910	GEN-2015-053	115	15.14	640226	HOSKINS3	345	14.30	652507	FTTHOMP4	230	20.00
585130	GEN-2015-076	115	3.85	640227	HOSKINS4	230	10.30	652509	FTRANDL4	230	11.03
587150	GEN-2016-021	345	5.93	640228	HOSKINS7	115	18.95	652511	GAVINS 7	115	9.14
587280	GEN-2016-043	345	12.25	640263	MADISON7	115	6.23	652514	HURON 4	230	10.78
587764	G16-094-TAP	230	12.95	640293	NELIGH 7	115	10.77	652516	LAKPLAT4	230	5.60
588340	GEN-2016-165	345	7.84	640294	NELIGH 8	69	6.06	652519	OAHE 4	230	14.12
588344	G16-165-TAP	345	9.70	640296	NORFK.N7	115	13.77	652532	GR PRAIRIE 3	345	9.99
588380	GEN-2016-159	345	3.90	640298	NORFOLK7	115	12.86	652540	BIGBND14	230	11.91
588387	G16-159-2	345	3.47	640305	ONEILL 7	115	3.92	652541	BIGBND24	230	11.21
635200	RAUN 3	345	25.78	640318	PETRSBG7	115	6.50	652564	SIOUXCY3	345	15.00
635201	RAUN 5	161	26.49	640342	SHELCRK3	345	10.56	652565	SIOUXCY4	230	19.59
635202	NEAL 4 5	161	18.41	640343	SHELCRK4	230	10.76	652606	LETCHER4	230	4.73
635203	NEAL N 5	161	25.08	640357	STANTON7	115	5.14	652607	WESSINGTON 4	230	6.80
635206	IDA CO 3	345	9.39	640363	STNTN.N7	115	7.06	652806	FTTHOM1-LNX3	345	9.61
635220	INTCHG 5	161	14.60	640377	TEKAMAH5	161	8.57	652807	FTTHOM2-LNX3	345	9.61
635230	LIBERTY5	161	24.41	640381	THEDFRD7	115	9.23	652832	GRPRAR1-LNX3	345	9.99
635400	HIGHLND 3	345	13.70	640386	TWIN CH4	230	8.55	652833	GRPRAR2-LNX3	345	9.99
640072	BATTLCR7	115	7.86	640387	TWIN CH7	115	10.63	652864	SIOUXCY-LNX3	345	15.00
640073	BATTLCR8	69	3.98	640444	PETERSBRG.N7	115	6.51	653571	GR ISLD3	345	12.48
640080	BELDEN 7	115	6.71	640500	THEDFORD3	345	5.88	653871	GR ISLD-LNX3	345	12.48
640081	BELDEN 8	69	3.85	640510	HOLT.CO3	345	8.78				

SECTION 5: CONCLUSIONS

Summary of Stability Analysis

The Stability Analysis determined that there were multiple contingencies across all seasons that resulted in system/voltage instability, generation tripping offline, and poor post-fault voltage recovery when all generation interconnection requests were at 100% output. To mitigate the system/voltage instability, generation tripping offline, and poor post-fault steady-state voltages, the following upgrades were provided by SPP and implemented (upgrades provided here are required for 17W season and thus, implemented in remaining years):

- Keystone to Red Willow 345 kV circuit #1
- Red Willow to Post Rock 345 kV circuit #1
- Grand Prairie to Antelope 345 kV circuit #1
- Reroute Laramie River Station (GEN-2016-110-Tap) to Stegall 345kV circuit #1 through the GEN-2016-023-Tap substation

The following three single phase stuck breaker faults required additional mitigation in the 17W and 18S seasons:

- FLT58-SB: Single phase stuck breaker fault at Gentleman 230 kV resulting in the loss of Gentleman to Ogalala 230 kV circuit #1 and Gentleman 345/230 kV transformer.
- FLT60-SB: Single phase stuck breaker fault at Gentleman 345 kV resulting in the loss of Gentleman to Sweetwater 345 kV circuit #1 and Gentleman 345 kV to Red Willow 345 kV circuit #1.
- FLT63-SB: Single phase stuck breaker fault at Gentleman 345 kV resulting in the loss of the Gentleman to Red Willow 345 kV circuit #1 and Gentleman 345/230 kV transformer.

It was identified that an SVC injection of +100 Mvar at Keystone 345 kV would mitigate the voltage instability observed in the region. Note for any prior outage in the Gentleman area, generation curtailment may be required by operations due to the limit from the stuck breaker faults above.

After implementing the above upgrades, the contingency analysis was re-simulated for all contingencies. With the upgrades, the Stability Analysis determined that there was no generation tripping or system instability observed as a result of interconnecting all study projects at 100% output.

High GGS Sensitivity Scenario

The High GGS Scenario Stability Analysis determined that no additional voltage instability, generation tripping offline, or poor post-fault voltage recovery existed with the mitigation applied from the normal dispatch scenario. The system recovers with SPP Performance Criteria for all contingencies when all generation interconnection requests were at 100% output.

Summary of the Short Circuit Analysis

The Short Circuit Analysis was performed on the 2018 Summer Peak and 2026 Summer Peak power flows for all study projects. Refer to Table 5-1 and Table 5-2 for a list of maximum fault currents observed for each study project for the 18S and 26S cases, respectively.

Table 5-1
2018S: List of Maximum Fault Currents Observed for Each Study Project

Study Project	Fault Current at POI (kA)	Maximum Fault Current (kA)	Fault Location
GEN-2016-034	6.35	20.00	Gentleman 230 kV
GEN-2016-074	10.87	31.63	Sheldon 115 kV
GEN-2016-096	9.22	31.63	Sheldon 115 kV
GEN-2016-106	18.27	31.63	Sheldon 115 kV
GEN-2016-110	6.82	20.00	Gentleman 230 kV
GEN-2016-147	4.20	28.99	NB West 230 kV
GEN-2016-159	14.27	40.00	S 1206 161 kV
GEN-2016-165	9.98	28.44	S 1251 161 kV

Table 5-2
2026S: List of Maximum Fault Currents Observed for Each Study Project

Study Project	Fault Current at POI (kA)	Maximum Fault Current (kA)	Fault Location
GEN-2016-034	6.36	20.10	Gentleman 230 kV
GEN-2016-074	10.93	32.48	Sheldon 115 kV
GEN-2016-096	9.26	32.48	Sheldon 115 kV
GEN-2016-106	18.42	32.48	Sheldon 115 kV
GEN-2016-110	6.82	20.10	Gentleman 230 kV
GEN-2016-147	4.21	28.99	NB West 230 kV
GEN-2016-159	14.30	40.84	S 1209 161 kV
GEN-2016-165	9.99	29.17	S 1251 161 kV

J10: GROUP 10 DYNAMIC STABILITY ANALYSIS REPORT

Submitted to

Southwest Power Pool

SPP Southwest Power Pool

Report On

Definitive Interconnection System Impact Study DISIS-2016-002 Study Group 10

Revision R1

Date of Submittal
April 18, 2018

anedenconsulting.com

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Executive Summary

Aneden Consulting (Aneden) was retained by the Southwest Power Pool (SPP) to complete the short circuit analysis and dynamic stability analysis as part of the Definitive System Impact Study DISIS-2016-002 for Southeast Oklahoma/Northeast Texas Area, defined as Group 10. The purpose of the analyses was to identify impacts to the transmission system caused by the interconnection requests in Group 10.

Group 10 included a single interconnection request, GEN-2016-167, which is a 73.5 MW solar PV farm proposed to interconnect to SPP's transmission system by tapping the existing Lieberman to North Benton 138 kV line as shown in Table ES-1 below. There were no active prior-queued interconnection requests in this area.

Table ES-1: DISIS-2016-002 Group 10 Project

Request	Capacity (MW)	Generator Model	Point of Interconnection (POI)
GEN-2016-167	73.5	Power Electronics Solar inverter HEC-US V1500	Tap Lieberman – North Benton 138 kV Line

Aneden performed short circuit analysis and dynamic stability analysis using the study models provided by SPP; - 2017 winter peak (2017WP), 2018 summer peak (2018SP) and 2026 summer peak (2026SP). All analyses were performed using the Siemens PTI PSS/E software and the results are summarized below.

The results from short circuit analysis showed that there were no changes in the fault currents in the immediate systems at or near GEN-2016-167 for both the 2018 summer peak and 2026 summer peak cases. The GEN-2016-167 PV generator model limited the fault contribution from the generator to zero.

The dynamic stability analysis was performed using the three loading scenarios 2017WP, 2018SP and 2026SP simulating up to 35 faults that included three-phase and single-line-to-ground faults including faults on prior outage cases and stuck breakers. GEN-2016-167 generator was tripped offline by its voltage and frequency relays under ten of the simulated fault events:

- For a three-phase fault at the GEN-2016-167 POI tap to the North Benton 138 kV substation, the GEN-2016-167 generator was tripped offline under both under and over frequency relays. Certain limitations within the generator stability model and/or low-inertia within the network can result in drastic changes to the bus reference angles which may then cause spikes in quantities such as the calculated frequencies. According to Siemens PTI, this is a well-known issue with the modeling of PV type devices in simulation software like PSS/E. Some of the frequency relay settings associated with GEN-2016-167 generator were adjusted to prevent the tripping of the generator caused by this modeling issue.

- In addition, GEN-2016-167 generator was also tripped offline with the prior outage on the GEN-2016-167 Tap to Lieberman 138 kV line followed by a three-phase fault on the North Benton to Linton 138 kV line. To mitigate this violation, the GEN-2016-167 generator output may have to be curtailed to about 36.75 MW.

- Similarly, GEN-2016-167 generator was also tripped offline with the prior outage on the GEN-2016-167 Tap to North Benton 138 kV line followed by any subsequent three-phase faults at the Lieberman 138 kV substation. The frequency relay setting adjustments made to resolve the GEN-2016-167 POI Tap to North Benton 138 kV three phase fault described above, also mitigated this issue.

The results of the dynamic stability analysis show that the GEN-2016-167 project generator model relay settings may have to be adjusted to prevent the tripping of the generator during fault simulations. In addition, GEN-2016-167 may also have to be curtailed after the outage of the POI bus to North Benton 138 kV line in order to prepare for the next three phase contingency near the project.

1.0 Introduction

Aneden Consulting (Aneden) was retained by the Southwest Power Pool (SPP) to complete the short circuit analysis and dynamic stability analysis as part of the Definitive System Impact Study DISIS-2016-002 for Southeast Oklahoma/Northeast Texas Area, defined as Group 10. The purpose of the analyses was to identify impacts to the transmission system caused by the interconnection request in Group 10.

Group 10 included a single interconnection request, GEN-2016-167, which is 73.5 MW solar PV farm proposed to interconnect the SPP transmission system by tapping the existing Lieberman to North Benton 138 kV line as shown in Table 1-1 below. There were no active prior-queued interconnection requests in this area.

Table 1-1: Group 10 Interconnection Request

Request	Capacity (MW)	Generator Model	Point of Interconnection (POI)
GEN-2016-167	73.5	Power Electronics Solar inverter HEC-US V1500	Tap Lieberman – North Benton 138 kV Line

1.1 Scope

The Study included short circuit and dynamic stability analyses. The methodology, assumptions and results of the analyses are presented in the following four main sections:

1. Study Assumptions and Criteria
2. Short Circuit Analysis
3. Dynamic Stability Analysis
4. Conclusions

1.2 Study Limitations

The assessments and conclusions provided in this report are based on assumptions and information provided to Aneden by others. While the assumptions and information provided may be appropriate for the purposes of this report, Aneden does not guarantee that those conditions assumed will occur. In addition, Aneden did not independently verify the accuracy or completeness of the information provided. As such, the conclusions and results presented in this report may vary depending on the extent to which actual future conditions differ from the assumptions made or information used herein.

2.0 Study Assumptions and Criteria

The short circuit and dynamic stability analyses were performed using the PTI PSS/E software version 33. The main assumptions and criteria applied in the study are summarized in the sections below.

2.1 Study System

The study system consisted of generators and transmission buses at or above 115 kV within the monitored areas listed in Table 2-1 below.

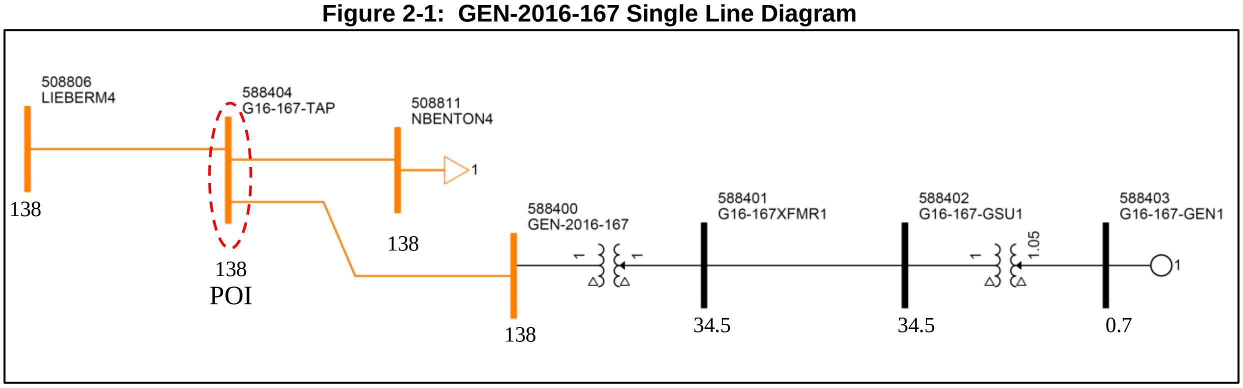
Table 2-1: Monitored Areas

Area Number	Name
520	AEPW
524	OKGE
525	WFEC
526	SPS
531	MIDW
534	SUNC
536	WERE
640	NPPD
645	OPPD
650	LES
652	WAPA

2.2 Study Models

Figure 2-1 shows the modeling configuration of the GEN-2016-167 in the study models.

Figure 2-1: GEN-2016-167 Single Line Diagram



The short-circuit analysis and dynamic stability analysis were completed using the models developed by SPP from the 2016 SPP Model Development Working Group (MDWG) PSS/E models. The models provided by SPP are the 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak study conditions. Table 2-2 summarizes the study models used for each analysis.

Table 2-2: Study Models

Case Name	Short Circuit	Dynamic Stability
MDWG16-17W_DIS1602_G10.SAV		X
MDWG16-18S_DIS1602_G10.SAV	X	X
MDWG16-26S_DIS1602_G10.SAV	X	X

2.3 Prior-Queued Projects

There were no prior-queued projects identified for the Southeast Oklahoma/Northeast Texas Area, Group 10.

2.4 Dynamic Performance Requirements

The dynamic stability analysis results were assessed according to the following excerpt from SPP's Disturbance Performance Requirements. The complete document is provided in Appendix B.

"Machine Rotor Angles shall exhibit well damped angular oscillations following a disturbance on the Bulk Electric System for all NERC TPL-001-4 P1 through P7 events. Machines with rotor angle deviations greater than or equal to 16 degrees (measured as absolute maximum peak to absolute minimum peak) shall be evaluated against SPPR1 or SPPR5 requirements below. Machines with rotor angle deviations less than 16 degrees which do not exhibit convergence shall be evaluated on an individual basis. Rotor angle deviations will be calculated relative to the system swing machine.

Well damped angular oscillations shall meet one of the following two requirements when calculated directly from the rotor angle:

1. Successive Positive Peak Ratio One (SPPR1) must be less than or equal to 0.95 where

SPPR1 is calculated as follows:

$$\text{SPPR1} = \frac{\text{Peak Rotor Angle of 2nd Positive Peak minus Minimum Value}}{\text{Peak Rotor Angle of 1st Positive Peak minus Minimum Value}} \leq 0.95$$

-or- Damping Factor % = (1 – SPPR1) x 100% $\geq$ 5%

The machine rotor angle damping ratio may be determined by appropriate modal analysis (i.e. Prony Analysis) where the following equivalent requirement must be met:

Damping Ratio $\geq$ 0.0081633

2. Successive Positive Peak Ratio Five (SPPR5) must be less than or equal to 0.774 where

SPPR5 is calculated as follows:

$$\text{SPPR5} = \frac{\text{Peak Rotor Angle of 6th Positive Peak minus Minimum Value}}{\text{Peak Rotor Angle of 1st Positive Peak minus Minimum Value}} \leq 0.774$$

-or- Damping Factor % = (1 – SPPR5) x 100% $\geq$ 22.6%

The machine rotor angle damping ratio may be determined by appropriate modal analysis (i.e. Prony Analysis) where the following equivalent requirement must be met:

Damping Ratio ≥ 0.0081633

Bus voltages on the Bulk Electric System shall recover above 0.70 per unit, 2.5 seconds after the fault is cleared. Bus voltages shall not swing above 1.20 per unit after the fault is cleared, unless affected transmission system elements are designed to handle the rise above 1.2 per unit."

3.0 Short Circuit Analysis

A short-circuit analysis was performed using the power flow models for the 2018SP and 2026SP seasons for Group 10, single interconnection GEN-2016-167. The detailed results of the short-circuit analysis are provided in Appendix A.

3.1 Methodology

The short-circuit analysis included applying a 3-phase fault on buses up to 5 levels away from the 138 kV point of interconnection tap located on the existing Lieberman to North Benton 138 kV line. PSS/E "Automatic Sequence Fault Calculation (ASCC)" fault analysis module was used to calculate the fault current levels with and without the GEN-2016-167 online.

3.2 Results

The results of the short circuit analysis are summarized shown in Table 3-1 and Table 3-2 for the 2018SP and 2026SP scenarios respectively. There was no increase in the fault current levels with the GEN-2016-167 PV generator online.

Table 3-1: 2018SP Short Circuit Results

Distance	Max. Change (kA)	Max %Change
0	0	0%
1	0	0%
2	0	0%
3	0	0%
4	0	0%
5	0	0%

Table 3-2: 2026SP Short Circuit Results

Distance	Max. Change (kA)	Max %Change
0	0	0%
1	0	0%
2	0	0%
3	0	0%
4	0	0%
5	0	0%

4.0 Dynamic Stability Analysis

Aneden performed a dynamic stability analysis to assess the system performance and identify any system stability issues associated with DISIS-2016-002 Group 10 interconnection request, GEN-2016-167. The analysis was performed according to SPP's Disturbance Performance Requirements provided in Appendix B. GEN-2016-167 dynamic modeling data is provided in Appendix C. The simulation plots can be found in Appendix D.

4.1 Methodology and Criteria

The dynamic stability analysis was performed using the DISIS-2016-002 (Group 10) study models described in Section 2.2 above. The power flow models and associated dynamics database were initialized (no-fault test) to confirm that there were no errors in the initial conditions of the immediate system and the dynamic data. The dynamics model data for the DISIS-2016-002 (Group 10) request, GEN-2016-167 is provided in Appendix C. The stability analysis was performed using PSS/E version 33.

During the fault simulations, the active power (PELEC), reactive power (QELEC), terminal voltage (ETERM), and frequency (FREQ) were monitored for the GEN-2016-167 generation interconnection request. The machine rotor angle for synchronous machines and speed for asynchronous machines within ten (10) buses away from the POI of GEN-2016-167 and within the study area including 520 (AEPW), 524 (OKGE), 525 (WFEC), 526 (SPS), 531 (MIDW), 534 (SUNC), 536 (WERE), 640 (NPPD), 645 (OPPD), 650 (OPPD), 650 (LES) and 652 (WAPA) were monitored. In addition, the voltages of all 100 kV and above buses within the study area were monitored.

4.2 Fault Definitions

Aneden developed thirty-five (35) faults including three-phase line faults with reclosing, three-phase transformer faults with normal clearing, prior outage events and single-line-to-ground (SLG) fault with stuck breaker. The single-line-to-ground fault impedance values were determined by applying a fault on the base case large enough to produce a 0.6 pu voltage value on the faulted bus. The fault events are described in Table 4-1 below. These contingencies were applied to the 2017 winter peak, 2018 summer peak, and the 2026 summer peak models.

Table 4-1: Fault Definitions

Fault ID	Contingency (Fault) Description
FLT01-3PH	**3 phase fault on G16-167-TAP (588404) to North Benton (508811) 138 kV Line, CKT 1, near G16-167-TAP**
	a. Apply fault at the G16-167-TAP (588404) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT02-3PH	**3 phase fault on G16-167-TAP (588404) to Lieberman (508806) 138 kV Line, CKT 1, near G16-167-TAP**
	a. Apply fault at the G16-167-TAP (588404) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault

Table 4-1 continued

Fault ID	Contingency (Fault) Description
FLT03-3PH	**3 phase fault on North Benton 138 kV (508811) to North Benton 69 kV (508810) to North Benton 13.8 kV (508823) XFMR 1, at North Benton 138 kV**
	a. Apply fault at the North Benton (508811) 138 kV bus
	b. Clear fault after 5 cycles by tripping the transformer
FLT04-3PH	**3 phase fault on North Benton 138 kV (508811) to Linton Road 138 kV (508807), CKT 1, near North Benton**
	a. Apply fault at the North Benton (508811) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT05-3PH	**3 phase fault on Linton Road 138 kV (508807) to Deen Point (507772) 138kV, CKT 1, near Linton Road**
	a. Apply fault at the Linton Road (508807) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT06-3PH	**3 phase fault on Lieberman (508806) 138 kV to Longwood (508808) Line, CKT 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT07-3PH	**3 phase fault on Longwood (508808) to Scottsville (508567) 138 kV Line, CKT 1, near Longwood**
	a. Apply fault at the Longwood (508808) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT08-3PH	**3 phase fault on Longwood (508808) to Oak Pan-Harr (508816) 138 kV Line, CKT 1, near Longwood**
	a. Apply fault at the Longwood (508808) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT09-3PH	**3 phase fault on Longwood (508808) to Noram (507774) 138 kV Line, CKT 1, near Longwood**
	a. Apply fault at the Longwood (508808) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT10-3PH	**3 phase fault on Longwood 138 kV (508808) to Longwood 345 kV (508809) to Longwood 13.5 kV (508819) XMFR 1, near Longwood**
	a. Apply fault at the Longwood (508808) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted transformer

Table 4-1 continued

Fault ID	Contingency (Fault) Description
FLT11-3PH	**3 phase fault on Lieberman (508806) 138 kV to Arsenal Hill (507711) Line, CKT 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT12-3PH	**3 phase fault on Arsenal Hill (507711) 138 kV to Raines Road (507749) 138 kV Line, CKT 1, near Arsenal Hill**
	a. Apply fault at the Arsenal Hill (507711) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT13-3PH	**3 phase fault on Arsenal Hill (507711) 138 kV to McWillie (507742) 138 kV Line, CKT 1, near Arsenal Hill**
	a. Apply fault at the Arsenal Hill (507711) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT14-3PH	**3 phase fault on Arsenal Hill (507711) 138 kV to Stlgens (507789) 138 kV Line, CKT 1, near Arsenal Hill**
	a. Apply fault at the Arsenal Hill (507711) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT15-3PH	**3 phase fault on Arsenal Hill (507711) 138 kV to Fort Humbug (507731) 138 kV Line, CKT 1, near Arsenal Hill**
	a. Apply fault at the Arsenal Hill (507711) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT16-3PH	**3 phase fault on Arsenal Hill 138 kV (507711) to Arsenal Hill 69 kV (507710) to Arsenal Hill 14.5 kV (507712) XMFR 1, near Arsenal Hill**
	a. Apply fault at the Arsenal Hill (507711) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted XMFR
FLT17-3PH	**3 phase fault on Lieberman (508806) 138 kV to IPC Jefferson (508833) 138 kV Line, CKT 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT18-3PH	**3 phase fault on IPC Jefferson (508833) 138 kV to Jefferson (508835) 138 kV Line, CKT 1, near IPC Jefferson**
	a. Apply fault at the IPC Jefferson (508833) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault

Table 4-1 continued

Fault ID	Contingency (Fault) Description
FLT19-3PH	**3 phase fault on Lieberman 138 kV (508806) to Lieberman 69 kV (508805) to Lieberman 13.8 kV (508820) XMFR 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted XMFR
FLT20-3PH	**3 phase fault on Lieberman 138 kV (508806) to Lieberman 13.5 kV (509402) XMFR 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted XMFR and dropping unit 1 at gen bus
FLT21-3PH	**3 phase fault on Lieberman 138 kV (508806) to Lieberman 13.5 kV (509401) XMFR 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted XMFR and dropping unit 1 at gen bus
FLT22-3PH	**3 phase fault on Lieberman 138 kV (508806) to Lieberman 13.5 kV (509400) XMFR 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted XMFR and dropping unit 1 at gen bus
FLT23-3PH	**3 phase fault on Lieberman 138 kV (508806) to Lieberman 13.5 kV (509399) XMFR 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted XMFR and dropping unit 1 at gen bus
FLT03-PO1	**Prior Outage of G16-167-TAP to Lieberman 138 kV line;** **3 phase fault on North Benton 138 kV (508811) to North Benton 69 kV (508810) to North Benton 13.8 kV (508823) XFMR 1, at North Benton**
	a. Apply fault at the North Benton (508811) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted XMFR
FLT04-PO1	**Prior Outage of G16-167-TAP to Lieberman 138 kV line;** **3 phase fault on North Benton 138 kV (508811) to Linton Road 138 kV (508807), CKT 1, near North Benton**
	a. Apply fault at the North Benton (508811) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT06-PO2	**Prior Outage of G16-167-TAP to North Benton 138 kV line;** **3 phase fault on Lieberman (508806) 138 kV to Longwood (508808) Line, CKT 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT11-PO2	**Prior Outage of G16-167-TAP to North Benton 138 kV line;** **3 phase fault on Lieberman (508806) 138 kV to Arsenal Hill (507711) 138 kV Line, CKT 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault

Table 4-1 continued

Fault ID	Contingency (Fault) Description
FLT17-PO2	**Prior Outage of G16-167-TAP to North Benton 138 kV line; 3 phase fault on Lieberman (508806) 138 kV to IPC Jefferson (508833) 138 kV Line, CKT 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted line
	c. Wait 20 cycles, and then re-close the line in (b) back into the fault
	d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
FLT19-PO2	**Prior Outage of G16-167-TAP to North Benton 138 kV line; 3 phase fault on Lieberman 138 kV (508806) to Lieberman 69 kV (508805) to Lieberman 13.8 kV (508820) XMFR 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted XMFR
FLT20-PO2	**Prior Outage of G16-167-TAP to North Benton 138 kV line; 3 phase fault on Lieberman 138 kV (508806) to Lieberman 13.5 kV (509402) XMFR 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted XMFR and dropping unit 1 at gen bus
FLT21-PO2	**Prior Outage of G16-167-TAP to North Benton 138 kV line; 3 phase fault on Lieberman 138 kV (508806) to Lieberman 13.5 kV (509401) XMFR 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted XMFR and dropping unit 1 at gen bus
FLT22-PO2	**Prior Outage of G16-167-TAP to North Benton 138 kV line; 3 phase fault on Lieberman 138 kV (508806) to Lieberman 13.5 kV (509400) XMFR 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted XMFR and dropping unit 1 at gen bus
FLT23-PO2	**Prior Outage of G16-167-TAP to North Benton 138 kV line; 3 phase fault on Lieberman 138 kV (508806) to Lieberman 13.5 kV (509399) XMFR 1, near Lieberman**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 5 cycles by tripping the faulted XMFR and dropping unit 1 at gen bus
FLT24-SB	**Single Phase Fault with Stuck Breaker at North Benson (508811) 138 kV**
	a. Apply fault at the North Benton (508811) 138 kV bus
	b. Clear fault after 16 cycles and trip the Following Elements
	1. Trip N. Benton 138kV substation (508811)
FLT25-SB	**Single Phase Fault with Stuck Breaker at Lieberman (508806) 138 kV**
	a. Apply fault at the Lieberman (508806) 138 kV bus
	b. Clear fault after 16 cycles and trip the Following Elements
	1. Trip Lieberman (508806) to Longwood (508808) 138kV circuit
	2. Trip Lieber3-1 generation facility (509401)

4.3 Results

Table 4-2 shows the results of the fault events applied to each of the study models. The associated stability plots are provided in Appendix D.

Table 4-2: Group 10 Dynamic Stability Results

Fault Name	2017WP	2018SP	2026SP
FLT01-3PH	G16-167 tripped offline	G16-167 tripped offline	G16-167 tripped offline
FLT02-3PH	Stable	Stable	Stable
FLT03-3PH	Stable	Stable	Stable
FLT04-3PH	Stable	Stable	Stable
FLT05-3PH	Stable	Stable	Stable
FLT06-3PH	Stable	Stable	Stable
FLT07-3PH	Stable	Stable	Stable
FLT08-3PH	Stable	Stable	Stable
FLT09-3PH	Stable	Stable	Stable
FLT10-3PH	Stable	Stable	Stable
FLT11-3PH	Stable	Stable	Stable
FLT12-3PH	Stable	Stable	Stable
FLT13-3PH	Stable	Stable	Stable
FLT14-3PH	Stable	Stable	Stable
FLT15-3PH	Stable	Stable	Stable
FLT16-3PH	Stable	Stable	Stable
FLT17-3PH	Stable	Stable	Stable
FLT18-3PH	Stable	Stable	Stable
FLT19-3PH	Stable	Stable	Stable
FLT20-3PH	Stable	Stable	Stable
FLT21-3PH	Stable	Stable	Stable
FLT22-3PH	Stable	Stable	Stable
FLT23-3PH	Stable	Stable	Stable
FLT03-PO1	Stable	Stable	Stable
FLT04-PO1	G16-167 tripped offline	G16-167 tripped offline	G16-167 tripped offline
FLT06-PO2	G16-167 tripped offline	G16-167 tripped offline	G16-167 tripped offline
FLT11-PO2	G16-167 tripped offline	G16-167 tripped offline	G16-167 tripped offline
FLT17-PO2	G16-167 tripped offline	G16-167 tripped offline	G16-167 tripped offline
FLT19-PO2	G16-167 tripped offline	G16-167 tripped offline	G16-167 tripped offline
FLT20-PO2	G16-167 tripped offline	G16-167 tripped offline	G16-167 tripped offline
FLT21-PO2	G16-167 tripped offline	G16-167 tripped offline	G16-167 tripped offline
FLT22-PO2	G16-167 tripped offline	G16-167 tripped offline	G16-167 tripped offline
FLT23-PO2	G16-167 tripped offline	G16-167 tripped offline	G16-167 tripped offline
FLT24-SB	Stable	Stable	Stable
FLT25-SB	Stable	Stable	Stable

As shown in Table 4-2 above, GEN-2016-167 was tripped offline by the generator's voltage and frequency relays under ten contingency conditions. The relay models provided to SPP for GEN-2016-167 are presented in Table 4-3 below. The relays that tripped GEN-2016-167 offline during the analysis are highlighted in the same table.

Table 4-3: GEN-2016-167 Relay Definitions

Relay ID	PSSE Relay Model Type	Lower Voltage/Frequency Threshold (pu or Hz)	Higher Voltage/Frequency Threshold (pu or Hz)	Relay Pickup Time (sec)	Breaker Pickup Time (sec)
58840300	'VTGTPAT'	0	1.15	3	0.1
58840301	**'VTGTPAT'**	**0**	**1.4**	**0**	**0.1**
58840302	'VTGTPAT'	0.1	10	0.6	0.1
58840303	'VTGTPAT'	0.5	10	1.9	0.1
58840304	'FRQTPAT'	0	61.5	30	0.1
58840305	**'FRQTPAT'**	**0**	**62.5**	**0**	**0.1**
58840306	'FRQTPAT'	57.5	100	10	0.1
58840307	**'FRQTPAT'**	**56.5**	**100**	**0**	**0.1**

Table 4-4 shows which relays were activated during each of the affected fault events and study model.

Table 4-4: GEN-2016-167 Generator Relay Action Per Fault Event

Relay ID	FLT01	FLT04-PO1	FLT06-PO2	FLT11-PO2	FLT17-PO2	FLT19-PO2	FLT20-PO2	FLT21-PO2	FLT22-PO2	FLT23-PO2
	2017 WP									
58840301		UVT								
58840305	OFT		OFT	OFT	OFT	OFT	OFT	OFT	OFT	OFT
	2018 SP									
58840301		UVT								
58840305			OFT	OFT	OFT	OFT	OFT	OFT	OFT	OFT
58840307	UFT									
	2026 SP									
58840305			OFT	OFT	OFT	OFT	OFT	OFT	OFT	OFT
58840307	UFT	UFT								

Note: OFT – Over-Frequency Trip, UFT – Under-Frequency Trip, UVT – Under-Voltage Trip

The following resolutions were identified for the observed results:

1. For FLT01-3PH, the three-phase fault (with reclosing) on the GEN-2016-167 POI Tap to North Benton 138 kV line close to the POI Tap, GEN-2016-167 was tripped offline. The generator was tripped for frequency levels going beyond the generator relay settings.

   Limitations within the stability models which include the inability to capture fast dynamics during abrupt changes such as fault inception and clearing and/or low-inertia within the networks can result in drastic changes to the bus reference angles which may then cause spikes in quantities such as the calculated frequencies. According to Siemens PTI, this is a well-known issue with the modeling of PV type devices in simulation software like PSS/E.

   To resolve the effect of this modeling issue, the relay pickup time for relays 58840305 and 58840307 (over and under frequency relays) were increased from 0 to 1 second effectively disabling the relays during the first second after a frequency spike is detected. Therefore, the original relay settings provided to SPP for GEN-2016-167 were not sufficient to prevent the generator tripping observed during the fault simulations.

   Figure 4-1 and Figure 4-2 show the generator and POI bus frequencies and voltages as well as the generator power during FLT01 before and after the relays setting changes respectively.

Figure 4-1: FLT01 2017WP Simulation Plot – No Changes to Relays

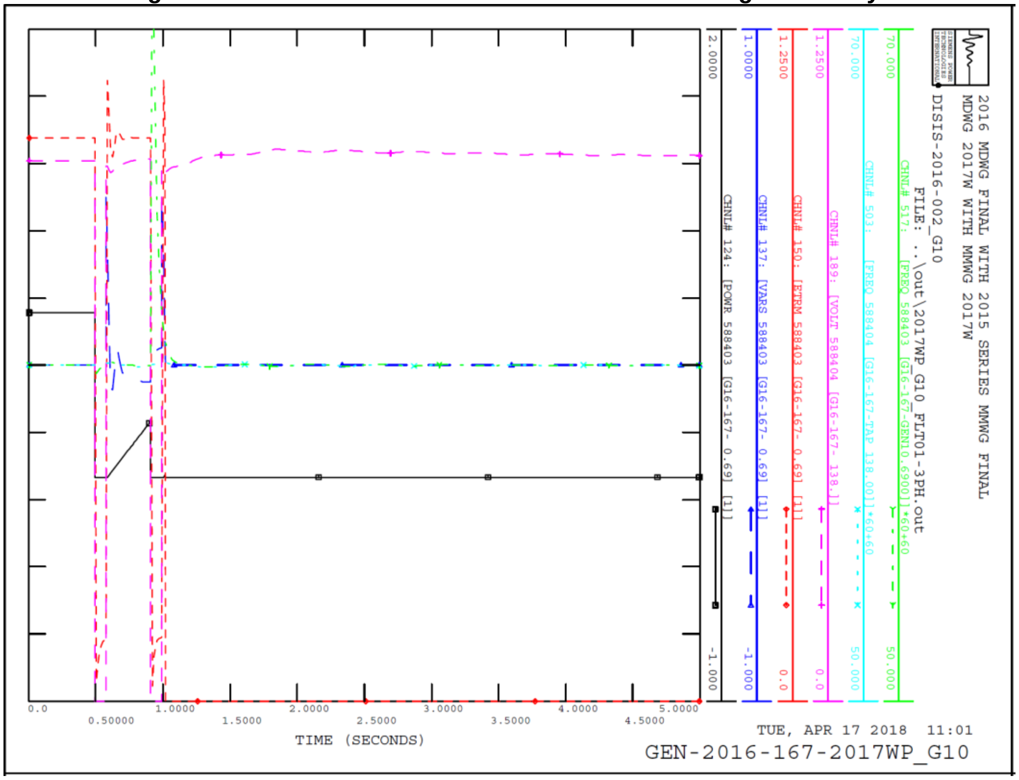
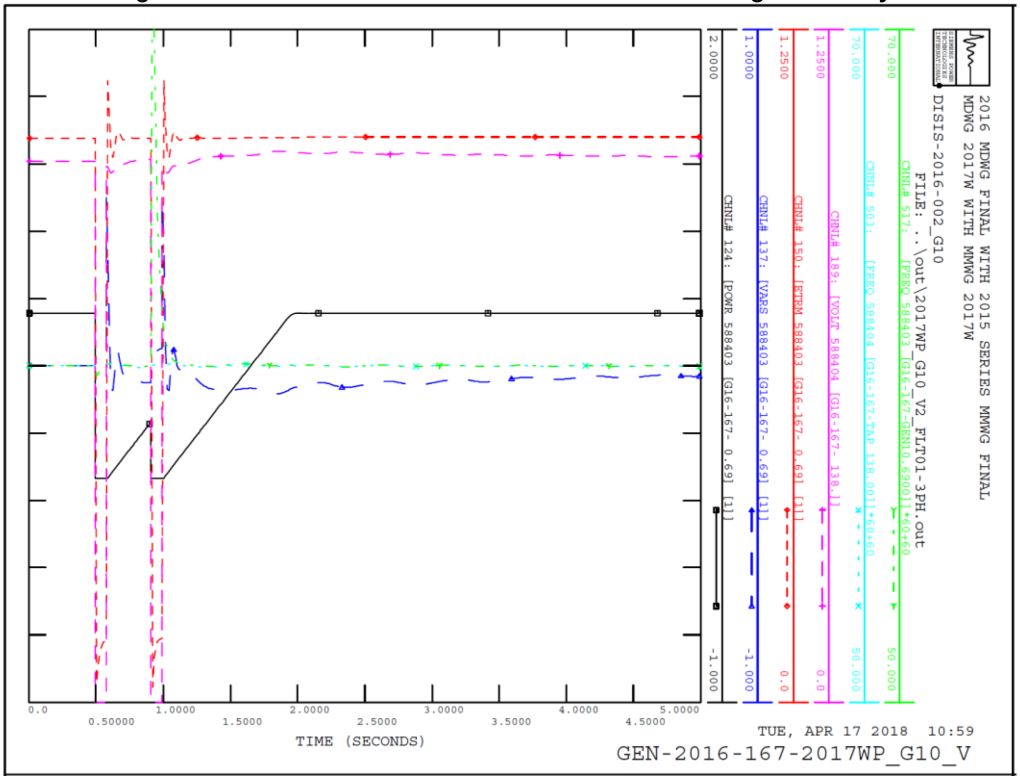


Figure 4-2: FLT01 2017WP Simulation Plot – After Changes to Relays



2. For FLT-04-PO1, a prior outage on the GEN-2016-167 POI Tap to Lieberman 138 kV line followed by a three-phase fault (with reclosing) on the North Benton to Linton 138 kV line close to the North Benton substation, GEN-2016-167 was tripped due to an over voltage relay. In order to prevent GEN-2016-167 from tripping offline, the generator output was reduced by 50% to 36.75 MW after the prior outage. With the generator reduced to 36.65 MW, GEN-2016-167 generator stayed online with the subsequent three-phase fault on the North Benton to Linton 138 kV line.

   For all eight Lieberman 138 kV substation three-phase faults applied with PO2, a prior outage on the GEN-2016-167 POI Tap to North Benton 138 kV line, GEN-2016-167 was tripped offline by the over frequency relay. Similar FLT01, to resolve this issue, the relay pickup times for relays 58840305 (over frequency relay) were increased from 0 to 1 second.

The changes made to the frequency settings are provided in Appendix D along with the dynamic simulation plots.

5.0 Conclusions

The purpose of this study was to evaluate the impacts of the DISIS-2016-002 (Group 10) generation interconnection project, GEN-2016-167, on the SPP transmission system as shown in Table 5-1. Short circuit analysis and stability analysis were performed for the evaluation using the PTI PSS/E version 33 software. The 2017 winter peak, 2018 summer peak and 2026 summer peak models developed by SPP were used in the study.

Table 5-1: Group 10 Interconnection Request

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2016-167	73.5	Power Electronics Solar inverter HEC-US V1500	Tap Lieberman – North Benton 138 kV line

The short circuit analysis was performed using the 2018SP and 2026SP study models and the results showed that there was no increase in existing fault currents with GEN-2016-167 online. Therefore, there was no short circuit impact associated with Group 10.

The dynamic stability analysis was performed using the three loading scenarios 2017WP, 2018SP and 2026SP simulating up to 35 faults that included three-phase and single-line-to-ground faults including faults on prior outage cases and stuck breakers. GEN-2016-167 generator was tripped offline by its voltage and frequency relays during ten (10) of the simulated fault events:

- For a three-phase fault at the GEN-2016-167 POI tap to the North Benton 138 kV substation, the GEN-2016-167 generator was tripped offline under both under/over frequency relay. These frequency spikes may be attributed to limitations within the stability models which include the inability to capture fast dynamics during fault inception and clearing and/or low-inertia within the networks. These conditions can result in drastic changes to the bus reference angles which may then cause spikes in quantities such as calculated frequencies. According to Siemens PTI, this is a well-known issue with the modeling of PV type devices in simulation software like PSS/E. The frequency relay pickup settings were adjusted to prevent the generator from tripping offline.

- In addition, GEN-2016-167 generator was also tripped offline with the prior outage on the GEN-2016-167 Tap to Lieberman 138 kV line followed by a three-phase fault on the North Benton to Linton 138 kV line. To mitigate this violation, the GEN-2016-167 generator output may have to be curtailed to about 36.75 MW after the outage of the 138 kV line between the POI Tap and the Lieberman substation.

- Similarly, GEN-2016-167 generator was also tripped offline with the prior outage on the GEN-2016-167 Tap to North Benton 138 kV line followed by any of the eight different three phase faults at the Lieberman 138 kV substation. Frequency relay pickup settings were adjusted to prevent the generator from tripping offline.

The results of the dynamic stability analysis show that the GEN-2016-167 project generator may have to be curtailed to 36.75 MW after the outage of the 138 kV line from the POI bus to Lieberman 138 kV substation. To resolve the generator tripping observed during some of the contingencies, changes were made to the frequency relay settings in the generator model provided to SPP. The frequency relay changes resolved the generator tripping due to frequency spikes and are captured in Appendix D along with the simulation plots.

J12: GROUP 12 DYNAMIC STABILITY ANALYSIS REPORT

Southwest Power Pool
DISIS-2016-002 Group12 Study Report
Final Report

Report No. E21995/0100

19 April 2018
Revised: 19 Apr 2018

CONFIDENTIAL
Contains Proprietary Information
DO NOT RELEASE

LEGAL NOTICE

Prepared for: Southwest Power Pool
Report No.: E21995/0100
Date: 19 April 2018
Revised: 19 Apr 2018

Author(s): Lang Chen
Reviewed by: Shu Liu
Approved by: Willie Wong

ABB Inc.
Power Grid Division
Power Consulting
901 Main Campus Drive, Suite 300
Raleigh, NC 27606

EXECUTIVE SUMMARY

Southwest Power Pool (SPP) has commissioned ABB Inc., to perform a System Impact Study for interconnection request DISIS-2016-002 (Group 12) which includes a single generation interconnection request GEN-2016-166 (35 MW solar farm connected to Prairie Grove 69kV substation).

The objective of this study is to evaluate the impact of the interconnection request on the existing and future planning system. The study is performed on three system scenarios provided by SPP:

- 2017 Winter Peak Case
- 2018 Summer Peak Case
- 2026 Summer Peak Case

With the PSS/E model and parameters provided to SPP the study request GEN-2016-166 was found to be tripped offline for some POI faults by low frequency relay, which is not a reliable response, in accordance with Good Utility Practice, or compliant with NERC standard PRC-024-2 with frequency and voltage measured at transmission side of the collector transformer. Therefore, the Interconnection Customer (IC) should review with the generator vendor the frequency relay settings, including the frequency measurement location, as well as dynamic response of the inverter model to avoid such type of tripping. Except this tripping issue, all online generating units were stable and showed adequate angular damping, and all voltages recovered after fault clearing and met the study criteria for all studied disturbances.

System three-phase short-circuit current levels at up to five buses away from the point of interconnection were calculated and tabulated for SPP's reference.

The results of this analysis are based on available data and assumptions made at the time of conducting this study. If any of the data and/or assumptions made in developing the study model change, the results provided in this report may not apply.

Contents

1 INTRODUCTION

Southwest Power Pool (SPP) has commissioned ABB Inc., to perform a System Impact Study for interconnection request DISIS-2016-002 (Group 12) which includes a single generation interconnection request GEN-2016-166 (35 MW solar farm connected to Prairie Grove 69kV substation) as shown in Table 1-1.

Table 1-1 Table 1 - Generation Interconnection Request Group 12

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2016-166	35	Solar	Prairie Grove 69kV Substation

The objective of this study is to evaluate the impact of GEN-2016-166 on the existing and future planning system. The study is performed on three system scenarios provided by SPP:

- 2017 Winter Peak Case
- 2018 Summer Peak Case
- 2026 Summer Peak Case

SPP provided the study cases for all three system scenarios with study project included. One line diagrams of the local area for all three seasons are show in Figure 1-1, Figure 1-2, and Figure 1-3 respectively. The detailed machine parameters are listed in Appendix A: .

Three system scenarios provided by SPP included the following prior queued projects for Group 12.

Table 1-2 Group 12 Prior Queued Projects

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2013-011	30.0 Increase (Pmax=683.0)	Coal 683MW	Turk 138kV (507454)
GEN-2016-013	10MW uprate (total = 60MW winter/52MW summer)	BDAX 7.290R 60MW	La Russell 161kV (547479)
GEN-2016-014	10MW uprate (total = 60MW winter/52MW summer)	BDAX 7.290R 60MW	La Russell 161kV (547479)

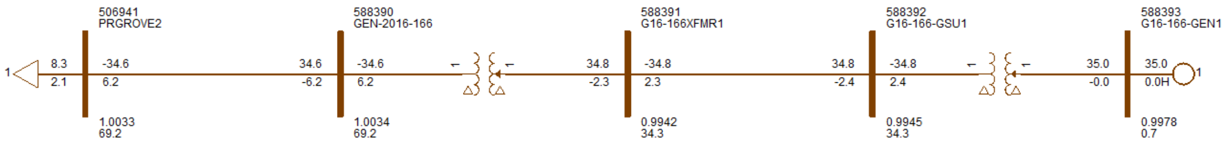


Figure 1-1 One Line Diagram for 2017 Winter Peak Case

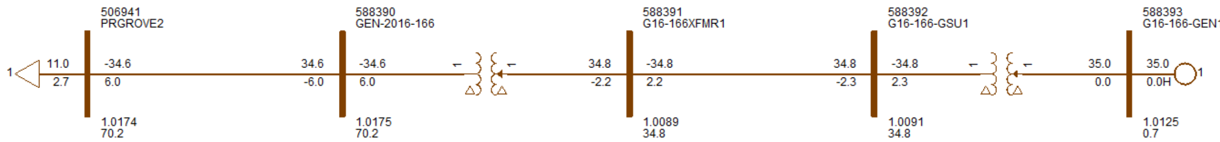


Figure 1-2 One Line Diagram for 2018 Summer Peak Case

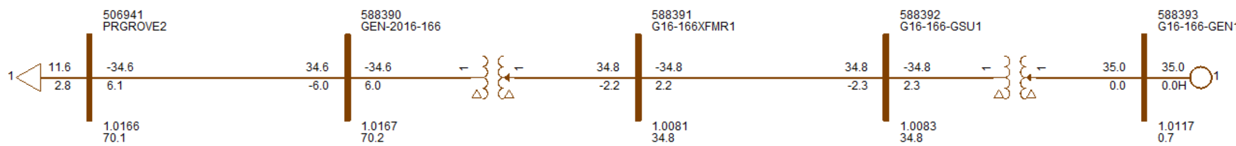


Figure 1-3 One Line Diagram for 2026 Summer Peak Case

2 STABILITY ANALYSIS

In this study, ABB investigated the stability of the system for faults in the vicinity of the study request. The studied faults involve three-phase (3PH) transformer faults with normal clearing, three-phase line faults with reclosing, and single-line-to-ground (SLG) faults with stuck breaker.

2.1 Contingency (Fault Definitions) Development

Stability analysis was performed to determine whether the electric system would meet stability criteria following the addition of project GEN-2016-166; therefore, faults in the vicinity of the point of interconnection were developed under the approval of SPP.

Three phase faults were developed at point of interconnection and nearby buses. All line faults were defined with reclosing. A five cycle fault was first applied then cleared by tripping the faulted line, and a reclose was initiated twenty cycle afterward followed by another five cycle fault, trip and lockout. Transformer faults were defined with five cycle of duration without reclosing. Prior outage faults were also developed at point of interconnection.

Single-line-to-ground faults were simulated with the standard method of applying fault impedance to the positive sequence network to represent the effect of the negative and zero sequence networks on the positive sequence network. It simulated potential breaker-failure situations for the substations. The SLG fault impedance was computed by assuming a positive sequence voltage at the fault location at approximately 60% of pre-fault voltage.

The full list and description of developed faults are shown in Table 2-1.

Table 2-1 List of Faults for Stability Analysis

Cont. No.	Cont. Name	Description
1	FLT01-3PH	3 phase fault on the Prairie Grove (506941) to Lincoln Rec (506972) 69kv circuit 1 line, near Prairie Grove a. Apply fault at the Prairie Grove 69kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT02-3PH	3 phase fault on the Prairie Grove (506941) to Greenland (506936) 69kv circuit 1 line, near Prairie Grove a. Apply fault at the Prairie Grove 69kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
3	FLT03-3PH	3 phase fault on the Lincoln Rec (506972) to Siloam Springs (506973) 69kv circuit 1 line, near Lincoln Rec a. Apply fault at the Lincoln Rec 69kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
4	FLT04-3PH	3 phase fault on the Siloam Springs (506948) to Chamber Springs (506944) 161kv circuit 1 line, near Siloam Springs a. Apply fault at the Siloam Springs 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
5	FLT05-3PH	3 phase fault on the Siloam Springs (506948) to Flint Creek (506934) 161kv circuit 1 line, near Siloam Springs a. Apply fault at the Siloam Springs 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT06-3PH	3 phase fault on the Siloam Springs (506948) to Siloam City (512643) 161kv circuit 1 line, near Siloam Springs a. Apply fault at the Siloam Springs 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
7	FLT07-3PH	3 phase fault on the Greenland (506936) to Strickler Rec (506974) 69kv circuit 1 line, near Greenland a. Apply fault at the Greenland 69kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
8	FLT08-3PH	3 phase fault on the Greenland (506936) to South Fayetteville (506946) 69kv circuit 1 line, near Greenland a. Apply fault at the Greenland 69kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
9	FLT09-3PH	3 phase fault on the South Fayetteville (506947) to Farmington (506956) 161kv circuit 1 line, near South Fayetteville a. Apply fault at the South Fayetteville 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT10-3PH	3 phase fault on the South Fayetteville (506947) to Southeast Fayetteville (506943) 161kv circuit 1 line, near South Fayetteville a. Apply fault at the South Fayetteville 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
11	FLT11-3PH	3 phase fault on the South Fayetteville (506947) to Fayetteville (506933) 161kv circuit 1 line, near South Fayetteville a. Apply fault at the South Fayetteville 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line

Cont. No.	Cont. Name	Description
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT12-3PH	3 phase fault on the Flint Creek (506935) 345/(506934) 161/(506920)13.8kv transformer, near Flint Creek 345 a. Apply fault at the Flint Creek 345kv bus. b. Clear fault after 5 cycles by tripping the faulted line
13	FLT13-3PH	3 phase fault on the Flint Creek (506934) to Tontitown (506957) 161kv circuit 1 line, near Flint Creek a. Apply fault at the Flint Creek 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
14	FLT14-3PH	3 phase fault on the Flint Creek (506934) to Siloam Springs Pod (504202) 161kv circuit 1 line, near Flint Creek a. Apply fault at the Flint Creek 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
15	FLT15-3PH	3 phase fault on the Flint Creek (506934) to Gentry Rec (504201) 161kv circuit 1 line, near Flint Creek a. Apply fault at the Flint Creek 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT16-3PH	3 phase fault on the Flint Creek (506934) to Sub 392 - Decatur South (547484) 161kv circuit 1 line, near Flint Creek a. Apply fault at the Flint Creek 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
17	FLT17-3PH	3 phase fault on the Chamber Springs (506944) to Farmington Aecc (504020) 161kv circuit 1 line, near Chamber Springs a. Apply fault at the Chamber Springs 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
18	FLT18-3PH	3 phase fault on the Chamber Springs (506944) to Siloam Springs pod (504202) 161kv circuit 1 line, near Chamber Springs a. Apply fault at the Chamber Springs 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
19	FLT19-3PH	3 phase fault on the Chamber Springs (506944) to Tontitown (506957) 161kv circuit 1 line, near Chamber Springs a. Apply fault at the Chamber Springs 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line

Cont. No.	Cont. Name	Description
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT20-3PH	3 phase fault on the Chamber Springs (506945) 345/(506944) 161/(506919)13.8kv transformer, near Chamber Springs 345 a. Apply fault at the Chamber Springs 345kv bus. b. Clear fault after 5 cycles by tripping the faulted line
21	FLT21-3PH	3 phase fault on the Siloam Springs (506948) 161/(506973) 69/(506917)13.2kv transformer, near Siloam Springs 161 a. Apply fault at the Siloam Springs 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line
22	FLT22-3PH	3 phase fault on the South Fayetteville (506947) 161/(506946) 69/(506918)13.8kv transformer, near South Fayetteville 161 a. Apply fault at the South Fayetteville 161kv bus. b. Clear fault after 5 cycles by tripping the faulted line
23	FLT23-3PH	3 phase fault on the Chamber Springs (506945) to Tontitown (506959) 345kv circuit 1 line, near Chamber Springs a. Apply fault at the Chamber Springs 345kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
24	FLT24-3PH	3 phase fault on the Chamber Springs (506945) to Clarksville (509745) 345kv circuit 1 line, near Chamber Springs a. Apply fault at the Chamber Springs 345kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
25	FLT25-3PH	3 phase fault on the Flint Creek (506935) to Brookline (549984) 345kv circuit 1 line, near Flint Creek a. Apply fault at the Flint Creek 345kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
26	FLT26-3PH	3 phase fault on the Flint Creek (506935) to Tonnece (512750) 345kv circuit 1 line, near Flint Creek a. Apply fault at the Flint Creek 345kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
27	FLT27-3PH	3 phase fault on the Flint Creek (506935) to Shipe Road (506979) 345kv circuit 1 line, near Flint Creek a. Apply fault at the Flint Creek 345kv bus. b. Clear fault after 5 cycles by tripping the faulted line c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
28	FLT28-PO	**Prior Outage of Prairie Grove (506941) to Lincoln Rec (506972) 69kv circuit 1 line** 3 phase fault on the Greenland (506936) to South Fayetteville (506946) 69kv circuit 1 line, near Greenland

Cont. No.	Cont. Name	Description
		a. Prior outage Prairie Grove (506941) to Lincoln Rec (506972) 69kv circuit 1 line (solve network for steady state solution). b. Apply fault at the Greenland 69kv bus. c. Clear fault after 5 cycles by tripping the faulted line d. Wait 20 cycles, and then re-close the line in (b) back into the fault. e. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
29	FLT29-PO	**Prior Outage of Prairie Grove (506941) to Greenland (506936) 69kv circuit 1 line** 3 phase fault on the Siloam Springs (506948) to Chamber Springs (506944) 161kv circuit 1 line, near Siloam Springs a. Prior outage Prairie Grove (506941) to Greenland (506936) 69kv circuit 1 line (solve network for steady state solution). b. Apply fault at the Siloam Springs 161kv bus. c. Clear fault after 5 cycles by tripping the faulted line d. Wait 20 cycles, and then re-close the line in (b) back into the fault. e. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
30	FLT30-SB	**Greenland 69KV Stuck Breaker** a. Apply single phase fault at the Greenland (506936) 69kv bus on the Greenland (506936)- Prairie Grove (506941) 69kv line b. Wait 16 cycles, and then trip Greenland (506936)- Prairie Grove (506941) 69kv line c. Trip South Fayetteville (506946)-Greenland (506936) 69kv line and remove the fault.
31	FLT31-SB	**Chamber Springs 345KV Stuck Breaker** a. Apply single phase fault at the Chamber Springs (506945) 345kv bus on the Chamber Springs (506945)-Clarksville (509745) 345kv line b. Wait 16 cycles, and then trip Chamber Springs (506945)-Clarksville (509745) 345kv line c. Trip Chamber Springs (506945)-Tontitown (506959) 345kv line and remove the fault.
32	FLT32-SB	**Flint Creek 345KV Stuck Breaker** a. Apply single phase fault at the Flint Creek (506935) 345kv bus on the Flint Creek (506935)-Tonnece (512750) 345kv line b. Wait 16 cycles, and then trip Flint Creek (506935)-Tonnece (512750) 345kv line c. Trip Flint Creek (506935)-Shipe Road (506979) 345kv line and remove the fault.
33	FLT33-SB	**Flint Creek 345KV Stuck Breaker** a. Apply single phase fault at the Flint Creek (506935) 345kv bus on the Flint Creek (506935)-Tonnece (512750) 345kv line b. Wait 16 cycles, and then trip Flint Creek (506935)-Tonnece (512750) 345kv line c. Trip Flint Creek (506935)-Brookline (549984) 345kv line and remove the fault.
34	FLT34-SB	**Tonnece 345KV Stuck Breaker** a. Apply single phase fault at the Tonnece (512750) 345kv bus on the Tonnece (512750)-Grda1 (512650) 345kv line b. Wait 16 cycles, and then trip Tonnece (512750)-Grda1 (512650) 345kv line c. Trip Tonnece (512750)-Flint Creek (506935) 345kv line and remove the fault.

2.2 *Study Methodology*

Stability analysis was performed using Siemens-PTI's PSS/E dynamic program V33.7.0. The Southwest Pool Disturbance Performance Criteria Requirements in Reference [1] were used to evaluate the system response during the initial transient period following a disturbance on the system. Generator response and bus voltages (115 kV and above) in Areas 502, 520, 523, 524, 525 and 351 were monitored to ensure the system performance meets criteria requirements. Bus voltage at point of interconnection and nearby 69 kV buses were also monitored to ensure proper transient response. Rotor angles of the nearby synchronous machines were investigated to make sure they maintained synchronism and had adequate damping following system faults.

To maintain system reliability generators must be designed in accordance with Good Utility Practice and comply with all applicable standards including NERC standard PRC-024-2 Generator Frequency and Voltage Protective Relay Settings. Therefore, the generators should be designed to ride through and not be tripped off line for faults on the transmission system, including those at or near the POI, that are cleared within normal clearing times. Generator speed of pre-queued projects was also monitored to ensure they stay online under system contingencies. For contingencies that result in a prior queued project tripping off-line; the contingency shall be re-run with the prior queued project's voltage and frequency tripping disabled.

2.3 Stability Analysis Results

Stability analysis was performed in PSS/E 33.7.0 and all disturbances listed in Table 2-1 were simulated for 20 seconds. As shown in the simulation results, the study generator GEN-2016-166 was tripped by its low frequency relay during some local faults at or near POI, and the detailed tripping instances are listed in Table 2-2.

Table 2-2 GEN-2016-166 Tripping Instances

Fault	2017 Winter Peak		2018 Summer Peak		2026 Summer Peak	
	Tripped?	Time [s]	Tripped?	Time [s]	Tripped?	Time [s]
FLT01-3PH	Yes	2.5292	Yes	2.5292	Yes	2.5292
FLT02-3PH	Yes	2.5292	No	N/A	No	N/A
FLT29-PO	Yes	2.5292	Yes	2.1125	Yes	2.1125

Fault FLT01-3PH of 2017 Winter Peak case is used as an example to demonstrate the problem, and this is a 3 phase fault at POI with reclosing. The following tripping message was shown in the simulation log file:

Model FRQTPAT Model Instance 58839307:
BREAKER TIMER TIMED OUT AT TIME = 2.529
MACHINE 1 AT BUS 588393 [G16-166-GEN10.6900] TRIPPED AT TIME = 2.5292

The FRQTPAT Model Instance 58839307 is shown as below, and the inverter will be tripped instantaneously when generator bus frequency is lower than 56.5 Hz.

58839307 'FRQTPAT' 588393 588393 '1' 56.500 100.000 ***0.000*** *0.10 /*

The POI and generator bus frequency are shown in Figure 2-1. The largest frequency deviation at generator bus is near 0.25 p.u. which is equivalent to 15 Hz. The generator bus frequency dropped to around 45 Hz which actuated the low frequency relay resulting in instantaneous tripping. The largest frequency deviation at POI is near 0.013 p.u. which is equivalent to 0.78 Hz. The POI bus frequency rose to around 60.78 Hz for far less than 10 seconds which is within the no-trip zone.

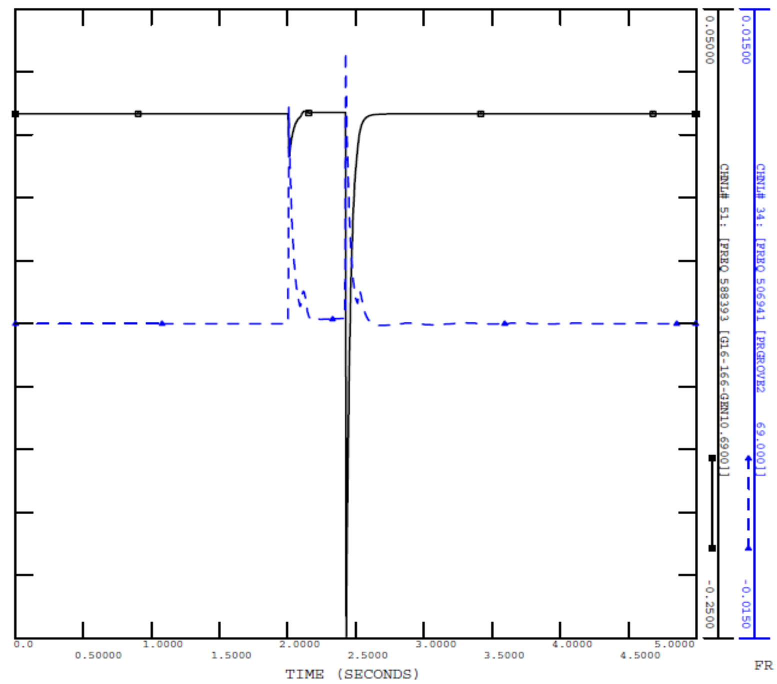


Figure 2-1 17WP FLT01-3PH POI and Generator Bus Frequency Plot

The corresponding machine quantities following the fault are shown in Figure 2-2. The study request got tripped after reclosing for fault applied at POI, which is not a reliable response, in accordance with Good Utility Practice, or compliant with NERC standard PRC-024-2 with frequency and voltage measured at transmission side of the collector transformer.

By increasing this low frequency relay pickup time from 0 to 1 second:

58839307 'FRQTPAT' 588393 588393 '1' 56.500 100.000 ***1.000*** *0.10 /*

All tripping instances listed in Table 2-2 were tested. The simulation results show that the study generator was kept in-service without tripping for all instances. Figure 2-3 shows the machine response for the same event as in Figure 2-2. Therefore, the Interconnection Customer (IC) should review with the generator vendor the frequency relay settings, including the frequency measurement location, as well as dynamic response of the inverter model to avoid such type of tripping.

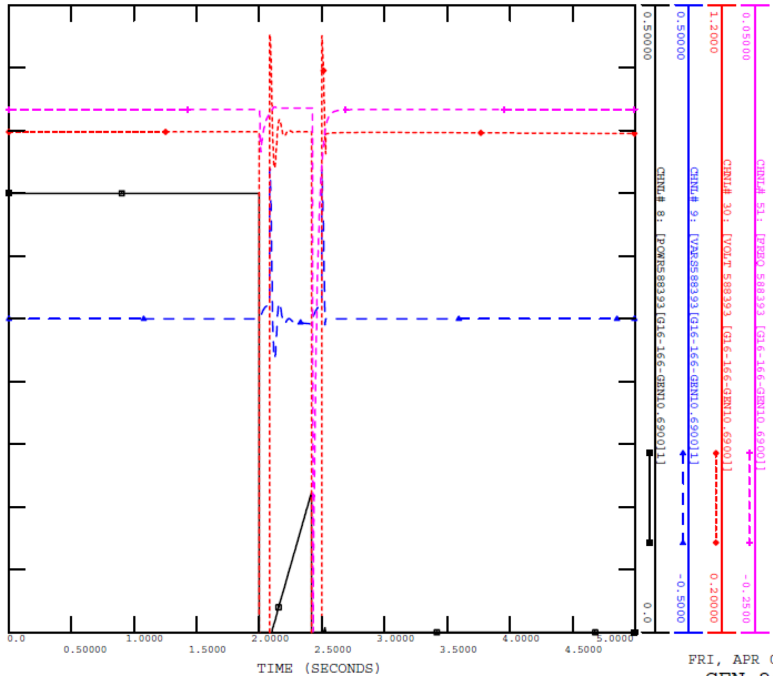


Figure 2-2 17WP FLT01-3PH GEN-2016-166 Machine Response

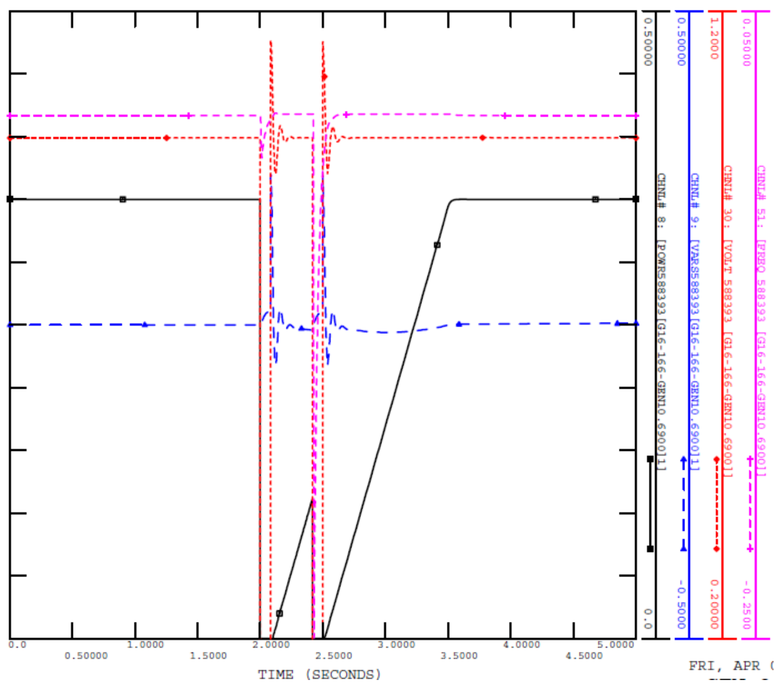


Figure 2-3 17WP FLT01-3PH GEN-2016-166 Machine Response - With Frequency Relay Adjustment

Except the tripping issue stated above, all online generating units were stable and showed adequate angular damping, and all voltages recovered after fault clearing and met the study criteria for all studied disturbances. The entire simulation results were summarized in Appendix B: Stability Analysis Results.

3 SHORT CIRCUIT ANALYSIS

Short circuit analysis was performed on the 2018 Summer Peak and 2026 Summer Peak power flow cases using ASCC function of PSS/E. Since the provided cases do not have complete sequence data, only three-phase symmetrical fault current levels were calculated at up to five buses away from the point of interconnection. And following simulation settings were used when performing such analysis:

- Use 3 phase fault
- Impose flat condition
- Output option – total fault currents in amps

The detailed analysis results are tabulated in Appendix C Short Circuit Analysis Result for SPP's reference.

4 REFERENCES

[1] Southwest Power Pool Disturbance Performance Requirements, Revision 3.0, July 21, 2016.

Appendix A: GEN-2016-166 Machine Parameters

Appendix A.1 Power Flow Model

Power flow model data is in separate file which is listed below:
AppendixA1_Power_Flow_Model.txt

(Available upon request to SPP)

Appendix A.2 Dynamic Model

Dynamic model data is in separate file which is listed below:
AppendixA2_Dynamic_Model.txt

(Available upon request to SPP)

Appendix B: Stability Analysis Results

Appendix B.1 Study Result Summary

Index	Fault Name	2017 Winter Peak			2018 Summer Peak			2026 Summer Peak		
		Stable	Volt & Angle Violation	Study Generator Tripped	Stable	Volt & Angle Violation	Study Generator Tripped	Stable	Volt & Angle Violation	Study Generator Tripped
1	FLT01-3PH	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
2	FLT02-3PH	Yes	No	Yes	Yes	No	No	Yes	No	No
3	FLT03-3PH	Yes	No	No	Yes	No	No	Yes	No	No
4	FLT04-3PH	Yes	No	No	Yes	No	No	Yes	No	No
5	FLT05-3PH	Yes	No	No	Yes	No	No	Yes	No	No
6	FLT06-3PH	Yes	No	No	Yes	No	No	Yes	No	No
7	FLT07-3PH	Yes	No	No	Yes	No	No	Yes	No	No
8	FLT08-3PH	Yes	No	No	Yes	No	No	Yes	No	No
9	FLT09-3PH	Yes	No	No	Yes	No	No	Yes	No	No
10	FLT10-3PH	Yes	No	No	Yes	No	No	Yes	No	No
11	FLT11-3PH	Yes	No	No	Yes	No	No	Yes	No	No
12	FLT12-3PH	Yes	No	No	Yes	No	No	Yes	No	No
13	FLT13-3PH	Yes	No	No	Yes	No	No	Yes	No	No
14	FLT14-3PH	Yes	No	No	Yes	No	No	Yes	No	No
15	FLT15-3PH	Yes	No	No	Yes	No	No	Yes	No	No
16	FLT16-3PH	Yes	No	No	Yes	No	No	Yes	No	No
17	FLT17-3PH	Yes	No	No	Yes	No	No	Yes	No	No
18	FLT18-3PH	Yes	No	No	Yes	No	No	Yes	No	No
19	FLT19-3PH	Yes	No	No	Yes	No	No	Yes	No	No
20	FLT20-3PH	Yes	No	No	Yes	No	No	Yes	No	No
21	FLT21-3PH	Yes	No	No	Yes	No	No	Yes	No	No
22	FLT22-3PH	Yes	No	No	Yes	No	No	Yes	No	No
23	FLT23-3PH	Yes	No	No	Yes	No	No	Yes	No	No
24	FLT24-3PH	Yes	No	No	Yes	No	No	Yes	No	No
25	FLT25-3PH	Yes	No	No	Yes	No	No	Yes	No	No
26	FLT26-3PH	Yes	No	No	Yes	No	No	Yes	No	No
27	FLT27-3PH	Yes	No	No	Yes	No	No	Yes	No	No
28	FLT28-PO	Yes	No	No	Yes	No	No	Yes	No	No
29	FLT29-PO	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
30	FLT30-SB	Yes	No	No	Yes	No	No	Yes	No	No
31	FLT31-SB	Yes	No	No	Yes	No	No	Yes	No	No
32	FLT32-SB	Yes	No	No	Yes	No	No	Yes	No	No
33	FLT33-SB	Yes	No	No	Yes	No	No	Yes	No	No
34	FLT34-SB	Yes	No	No	Yes	No	No	Yes	No	No

Appendix B.2 Study Result Plot

Plots of stability simulations for all three scenarios are in separate file which is listed below:
AppendixB2_Study_Result_Plot.zip

(Plots are available upon request to SPP)

Appendix C Short Circuit Analysis Result

Appendix C.1 2018 Summer Peak Case

Bus Number	Bus Name	3PH (Amp)	Bus Number	Bus Name	3PH (Amp)
503908	ELLIS 2 69.000	3934.9	506960	BEN279_5 161.00	13541.2
504010	ELMSPRGS 5 161.00	16344.2	506967	CEDARTP2 69.000	4645.2
504015	EFAYETVL 5 161.00	9889.2	506972	LINCOLN2 69.000	4694.6
504020	FARMNGTN 5 161.00	12476.6	506973	SILOAM 2 69.000	10890.5
504021	FARM_1 2 69.000	7008	506974	STRICKR2 69.000	3855.4
504022	FARM_T1 1 13.800	14309.6	506978	MATTISN5 161.00	18996.3
504032	VBI_N 2 69.000	10809.5	506979	SHIPERD7 345.00	9901.1
504185	FIG_FIVE 2 69.000	7361.7	506983	GREGGST5 161.00	11563
504201	GENTRY 5 161.00	25469.3	509394	FLINTCR1 22.000	183806.2
504202	SILOAMSP 5 161.00	18617	509745	CLARKSV7 345.00	20258.9
506917	SILOAM-1 13.200	14701	512642	SILSPWW5 161.00	14377.2
506918	SFAYTV-1 13.800	19200.2	512643	SILMCTY5 161.00	19255
506919	CHAMSPR1 13.800	32500.3	512714	KANSATP5 161.00	11387.5
506920	FLINT2-1 13.800	24231.6	512730	SSSWES2 69.000	11169
506921	FLINT1-1 13.800	29459.6	512737	SSSWTP2 69.000	12209.5
506927	DYESS 5 161.00	15665.7	512750	TONECE7 345.00	14474.8
506933	FAYETVL5 161.00	11705.7	512751	TONECE5 161.00	14740.7
506934	FLINTCR5 161.00	31710.9	512752	TONECE1 13.800	49550.6
506935	FLINTCR7 345.00	14642.2	512753	TONNEC2 69.000	4712.2
506936	GREENLD2 69.000	7141.2	512754	TONNEC1 13.800	7385.7
506937	HYLAND 5 161.00	10249.6	512820	SILMCTY2 69.000	13087.8
506938	LOWELL 5 161.00	11675.7	512849	SLMCTY1 13.800	13868.8
506939	VANASCH5 161.00	11816.4	512850	SLMCTY2 13.800	14493.1
506941	PRGROVE2 69.000	4869.2	515336	VBI 2 69.000	10871.9
506943	SEFAYTV5 161.00	10946.7	547484	DEC392 5 161.00	14812.5
506944	CHAMSPR5 161.00	21573.6	547496	NOL435 5 161.00	9613
506945	CHAMSPR7 345.00	9471.7	547594	DEC392 2 69.000	8193.1
506946	SFAYTVL2 69.000	10292.2	547714	DEC392 1 12.500	9466.9
506947	SFAYTVL5 161.00	12232.7	549984	BROOKLINE 7345.00	11080
506948	SILOAM 5 161.00	20941.3	588390	GEN-2016-16669.000	4824.2
506956	FARMING5 161.00	12124.8	588391	G16-166XFMR134.500	3408.3
506957	TONTITN5 161.00	19450.3	588392	G16-166-GSU134.500	3391.7
506958	TONTITN1 13.800	37019.8	588393	G16-166-GEN10.6900	121855.3
506959	TONTITN7 345.00	8426.7			

Appendix C.2 2026 Summer Peak Case

Bus Number	Bus Name	3PH (Amp)	Bus Number	Bus Name	3PH (Amp)
503908	ELLIS 2 69.000	3924.3	506960	BEN279_5 161.00	14224.2
504010	ELMSPRGS 5 161.00	20423.3	506967	CEDARTP2 69.000	4635.6
504015	EFAYETVL 5 161.00	10989.1	506972	LINCOLN2 69.000	4741.2
504020	FARMNGTN 5 161.00	14108.3	506973	SILOAM 2 69.000	11076.5
504021	FARM_1 2 69.000	8314.4	506974	STRICKR2 69.000	3874.5
504022	FARM_T1 1 13.800	15439.5	506978	MATTISN5 161.00	25466.5
504032	VBI_N 2 69.000	10689.2	506979	SHIPERD7 345.00	10351.8
504185	FIG_FIVE 2 69.000	7314.6	506983	GREGGST5 161.00	13059.3
504201	GENTRY 5 161.00	27417.8	509394	FLINTCR1 22.000	189814.8
504202	SILOAMSP 5 161.00	20103.7	509745	CLARKSV7 345.00	20034.3
506917	SILOAM-1 13.200	14766.2	512642	SILSPWW5 161.00	14890.2
506918	SFAYTV-1 13.800	19440.9	512643	SILMCTY5 161.00	20402.2
506919	CHAMSPR1 13.800	33037.1	512714	KANSATP5 161.00	11580.6
506920	FLINT2-1 13.800	24357.3	512730	SSSWES2 69.000	11327.2
506921	FLINT1-1 13.800	29649.4	512737	SSSWTP2 69.000	12398.6
506927	DYESS 5 161.00	18892.4	512750	TONECE7 345.00	15240
506933	FAYETVL5 161.00	13203.5	512751	TONECE5 161.00	15289.6
506934	FLINTCR5 161.00	34717.9	512752	TONECE1 13.800	50066.8
506935	FLINTCR7 345.00	15497.7	512753	TONNEC2 69.000	4735.4
506936	GREENLD2 69.000	7275.6	512754	TONNEC1 13.800	7397
506937	HYLAND 5 161.00	11392.3	512820	SILMCTY2 69.000	13304.9
506938	LOWELL 5 161.00	12965.6	512849	SLMCTY1 13.800	13916.8
506939	VANASCH5 161.00	13425	512850	SLMCTY2 13.800	14545.5
506941	PRGROVE2 69.000	4923.1	515336	VBI 2 69.000	10749.7
506943	SEFAYTV5 161.00	12239.3	547484	DEC392 5 161.00	15299
506944	CHAMSPR5 161.00	24691	547496	NOL435 5 161.00	9707
506945	CHAMSPR7 345.00	10707.7	547594	DEC392 2 69.000	8247.2
506946	SFAYTVL2 69.000	10659.2	547714	DEC392 1 12.500	9480
506947	SFAYTVL5 161.00	13842.4	549984	BROOKLINE 7345.00	11160.5
506948	SILOAM 5 161.00	22496.9	588390	GEN-2016-16669.000	4877.1
506956	FARMING5 161.00	13672.1	588391	G16-166XFMR134.500	3421.3
506957	TONTITN5 161.00	25881.2	588392	G16-166-GSU134.500	3404.6
506958	TONTITN1 13.800	38720	588393	G16-166-GEN10.6900	122189.3
506959	TONTITN7 345.00	9711.7			

J13: GROUP 13 DYNAMIC STABILITY ANALYSIS REPORT

Southwest Power Pool Inc. (SPP)

Definitive Impact Study

DISIS-2016-002 (Group 13)

Report Submitted to
Southwest Power Pool Inc.
June 2018

POWER-tek Global Inc.
Mississauga, Ontario, L4Z 1H8 Canada
647 300 3160
info@powertek-usa.com, www.powertek-usa.com

TABLE OF CONTENTS

1. Executive Summary

The DISIS-2016-002 (Group 13) Impact Study is a generation interconnection study performed by POWER-tek Global Inc. for Southwest Power Pool (SPP). This report presents the results of impact study comprising of short circuit and stability analyses for the proposed interconnection projects under DISIS-2016-002 (Group 13) ("The Projects") as described in Table 1.1 below:

Table 1.1: Interconnection Request

Request	Size (MW)	Generator Model	Point of Interconnection (POI)
GEN-2016-088	151.2	Wind	Transource Ketchem 345kV Substation (541500)
GEN-2016-115	300	Wind	Holt County Switching Station 345kV (541197)
GEN-2016-149	302	Wind	Stranger Creek 345kV Substation (532772)
GEN-2016-150	302	Wind	Stranger Creek 345kV Substation (532772)
GEN-2016-157	252	Wind	West Gardner 345kV Substation (542965)
GEN-2016-158	252	Wind	West Gardner 345kV Substation (542965)
GEN-2016-168	20	Solar	Higginsville 69kV Substation (543102)
GEN-2016-174	302	Wind	Stranger Creek 345kV Substation (532772)
GEN-2016-176	302	Wind	Stranger Creek 345kV Substation (532772)

Short circuit analysis up to 5 Buses away from each point of interconnection (POI) and transient stability simulations were performed for the Projects in service at its full output. SPP provided three base cases for Winter-2017, Summer-2018, and Summer-2026, each comprising of a power flow, sequence data and corresponding dynamics database. The previous queued request projects were already modeled in the base cases.

Except for FLT01-3PH, and FLT20-3PH, there are no impacts on the stability performance of the SPP system during cluster scenarios for the contingencies tested on the provided base cases. The following are the recommendations for these two contingencies:

- **FLT01-3PH**: Current study request GEN-2016-168 was found to trip on frequency relay protection. By changing the pickup time (one second) for over frequency relay "FRQTPAT", the machine response become stable. It is recommended that the inverter vendor review the PSS/E model to validate the response observed. The plots in FLT01-3PHA are evident for stable response.
- **FLT20-3PH:** With the interconnection of current study request GEN-2016-115 at the Holt County 345kV Switching Station the system response of the line outage of HOLT (541510) to S3458 (645458) 345kV line was found to be unstable with power oscillations from the GEN-2014-021 units resulting from low system voltages. Adjusting the output of the GEN-2014-021 units to +0.98 pf (at 30 MVAR each) along-with switching OFF the Bus Reactors (100MVAR) at MULLNCR7 (541197) after tripping of the said circuit HOLT (541510) to S3458 (645458), the response for GEN-2016-115, and GEN-2016-088 quantities as well as the voltages in the respective areas become stable. The reactor switching is very important following the tripping of the circuit when both requests are near maximum rated output. The plots in FLT20-3PHA are evident for stable response.

For all other contingencies, the study machines stayed on-line and stable for all simulated faults. The project stability simulations with eighty nine (89) specified test disturbances did not show instability problems in the SPP system. Any oscillations were damped out.

2. Introduction

2.1. Project Overview and Assumptions

The DISIS-2016-002 (Group 13) Impact Study is a generation interconnection study performed by POWER-tek Global Inc. for SPP. This report presents the results of impact study comprising of short circuit analysis and stability analyses for the proposed interconnection projects under DISIS-2016-002 (Group 13) ("The Projects") as described in Table 2.1.1 below:

Table 2.1.1: Interconnection requests

Request	Size (MW)	Generator Model	Point of Interconnection (POI)
GEN-2016-088	151.2	Wind	Transource Ketchem 345kV Substation (541500)
GEN-2016-115	300	Wind	Holt County Switching Station 345kV (541197)
GEN-2016-149	302	Wind	Stranger Creek 345kV Substation (532772)
GEN-2016-150	302	Wind	Stranger Creek 345kV Substation (532772)
GEN-2016-157	252	Wind	West Gardner 345kV Substation (542965)
GEN-2016-158	252	Wind	West Gardner 345kV Substation (542965)
GEN-2016-168	20	Solar	Higginsville 69kV Substation (543102)
GEN-2016-174	302	Wind	Stranger Creek 345kV Substation (532772)
GEN-2016-176	302	Wind	Stranger Creek 345kV Substation (532772)

Figure 2.1.1, 2.1.2, 2.1.3, 2.1.4, and 2.1.5 shows the single line diagram for the interconnection of the Projects to present and planned system of SPP. This arrangement was modeled and studied in power flow cases for these projects.

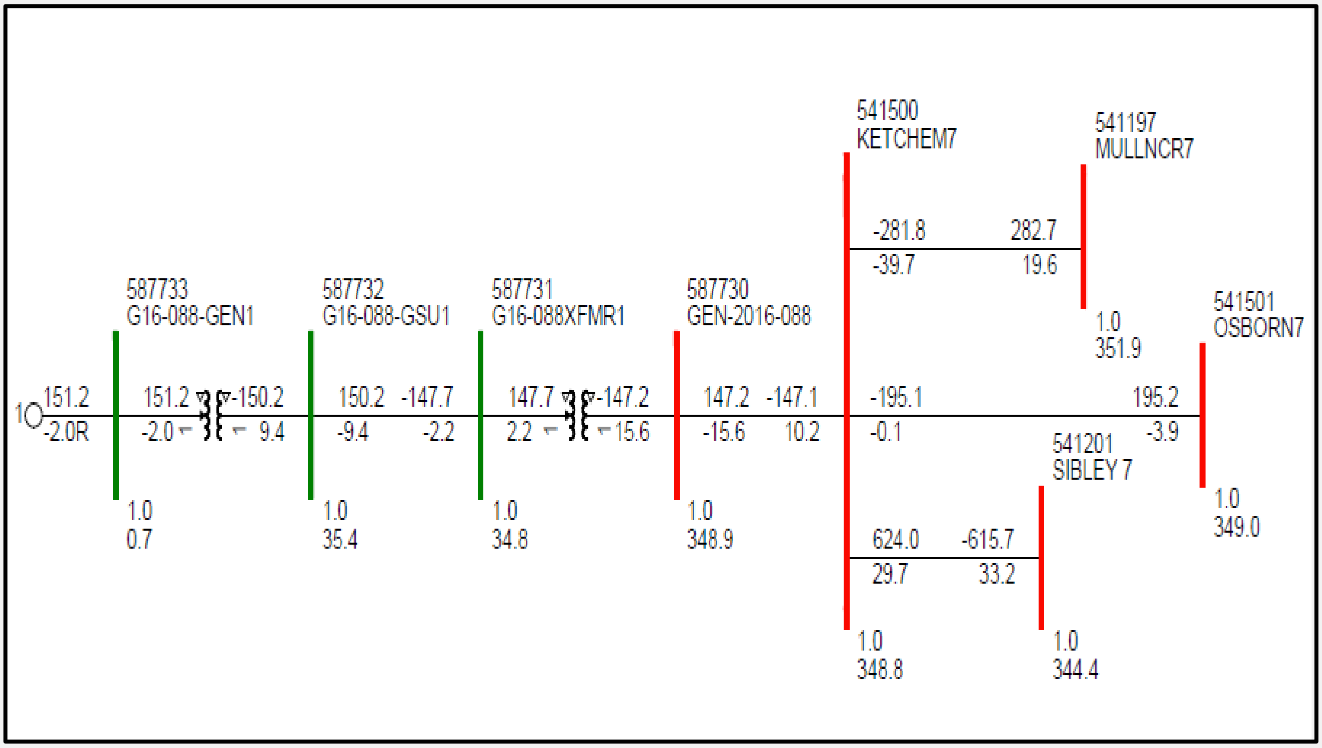


Figure 2.1.1: Power flow single line diagram for GEN-2016-088 and surrounding system components

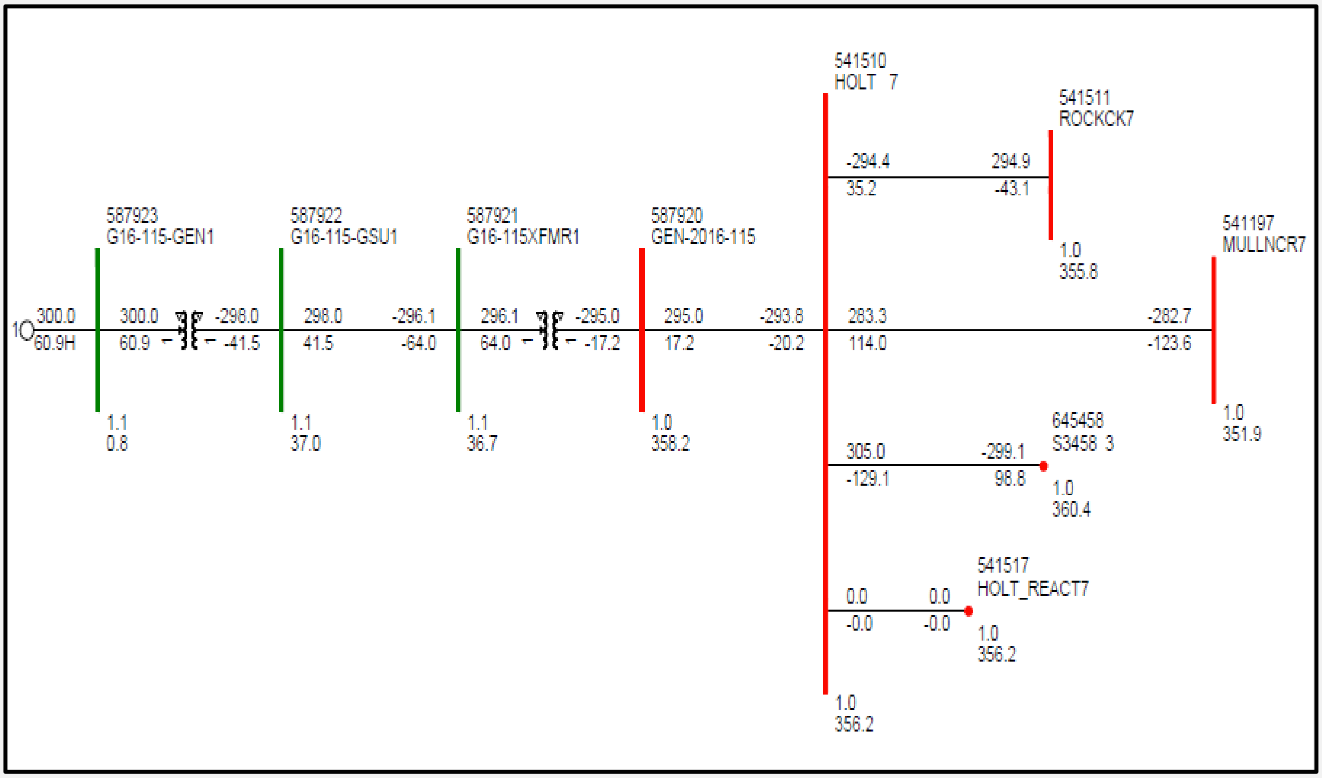


Figure 2.1.2: Power flow single line diagram for GEN-2016-115 and surrounding system components

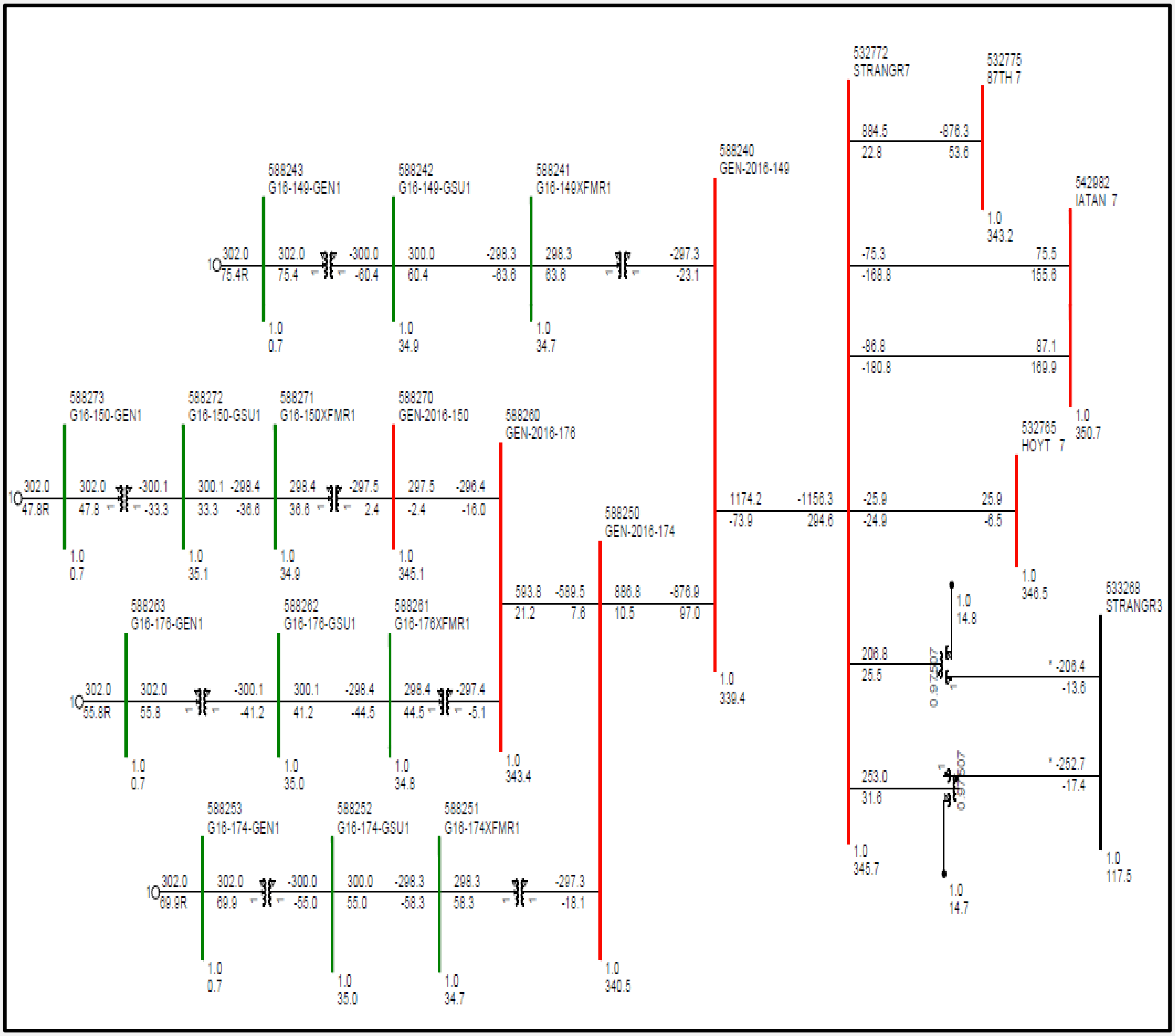


Figure 2.1.3: Power flow single line diagram for GEN-2016-149, GEN-2016-150, GEN-2016-174, and GEN-2016-176 and surrounding system components

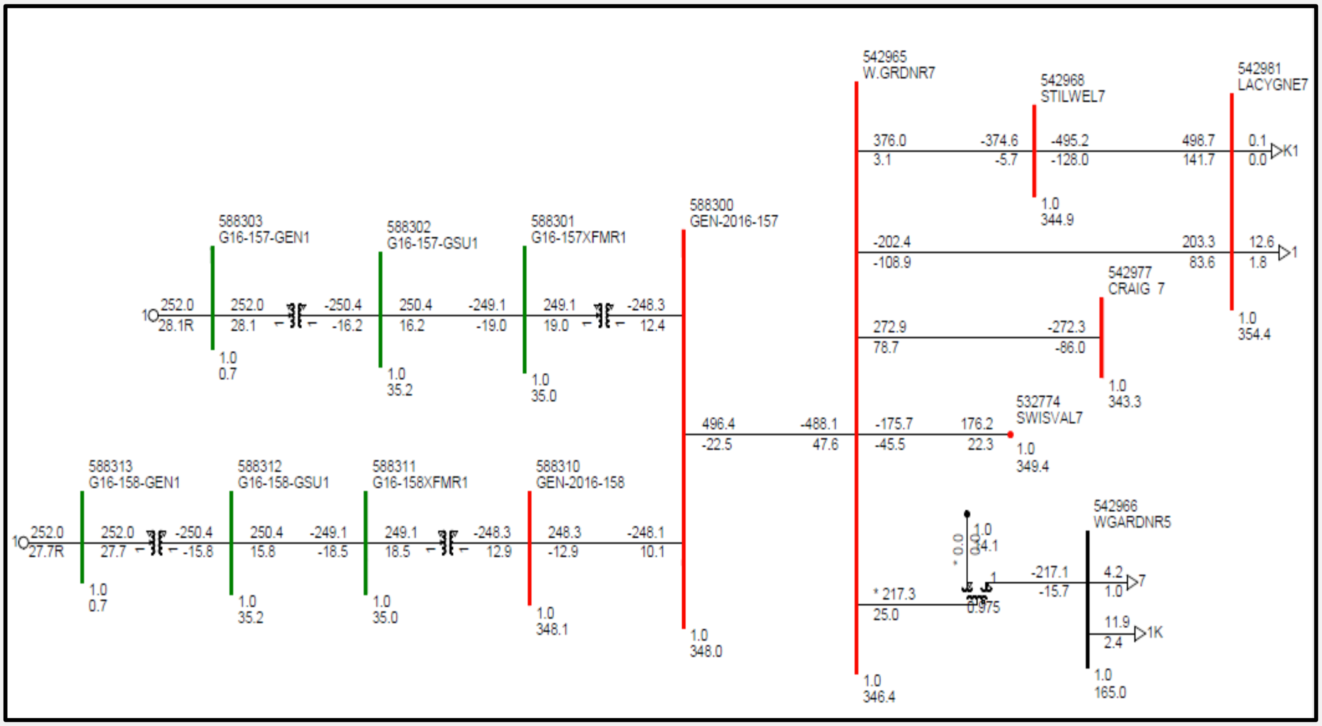


Figure 2.1.4: Power flow single line diagram for GEN-2016-157 and surrounding system components

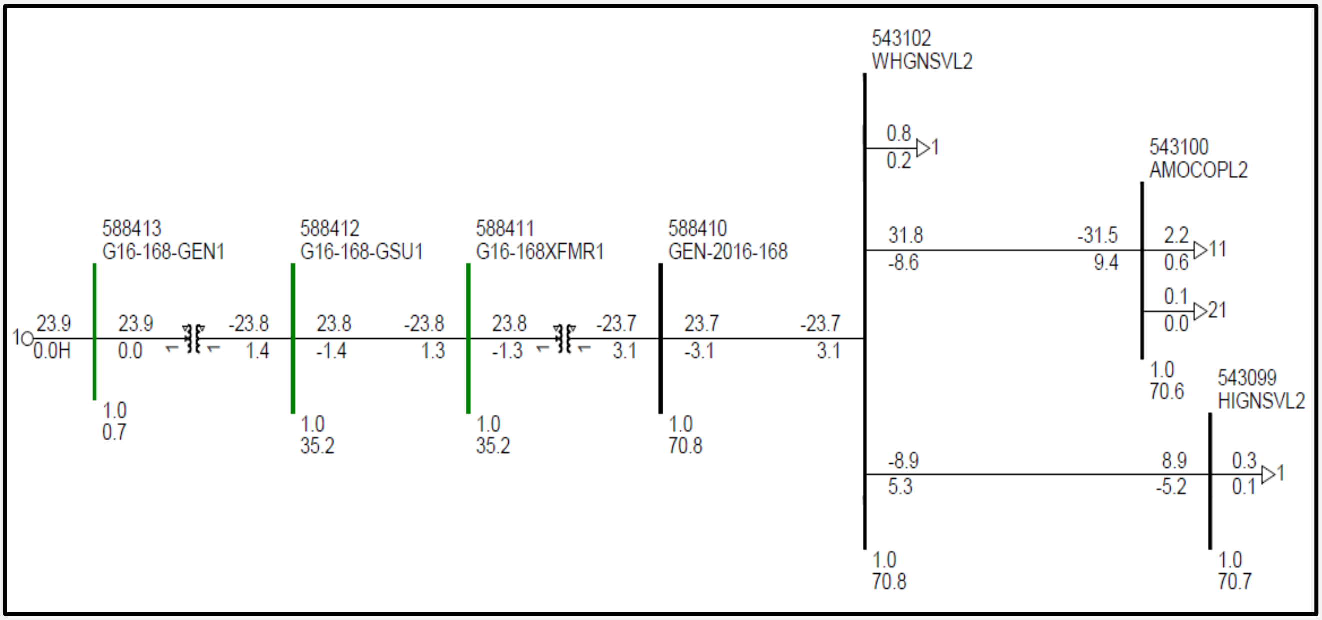


Figure 2.1.5: Power flow single line diagram for GEN-2016-168 and surrounding system components

Appendix-D contains the machines, interconnection, and machines user model parameters.

Table 2.1.2 below shows the list of prior queued projects modeled in the base case.

Table 2.1.2: List of previous queued request projects

Request	Size (MW)	Wind Turbine Model	Point of Interconnection
KCPL Distributed: Osawatomie	76.0	GENROU	Paola 161kV (543069)
GEN-2008-129	675	Thermal - ST 191/293MW	Pleasant Hill 161kV (541225)
GEN-2010-036	4.6	Hydro 1.0/1.3MW	6th Street 115kV (533264)
GEN-2011-011/GEN-2004-008	900	Thermal - CT 954.5W	Iatan 345kV (542982)
ASGI-2013-007	90	GE 2.5MW	Tap Hickory Creek (300087) – Locust Creek (300094) 161kV (562450)
GEN-2014-021	300	Vestas V110 VCSS 2.0MW	Tap Nebraska City/S3458 (645458) to Mullins Creek (541197) 345kV (560009)
GEN-2015-005	200.11	GE 116m 1.79/2/2.1MW	Nebraska City-Sibley 345kV (bus 560028)
ASGI-2016-003	12	Caterpiller Diesel Engine 12MW	Paola 161kV (587563)
ASGI-2017-006	238	Vestas V110 VCSS 2MW	Maryville 161kV (300097)

ATC (Available Transfer Capability) studies were not performed as part of this study. These studies will be required at the time transmission service is actually requested. Additional transmission upgrades may be required based on that analysis.

Study assumptions in general have been based on the specific information and data provided by SPP. The accuracy of the conclusions contained within this study is dependent on the assumptions made with respect to other generation additions and transmission improvements planned by other entities. Changes in the assumptions of the timing of other generation additions or transmission improvements may affect this study's conclusions.

2.2. Objectives

The objectives of the study are to determine the impact on system stability of interconnecting the proposed power plants to SPP's transmission system.

2.3. Models and Simulations Tools Used

Version 33.7 of the Siemens, PSS/E^{TM} power system simulation program was used in this study.

SPP provided its latest stability database cases for Winter-2017, Summer-2018, and Summer-2026 peak seasons. The Project's PSS/E model had been developed prior to this study and was included in the power flow case and the dynamics database. Machines, interconnection and dynamic model data for the Project plants is provided in Appendix D.

Power flow single line diagram of the projects in summer 2018 peak condition is shown in Figure 2.1.1, 2.1.2, 2.1.3, 2.1.4, and 2.1.5 respectively. These figures shows that wind farms model includes representation of the radial transmission line, the substation transformer from transmission voltage (230kV and 345kV) to 34.5V. The remainder of each wind farm is represented by lumped equivalents including a generator, a step-up transformer, and collector system impedance.

No special modeling is required of line relays in these cases, except for the special modeling related to the wind-turbine tripping.

All generators in Areas 536, 540, 541, 542, 544, 545, 635, 640, 645, 650, 652, 330, and 356 were monitored.

3. Short Circuit Analysis

The short circuit analysis out five buses away was performed for 2018, and 2026 summer peak case for each interconnection request under project cluster scenario of DISIS-2016-002 (Group 13). No outage was assumed in the system model.

3.1. Short Circuit Result for 2018 Summer Peak Case

The short circuit results for summer-2018 scenario (assumed not outage) at the POI are tabulated below.

3.1.1. Short Circuit Result for Transource Ketchem 345kV Substation (541500)

The results of the short circuit analysis for POI i.e., Transource Ketchem 345kV Substation (541500) and five bus levels away are tabulated below in Table 3.1.1.

Table 3.1.1: Short circuit results for Transource Ketchem 345kV Substation (541500)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541500	KETCHEM7 345.0	0 LEVELS AWAY	8006.9
541197	MULLNCR7 345.0	1 LEVELS AWAY	8165.5
541201	SIBLEY 7 345.0	1 LEVELS AWAY	20773.6
541501	OSBORN7 345.0	1 LEVELS AWAY	7088.1
587730	GEN-2016-088345.0	1 LEVELS AWAY	6926.2
345408	7OVERTON 345.0	2 LEVELS AWAY	12282.4
541200	PHILL 7 345.0	2 LEVELS AWAY	18438.8
541202	SIBLEY 5 161.0	2 LEVELS AWAY	30166.5
541360	SIBLEY T 13.80	2 LEVELS AWAY	68131.3
541411	MC REAC1 345.0	2 LEVELS AWAY	7783.8
541412	MC REAC2 345.0	2 LEVELS AWAY	7783.8
541413	MC REAC3 345.0	2 LEVELS AWAY	7783.8
541414	SIB REA1 345.0	2 LEVELS AWAY	18470
541502	OSBORN_B1_1 34.50	2 LEVELS AWAY	26003.3
541505	OSBORN_TER_113.80	2 LEVELS AWAY	35393
541510	HOLT 7 345.0	2 LEVELS AWAY	9664.5
542972	HAWTH 7 345.0	2 LEVELS AWAY	21744.4
587731	G16-088XFMR134.50	2 LEVELS AWAY	18546.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
345088	7MCCREDIE 345.0	3 LEVELS AWAY	16687
345409	5OVERTON 161.0	3 LEVELS AWAY	20592.9
541198	PECULR 7 345.0	3 LEVELS AWAY	20232.8
541225	PHILL 5 161.0	3 LEVELS AWAY	33410.9
541250	SIBLEYPL 161.0	3 LEVELS AWAY	32985.6
541361	PHILL T 13.80	3 LEVELS AWAY	68191.1
541504	OSBORN_TX_1 34.50	3 LEVELS AWAY	22476.4
541511	ROCKCK7 345.0	3 LEVELS AWAY	7345.8
541517	HOLT_REACT7 345.0	3 LEVELS AWAY	9608.8
542973	HAWTHRN5 161.0	3 LEVELS AWAY	52182.8
542980	NASHUA 7 345.0	3 LEVELS AWAY	21039.4
543644	HAWT T20 13.80	3 LEVELS AWAY	19694.2
543645	HAWT T22 13.80	3 LEVELS AWAY	20500.6
587732	G16-088-GSU134.50	3 LEVELS AWAY	15635.6
587920	GEN-2016-115345.0	3 LEVELS AWAY	6903.6
645458	S3458 3 345.0	3 LEVELS AWAY	28480.3
300044	7MCCRED 345.0	4 LEVELS AWAY	16657
300500	5HUNTSDL 161.0	4 LEVELS AWAY	13451.2
345221	5MOBERLY 161.0	4 LEVELS AWAY	14731
345230	7MONTGMRY 345.0	4 LEVELS AWAY	27740.8
345411	5OVERTON 2 161.0	4 LEVELS AWAY	20592.9
541151	SIBLEY#3 22.00	4 LEVELS AWAY	120493.9
541162	DOGWDSTG 18.00	4 LEVELS AWAY	99029.2
541163	DOGWDCT1 18.00	4 LEVELS AWAY	90576
541164	DOGWDCT2 18.00	4 LEVELS AWAY	91750.9
541199	ST JOE 3 345.0	4 LEVELS AWAY	18900.2
541215	HLLMRK 5 161.0	4 LEVELS AWAY	13303.4
541235	DUNCAN 5 161.0	4 LEVELS AWAY	19584.8
541239	HSNVL 5 161.0	4 LEVELS AWAY	15489.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541243	LKWINGB5 161.0	4 LEVELS AWAY	24113.8
541244	ORRICK 5 161.0	4 LEVELS AWAY	14480.6
541263	SIBLEY 2 69.00	4 LEVELS AWAY	15911.4
541280	PHILL 2 69.00	4 LEVELS AWAY	13229.7
541313	HARRIS 161.0	4 LEVELS AWAY	25552.3
541342	PECULR 5 161.0	4 LEVELS AWAY	23029.9
541372	PECULRT 13.80	4 LEVELS AWAY	57933.7
541503	OSBORN_G1_1 0.690	4 LEVELS AWAY	928341.4
541506	OSBORN_G2_1 0.690	4 LEVELS AWAY	228889.8
541512	ROCKCK_B_1 34.50	4 LEVELS AWAY	39779
541515	ROCKCK_TR1_113.20	4 LEVELS AWAY	2587706.8
541516	ROCKCK_TR2_113.20	4 LEVELS AWAY	2682402.2
542951	HAW G5 1 22.00	4 LEVELS AWAY	189758.4
542961	HAWCT6 1 16.00	4 LEVELS AWAY	80865
542967	HAW G9 1 13.80	4 LEVELS AWAY	77052.6
542968	STILWEL7 345.0	4 LEVELS AWAY	24553
542976	LEVEE 5 161.0	4 LEVELS AWAY	46696
542982	IATAN 7 345.0	4 LEVELS AWAY	28808.6
542997	LEEDS 5 161.0	4 LEVELS AWAY	31573.3
543000	BLUEVLY5 161.0	4 LEVELS AWAY	35627.2
543011	CHOUTEU5 161.0	4 LEVELS AWAY	32224.9
543020	BRMGHAM5 161.0	4 LEVELS AWAY	25298.9
543027	RANDLPH5 161.0	4 LEVELS AWAY	30470.6
543028	NASHUA-5 161.0	4 LEVELS AWAY	26862.3
543080	HAWTH 2 69.00	4 LEVELS AWAY	12845
543640	NASH T11 13.80	4 LEVELS AWAY	11879.9
548808	ECKLES-161 161.0	4 LEVELS AWAY	26775
548814	SUB M-161 161.0	4 LEVELS AWAY	20057.6
587733	G16-088-GEN10.690	4 LEVELS AWAY	666952.8

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
587921	G16-115XFMR134.50	4 LEVELS AWAY	36941.3
640139	COOPER 3 345.0	4 LEVELS AWAY	26646.2
645011	NEBCTY1G 18.00	4 LEVELS AWAY	219266.8
645012	NEBCTY2G 23.00	4 LEVELS AWAY	188201.5
645456	S3456 3 345.0	4 LEVELS AWAY	30251.6
645740	S3740 3 345.0	4 LEVELS AWAY	17221.9
650189	103&ROKEBY3 345.0	4 LEVELS AWAY	19518.7
300039	7FAIRPT 345.0	5 LEVELS AWAY	12250.6
300043	7KINGDM 345.0	5 LEVELS AWAY	14288.1
300049	7THOMHL 345.0	5 LEVELS AWAY	13929
300098	5MOCITY 161.0	5 LEVELS AWAY	19074.6
300126	5MOBTAP 161.0	5 LEVELS AWAY	14740.8
300320	5LEVASY 161.0	5 LEVELS AWAY	10696.8
300709	2SHARSNV 69.00	5 LEVELS AWAY	6202.6
343004	5PERCHE 161.0	5 LEVELS AWAY	13494.2
344224	7CALAWY 1 345.0	5 LEVELS AWAY	24779.1
344233	5CALIF UE 161.0	5 LEVELS AWAY	10072.5
344535	7ENON 345.0	5 LEVELS AWAY	17067.1
344886	7LABADIE3 345.0	5 LEVELS AWAY	37678.4
345071	5MCBAIN T 161.0	5 LEVELS AWAY	15189.4
345222	2MOBERLY 69.00	5 LEVELS AWAY	7065.2
345231	5MONTGMRY 161.0	5 LEVELS AWAY	17890.8
345992	7SPENCER 345.0	5 LEVELS AWAY	14895.4
532772	STRANGR7 345.0	5 LEVELS AWAY	26127.8
541150	IATAN 11 13.80	5 LEVELS AWAY	18116.3
541152	SIBLEY#2 13.20	5 LEVELS AWAY	41449.2
541153	SIBLEY#1 13.20	5 LEVELS AWAY	38019.7
541203	NASHUA 5 161.0	5 LEVELS AWAY	26862.3
541205	BLSPE 5 161.0	5 LEVELS AWAY	20631.9

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541207	ARCHIE 5 161.0	5 LEVELS AWAY	16708.7
541218	GRNWD 5 161.0	5 LEVELS AWAY	23737.5
541230	RNRIDGE5 161.0	5 LEVELS AWAY	21352.1
541236	RICHMND5 161.0	5 LEVELS AWAY	7921.2
541241	SEDEAST5 161.0	5 LEVELS AWAY	7345.3
541247	LBRTYWT5 161.0	5 LEVELS AWAY	14598.3
541248	LBRTYST5 161.0	5 LEVELS AWAY	18468.6
541249	HOOKRD 5 161.0	5 LEVELS AWAY	21943.6
541253	ST JOE 5 161.0	5 LEVELS AWAY	19696.9
541262	LIBERTY2 69.00	5 LEVELS AWAY	9832.2
541279	RGREEN 2 69.00	5 LEVELS AWAY	13299.1
541295	HSNVL 2 69.00	5 LEVELS AWAY	8531.9
541340	BELTONS5 161.0	5 LEVELS AWAY	19151.3
541344	PECULRS5 161.0	5 LEVELS AWAY	21889
541347	RAYMORE 69.00	5 LEVELS AWAY	8601.4
541350	IATAN5 161.0	5 LEVELS AWAY	16952.6
541370	STJOE 1T 13.80	5 LEVELS AWAY	63377
541371	STJOE 2T 13.80	5 LEVELS AWAY	63428
541400	EASTOWN7 345.0	5 LEVELS AWAY	17264.1
541513	ROCKCK_T_1 34.50	5 LEVELS AWAY	39455.8
542957	IAT G1 1 24.00	5 LEVELS AWAY	188539.2
542962	IAT G2 1 25.00	5 LEVELS AWAY	243639.2
542963	HAWCT7 1 13.80	5 LEVELS AWAY	51183.7
542964	HAWCT8 1 13.80	5 LEVELS AWAY	51959.8
542965	W.GRDNR7 345.0	5 LEVELS AWAY	26277
542969	STILWEL5 161.0	5 LEVELS AWAY	38815.2
542981	LACYGNE7 345.0	5 LEVELS AWAY	25371.3
542985	NEAST 5 161.0	5 LEVELS AWAY	38808.1
543004	BLUMILS5 161.0	5 LEVELS AWAY	17152.7

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
543009	WINJT N5 161.0	5 LEVELS AWAY	18413.6
543010	WINJT S5 161.0	5 LEVELS AWAY	21920.4
543015	AVONDAL5 161.0	5 LEVELS AWAY	27052.5
543023	CLAYCM25 161.0	5 LEVELS AWAY	13149.2
543029	SHOLCRK5 161.0	5 LEVELS AWAY	16280
543062	SALSBRY5 161.0	5 LEVELS AWAY	11291
543091	DUNCNRD2 69.00	5 LEVELS AWAY	6411.3
543114	PLUMRRD2 69.00	5 LEVELS AWAY	12403.3
543639	LEEDREAC 161.0	5 LEVELS AWAY	22874.9
543647	STIL T11 13.80	5 LEVELS AWAY	18888.6
543648	STIL T22 13.80	5 LEVELS AWAY	19822.3
548803	SUB F 69.00	5 LEVELS AWAY	13884.6
548807	BLUVLY-161 161.0	5 LEVELS AWAY	17851.5
548815	SUB M 69.00	5 LEVELS AWAY	21292.6
548820	SUB N-161 161.0	5 LEVELS AWAY	15559.8
587922	G16-115-GSU134.50	5 LEVELS AWAY	36845.3
635000	CBLUFFS3 345.0	5 LEVELS AWAY	29175.7
635017	ATCHSN 3 345.0	5 LEVELS AWAY	16932.9
640009	COOPER1G 22.00	5 LEVELS AWAY	270040.3
640140	COOPER 5 161.0	5 LEVELS AWAY	17469.9
640142	COOPER T2 913.80	5 LEVELS AWAY	44615.5
640277	MOORE 3 345.0	5 LEVELS AWAY	21048.5
643172	COOPER T5 913.80	5 LEVELS AWAY	25604.2
645041	CASS 1G 15.00	5 LEVELS AWAY	98035.1
645042	CASS 2G 15.00	5 LEVELS AWAY	98319
645111	NBAXT1 9 4.200	5 LEVELS AWAY	48499.5
645112	NBAXT2 9 4.200	5 LEVELS AWAY	48206
645455	S3455 3 345.0	5 LEVELS AWAY	27497.9
645459	S3459 3 345.0	5 LEVELS AWAY	21217.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
646206	S1206 5 161.0	5 LEVELS AWAY	39971.8
648256	S3456T49 13.80	5 LEVELS AWAY	18575.6
650185	WAGENER 3 345.0	5 LEVELS AWAY	19441.6

3.1.2. Short Circuit Result for Holt County Switching Station 345kV (541197)

The results of the short circuit analysis for POI i.e., Holt County Switching Station 345kV (541197) and five bus levels away are tabulated below in Table 3.1.2.

Table 3.1.2: Short circuit results for Holt County Switching Station 345kV (541197)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541197	MULLNCR7 345.0	0 LEVELS AWAY	8165.5
541411	MC REAC1 345.0	1 LEVELS AWAY	7783.8
541412	MC REAC2 345.0	1 LEVELS AWAY	7783.8
541413	MC REAC3 345.0	1 LEVELS AWAY	7783.8
541500	KETCHEM7 345.0	1 LEVELS AWAY	8006.9
541510	HOLT 7 345.0	1 LEVELS AWAY	9664.5
541201	SIBLEY 7 345.0	2 LEVELS AWAY	20773.6
541501	OSBORN7 345.0	2 LEVELS AWAY	7088.1
541511	ROCKCK7 345.0	2 LEVELS AWAY	7345.8
541517	HOLT_REACT7 345.0	2 LEVELS AWAY	9608.8
587730	GEN-2016-088345.0	2 LEVELS AWAY	6926.2
587920	GEN-2016-115345.0	2 LEVELS AWAY	6903.6
645458	S3458 3 345.0	2 LEVELS AWAY	28480.3
345408	7OVERTON 345.0	3 LEVELS AWAY	12282.4
541200	PHILL 7 345.0	3 LEVELS AWAY	18438.8
541202	SIBLEY 5 161.0	3 LEVELS AWAY	30166.5
541360	SIBLEY T 13.80	3 LEVELS AWAY	68131.3

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541414	SIB REA1 345.0	3 LEVELS AWAY	18470
541502	OSBORN_B1_1 34.50	3 LEVELS AWAY	26003.3
541505	OSBORN_TER_113.80	3 LEVELS AWAY	35393
541512	ROCKCK_B_1 34.50	3 LEVELS AWAY	39779
541515	ROCKCK_TR1_113.20	3 LEVELS AWAY	2587706.8
541516	ROCKCK_TR2_113.20	3 LEVELS AWAY	2682402.2
542972	HAWTH 7 345.0	3 LEVELS AWAY	21744.4
587731	G16-088XFMR134.50	3 LEVELS AWAY	18546.4
587921	G16-115XFMR134.50	3 LEVELS AWAY	36941.3
640139	COOPER 3 345.0	3 LEVELS AWAY	26646.2
645011	NEBCTY1G 18.00	3 LEVELS AWAY	219266.8
645012	NEBCTY2G 23.00	3 LEVELS AWAY	188201.5
645456	S3456 3 345.0	3 LEVELS AWAY	30251.6
645740	S3740 3 345.0	3 LEVELS AWAY	17221.9
650189	103&ROKEBY3 345.0	3 LEVELS AWAY	19518.7
300039	7FAIRPT 345.0	4 LEVELS AWAY	12250.6
345088	7MCCREDIE 345.0	4 LEVELS AWAY	16687
345409	5OVERTON 161.0	4 LEVELS AWAY	20592.9
541198	PECULR 7 345.0	4 LEVELS AWAY	20232.8
541199	ST JOE 3 345.0	4 LEVELS AWAY	18900.2
541225	PHILL 5 161.0	4 LEVELS AWAY	33410.9
541250	SIBLEYPL 161.0	4 LEVELS AWAY	32985.6
541361	PHILL T 13.80	4 LEVELS AWAY	68191.1
541504	OSBORN_TX_1 34.50	4 LEVELS AWAY	22476.4
541513	ROCKCK_T_1 34.50	4 LEVELS AWAY	39455.8
542973	HAWTHRN5 161.0	4 LEVELS AWAY	52182.8
542980	NASHUA 7 345.0	4 LEVELS AWAY	21039.4
543644	HAWT T20 13.80	4 LEVELS AWAY	19694.2
543645	HAWT T22 13.80	4 LEVELS AWAY	20500.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
587732	G16-088-GSU134.50	4 LEVELS AWAY	15635.6
587922	G16-115-GSU134.50	4 LEVELS AWAY	36845.3
635000	CBLUFFS3 345.0	4 LEVELS AWAY	29175.7
635017	ATCHSN 3 345.0	4 LEVELS AWAY	16932.9
640009	COOPER1G 22.00	4 LEVELS AWAY	270040.3
640140	COOPER 5 161.0	4 LEVELS AWAY	17469.9
640142	COOPER T2 913.80	4 LEVELS AWAY	44615.5
640277	MOORE 3 345.0	4 LEVELS AWAY	21048.5
643172	COOPER T5 913.80	4 LEVELS AWAY	25604.2
645041	CASS 1G 15.00	4 LEVELS AWAY	98035.1
645042	CASS 2G 15.00	4 LEVELS AWAY	98319
645111	NBAXT1 9 4.200	4 LEVELS AWAY	48499.5
645112	NBAXT2 9 4.200	4 LEVELS AWAY	48206
645455	S3455 3 345.0	4 LEVELS AWAY	27497.9
645459	S3459 3 345.0	4 LEVELS AWAY	21217.6
646206	S1206 5 161.0	4 LEVELS AWAY	39971.8
648256	S3456T49 13.80	4 LEVELS AWAY	18575.6
650185	WAGENER 3 345.0	4 LEVELS AWAY	19441.6
84760	J476 POI 345.0	5 LEVELS AWAY	16848.7
300044	7MCCRED 345.0	5 LEVELS AWAY	16657
300076	5FAIRPT 161.0	5 LEVELS AWAY	16943.1
300500	5HUNTSDL 161.0	5 LEVELS AWAY	13451.2
345221	5MOBERLY 161.0	5 LEVELS AWAY	14731
345230	7MONTGMRY 345.0	5 LEVELS AWAY	27740.8
345411	5OVERTON 2 161.0	5 LEVELS AWAY	20592.9
541151	SIBLEY#3 22.00	5 LEVELS AWAY	120493.9
541162	DOGWDSTG 18.00	5 LEVELS AWAY	99029.2
541163	DOGWDCT1 18.00	5 LEVELS AWAY	90576
541164	DOGWDCT2 18.00	5 LEVELS AWAY	91750.9

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541215	HLLMRK 5 161.0	5 LEVELS AWAY	13303.4
541235	DUNCAN 5 161.0	5 LEVELS AWAY	19584.8
541239	HSNVL 5 161.0	5 LEVELS AWAY	15489.6
541243	LKWINGB5 161.0	5 LEVELS AWAY	24113.8
541244	ORRICK 5 161.0	5 LEVELS AWAY	14480.6
541253	ST JOE 5 161.0	5 LEVELS AWAY	19696.9
541263	SIBLEY 2 69.00	5 LEVELS AWAY	15911.4
541280	PHILL 2 69.00	5 LEVELS AWAY	13229.7
541313	HARRIS 161.0	5 LEVELS AWAY	25552.3
541342	PECULR 5 161.0	5 LEVELS AWAY	23029.9
541370	STJOE 1T 13.80	5 LEVELS AWAY	63377
541371	STJOE 2T 13.80	5 LEVELS AWAY	63428
541372	PECULRT 13.80	5 LEVELS AWAY	57933.7
541400	EASTOWN7 345.0	5 LEVELS AWAY	17264.1
541503	OSBORN_G1_1 0.690	5 LEVELS AWAY	928341.4
541506	OSBORN_G2_1 0.690	5 LEVELS AWAY	228889.8
541514	ROCKCK_G1_1 0.690	5 LEVELS AWAY	1426202
541518	ROCKCK_G2_1 0.690	5 LEVELS AWAY	1426202
542951	HAW G5 1 22.00	5 LEVELS AWAY	189758.4
542961	HAWCT6 1 16.00	5 LEVELS AWAY	80865
542967	HAW G9 1 13.80	5 LEVELS AWAY	77052.6
542968	STILWEL7 345.0	5 LEVELS AWAY	24553
542976	LEVEE 5 161.0	5 LEVELS AWAY	46696
542982	IATAN 7 345.0	5 LEVELS AWAY	28808.6
542997	LEEDS 5 161.0	5 LEVELS AWAY	31573.3
543000	BLUEVLY5 161.0	5 LEVELS AWAY	35627.2
543011	CHOUTEU5 161.0	5 LEVELS AWAY	32224.9
543020	BRMGHAM5 161.0	5 LEVELS AWAY	25298.9
543027	RANDLPH5 161.0	5 LEVELS AWAY	30470.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
543028	NASHUA-5 161.0	5 LEVELS AWAY	26862.3
543080	HAWTH 2 69.00	5 LEVELS AWAY	12845
543640	NASH T11 13.80	5 LEVELS AWAY	11879.9
548808	ECKLES-161 161.0	5 LEVELS AWAY	26775
548814	SUB M-161 161.0	5 LEVELS AWAY	20057.6
560062	G15-088-TAP 345.0	5 LEVELS AWAY	10977.8
587733	G16-088-GEN10.690	5 LEVELS AWAY	666952.8
587923	G16-115-GEN10.690	5 LEVELS AWAY	1985098.4
635001	CBLUFFS5 161.0	5 LEVELS AWAY	35513.4
635013	PNYCRK 3 345.0	5 LEVELS AWAY	26818
635014	POTTCO 3 345.0	5 LEVELS AWAY	22021.1
635016	STHLND 3 345.0	5 LEVELS AWAY	26811.8
635019	ATCHSN 9 34.50	5 LEVELS AWAY	28795.8
635023	CBLUF33G 24.00	5 LEVELS AWAY	194223.8
635024	CBLUF4G 26.00	5 LEVELS AWAY	196612.5
635025	CBLF1XT9 13.80	5 LEVELS AWAY	30071.8
635026	CBLF2XT9 13.80	5 LEVELS AWAY	35045.6
640271	MCCOOL 3 345.0	5 LEVELS AWAY	10219.6
640278	SHELDON7 115.0	5 LEVELS AWAY	30574.7
640280	MOORE 9 13.80	5 LEVELS AWAY	31639.2
640446	COOPER 869.00	5 LEVELS AWAY	4558.4
643173	COOPER T6 913.80	5 LEVELS AWAY	6037.7
645033	SARPY 3G 13.80	5 LEVELS AWAY	76389
645034	SARPY 4G 13.80	5 LEVELS AWAY	40165.2
645035	SARPY 5G 13.80	5 LEVELS AWAY	40248.6
645451	S3451 3 345.0	5 LEVELS AWAY	19108.5
645454	S3454 3 345.0	5 LEVELS AWAY	23734.1
646201	S1201 5 161.0	5 LEVELS AWAY	28687.2
646209	S1209 5 161.0	5 LEVELS AWAY	35840.1

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
646216	S1216 5 161.0	5 LEVELS AWAY	27648.3
646232	S1232 5 161.0	5 LEVELS AWAY	24476.1
646244	S1244 5 161.0	5 LEVELS AWAY	20640.7
646255	S1255 5 161.0	5 LEVELS AWAY	39625.8
646280	S1280 5 161.0	5 LEVELS AWAY	10067.2
647006	S906 N 8 69.00	5 LEVELS AWAY	31451.7
647906	S906 S 8 69.00	5 LEVELS AWAY	31118.5
648206	S1206T19 13.80	5 LEVELS AWAY	17752.9
648255	S3455T19 13.80	5 LEVELS AWAY	17891.6
648259	S3459T39 13.80	5 LEVELS AWAY	4149.7
648306	S1206T29 13.80	5 LEVELS AWAY	30355
648355	S3455T39 13.80	5 LEVELS AWAY	4167.6
650114	NW68HOLDRG3 345.0	5 LEVELS AWAY	16287.9
650285	WAGENER 7 115.0	5 LEVELS AWAY	29771.1
650385	WAGENER1 9 13.80	5 LEVELS AWAY	27880.3
650485	WAGENER2 9 13.80	5 LEVELS AWAY	19677.4

3.1.3. Short Circuit Result for Stranger Creek 345kV Substation (532772)

The results of the short circuit analysis for POI i.e., Stranger Creek 345kV Substation (532772) and five bus levels away are tabulated below in Table 3.1.3.

Table 3.1.3: Short circuit results for Stranger Creek 345kV Substation (532772)

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
532772	STRANGR7 345.0	0 LEVELS AWAY	26127.8
532765	HOYT 7 345.0	1 LEVELS AWAY	15747.8
532775	87TH 7 345.0	1 LEVELS AWAY	20829.5
532811	STRAN1 1 14.40	1 LEVELS AWAY	48875.1

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532816	STRAN3 1 14.40	1 LEVELS AWAY	41703.9
533268	STRANGR3 115.0	1 LEVELS AWAY	33535.4
542982	IATAN 7 345.0	1 LEVELS AWAY	28808.6
588240	GEN-2016-149345.0	1 LEVELS AWAY	8633.5
532766	JEC N 7 345.0	2 LEVELS AWAY	23639.5
532804	HOYT 1 14.40	2 LEVELS AWAY	31483.4
532818	87TH 1X1 13.80	2 LEVELS AWAY	71179.1
533163	HOYT 3 115.0	2 LEVELS AWAY	22830.4
533211	ARNOLD 3 115.0	2 LEVELS AWAY	7267.9
533244	JARBALO3 115.0	2 LEVELS AWAY	25261.3
533259	NW LEAV3 115.0	2 LEVELS AWAY	16096
533272	THORNTN3 115.0	2 LEVELS AWAY	15268.4
533283	87TH 3 115.0	2 LEVELS AWAY	26266.9
541150	IATAN 11 13.80	2 LEVELS AWAY	18116.3
541350	IATAN5 161.0	2 LEVELS AWAY	16952.6
541400	EASTOWN7 345.0	2 LEVELS AWAY	17264.1
542957	IAT G1 1 24.00	2 LEVELS AWAY	188539.2
542962	IAT G2 1 25.00	2 LEVELS AWAY	243639.2
542977	CRAIG 7 345.0	2 LEVELS AWAY	22339.7
542980	NASHUA 7 345.0	2 LEVELS AWAY	21039.4
588241	G16-149XFMR134.50	2 LEVELS AWAY	32281.1
588250	GEN-2016-174345.0	2 LEVELS AWAY	5671.5
532652	JEC U2 26.00	3 LEVELS AWAY	189412.3
532653	JEC U3 26.00	3 LEVELS AWAY	188706.5
532767	GEARY 7 345.0	3 LEVELS AWAY	9944.1
532770	MORRIS 7 345.0	3 LEVELS AWAY	12796.7
532805	JEC 13 1 14.40	3 LEVELS AWAY	33403.3
532806	JEC 26 1 14.40	3 LEVELS AWAY	33614.1
532852	JEC 6 230.0	3 LEVELS AWAY	24665.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533169	NTHLAND3 115.0	3 LEVELS AWAY	14787
533198	HOYTJS 3 115.0	3 LEVELS AWAY	19864.7
533199	HOYTJN 3 115.0	3 LEVELS AWAY	18940.7
533215	OVRLAND3 115.0	3 LEVELS AWAY	6775
533216	KERFORD3 115.0	3 LEVELS AWAY	7293.9
533218	PARALEL3 115.0	3 LEVELS AWAY	5667.1
533219	TONGATP3 115.0	3 LEVELS AWAY	15073.3
533233	166TH 3 115.0	3 LEVELS AWAY	15908.1
533242	HALLMRK3 115.0	3 LEVELS AWAY	12121.2
533246	EFAIRMNT3 115.0	3 LEVELS AWAY	10592.7
533251	MIDLNDJ3 115.0	3 LEVELS AWAY	14213
533266	SPRUCE 3 115.0	3 LEVELS AWAY	14606.3
533273	TIMBRLN3 115.0	3 LEVELS AWAY	13153.8
533278	WAVERLY3 115.0	3 LEVELS AWAY	14234.4
533281	MNTCLLO3 115.0	3 LEVELS AWAY	22290.7
533284	95WAJ 3 115.0	3 LEVELS AWAY	14982.9
533449	ARNOLD 1 7.200	3 LEVELS AWAY	20577.8
533471	ARNOLD 2 69.00	3 LEVELS AWAY	7286.2
541199	ST JOE 3 345.0	3 LEVELS AWAY	18900.2
541351	WESTON 5 161.0	3 LEVELS AWAY	12616.1
541401	EASTOWN5 161.0	3 LEVELS AWAY	16955.4
541402	EASTOWN1 13.80	3 LEVELS AWAY	56481.2
542965	W.GRDNR7 345.0	3 LEVELS AWAY	26277
542972	HAWTH 7 345.0	3 LEVELS AWAY	21744.4
542978	CRAIG 5 161.0	3 LEVELS AWAY	39942.7
543028	NASHUA-5 161.0	3 LEVELS AWAY	26862.3
543640	NASH T11 13.80	3 LEVELS AWAY	11879.9
543641	CRAI T11 13.80	3 LEVELS AWAY	12282.6
543642	CRAI T22 13.80	3 LEVELS AWAY	19128.2

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
543643	CRAI T33 13.80	3 LEVELS AWAY	18794.2
588242	G16-149-GSU134.50	3 LEVELS AWAY	31629.9
588251	G16-174XFMR134.50	3 LEVELS AWAY	28253.1
588260	GEN-2016-176345.0	3 LEVELS AWAY	4231.3
300039	7FAIRPT 345.0	4 LEVELS AWAY	12250.6
532651	JEC U1 26.00	4 LEVELS AWAY	180327.8
532768	EMPEC 7 345.0	4 LEVELS AWAY	17334.7
532773	SUMMIT 7 345.0	4 LEVELS AWAY	11430.6
532774	SWISVAL7 345.0	4 LEVELS AWAY	16402.3
532809	MORRIS1X1 14.40	4 LEVELS AWAY	31464.8
532834	GEARY1X1 13.80	4 LEVELS AWAY	67943.4
532851	AUBURN 6 230.0	4 LEVELS AWAY	13310.9
532861	EMANHAT6 230.0	4 LEVELS AWAY	9598.3
532863	MORRIS 6 230.0	4 LEVELS AWAY	13863
533156	54&MERI3 115.0	4 LEVELS AWAY	16400.9
533162	INDNOLA3 115.0	4 LEVELS AWAY	19345.6
533165	HTI JCT3 115.0	4 LEVELS AWAY	16606
533220	WALNUT 3 115.0	4 LEVELS AWAY	5070.2
533235	CAPTAIN3 115.0	4 LEVELS AWAY	10703.9
533239	ESAAPJ 3 115.0	4 LEVELS AWAY	12522.9
533243	JAGGARD3 115.0	4 LEVELS AWAY	15949.9
533249	LEC U4 3 115.0	4 LEVELS AWAY	23680
533255	MOONLTJ3 115.0	4 LEVELS AWAY	11518.3
533260	MIDLADS3 115.0	4 LEVELS AWAY	24813.4
533261	PENTAGN3 115.0	4 LEVELS AWAY	21237.2
533265	SOUTHTN3 115.0	4 LEVELS AWAY	10925.3
533336	GEARY 3 115.0	4 LEVELS AWAY	17159.1
533456	COLINE 2 69.00	4 LEVELS AWAY	8261.3
533479	ARNOJCT2 69.00	4 LEVELS AWAY	7286.2

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533481	NORTONV2 69.00	4 LEVELS AWAY	3175.4
541201	SIBLEY 7 345.0	4 LEVELS AWAY	20773.6
541203	NASHUA 5 161.0	4 LEVELS AWAY	26862.3
541221	PLTCTY 5 161.0	4 LEVELS AWAY	15571.9
541230	RNRIDGE5 161.0	4 LEVELS AWAY	21352.1
541253	ST JOE 5 161.0	4 LEVELS AWAY	19696.9
541254	EAST 5 161.0	4 LEVELS AWAY	15353.1
541256	IND PRK5 161.0	4 LEVELS AWAY	14991.8
541370	STJOE 1T 13.80	4 LEVELS AWAY	63377
541371	STJOE 2T 13.80	4 LEVELS AWAY	63428
542966	WGARDNR5 161.0	4 LEVELS AWAY	27028.7
542968	STILWEL7 345.0	4 LEVELS AWAY	24553
542973	HAWTHRN5 161.0	4 LEVELS AWAY	52182.8
542979	PFLUMM 5 161.0	4 LEVELS AWAY	27070.2
542981	LACYGNE7 345.0	4 LEVELS AWAY	25371.3
543029	SHOLCRK5 161.0	4 LEVELS AWAY	16280
543038	LENEXAS5 161.0	4 LEVELS AWAY	26430
543039	LENEXAN5 161.0	4 LEVELS AWAY	27526
543048	COLLEGE5 161.0	4 LEVELS AWAY	28031.6
543049	CEDRCRK5 161.0	4 LEVELS AWAY	27853.7
543644	HAWT T20 13.80	4 LEVELS AWAY	19694.2
543645	HAWT T22 13.80	4 LEVELS AWAY	20500.6
543649	WGAR T11 13.80	4 LEVELS AWAY	16018.3
588243	G16-149-GEN10.690	4 LEVELS AWAY	1353447.6
588252	G16-174-GSU134.50	4 LEVELS AWAY	27798.4
588261	G16-176XFMR134.50	4 LEVELS AWAY	25141.2
588270	GEN-2016-150345.0	4 LEVELS AWAY	3227.4
588300	GEN-2016-157345.0	4 LEVELS AWAY	4936.2
640139	COOPER 3 345.0	4 LEVELS AWAY	26646.2

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
300076	5FAIRPT 161.0	5 LEVELS AWAY	16943.1
300307	2PLATCTY 69.00	5 LEVELS AWAY	8705.2
345408	7OVERTON 345.0	5 LEVELS AWAY	12282.4
532662	LEC U4 14.40	5 LEVELS AWAY	87307.6
532740	EMPEC121 13.80	5 LEVELS AWAY	60922.9
532741	EMPEC341 13.80	5 LEVELS AWAY	60922.9
532742	EMPEC5 1 18.00	5 LEVELS AWAY	85445.1
532743	EMPEC6 1 18.00	5 LEVELS AWAY	85445.1
532744	EMPEC7 1 18.00	5 LEVELS AWAY	85445.1
532769	LANG 7 345.0	5 LEVELS AWAY	17122.6
532793	NEOSHO 7 345.0	5 LEVELS AWAY	16064.4
532799	WAVERLY7 345.0	5 LEVELS AWAY	14610.2
532813	SUMMIT 1 14.40	5 LEVELS AWAY	30657.8
532815	SWISV1X1 14.40	5 LEVELS AWAY	36193.5
532819	SWISV2X2 14.40	5 LEVELS AWAY	803272.1
532856	SWISVAL6 230.0	5 LEVELS AWAY	21382.8
532862	MCDOWEL6 230.0	5 LEVELS AWAY	6913.1
532865	NMANHT6 230.0	5 LEVELS AWAY	8797.4
532873	SUMMIT 6 230.0	5 LEVELS AWAY	13746.3
532874	UNIONRG6 230.0	5 LEVELS AWAY	8898.3
532880	AUBURN 1 14.40	5 LEVELS AWAY	64890
532888	EMANHAT1 18.00	5 LEVELS AWAY	30037.1
532890	MORRIS2X1 13.80	5 LEVELS AWAY	39043.8
533151	AUBURN 3 115.0	5 LEVELS AWAY	21261.4
533152	CIRCLVL3 115.0	5 LEVELS AWAY	6110.8
533153	COLINE 3 115.0	5 LEVELS AWAY	22096.6
533164	HTI 3 115.0	5 LEVELS AWAY	13436.3
533166	INDIANH3 115.0	5 LEVELS AWAY	17243.9
533168	N TYLER3 115.0	5 LEVELS AWAY	16141.8

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533196	EDUCATE3 115.0	5 LEVELS AWAY	15702.4
533226	TCSEVRN3 115.0	5 LEVELS AWAY	3146.8
533234	BISMARK3 115.0	5 LEVELS AWAY	18117.3
533240	EUDORA 3 115.0	5 LEVELS AWAY	11051.9
533248	LEC U3 3 115.0	5 LEVELS AWAY	23817.1
533250	LWRNCHL3 115.0	5 LEVELS AWAY	25129.2
533252	MIDLADN3 115.0	5 LEVELS AWAY	24813.4
533254	MOONLIT3 115.0	5 LEVELS AWAY	10138.5
533262	BONITA 3 115.0	5 LEVELS AWAY	9642.7
533282	MUND 3 115.0	5 LEVELS AWAY	15936.5
533305	MORRIS 3 115.0	5 LEVELS AWAY	12437.9
533326	EMANHAT3 115.0	5 LEVELS AWAY	13120.2
533328	FT JCT 3 115.0	5 LEVELS AWAY	14550
533335	MCDOWEL3 115.0	5 LEVELS AWAY	17732.8
533362	CHAPMAN3 115.0	5 LEVELS AWAY	10397.8
533443	COLINE 1 34.50	5 LEVELS AWAY	3253.4
533451	WALNUT 1 34.50	5 LEVELS AWAY	2173.2
533458	ROCKCRK2 69.00	5 LEVELS AWAY	3634.6
533477	MW SOLV2 69.00	5 LEVELS AWAY	6172.2
533480	MUSCOTA2 69.00	5 LEVELS AWAY	1543.8
533483	VALLEY22 69.00	5 LEVELS AWAY	2988.5
533484	WALNUT 2 69.00	5 LEVELS AWAY	5861.3
539805	ELMCREEK7 345.0	5 LEVELS AWAY	5208.7
541198	PECULR 7 345.0	5 LEVELS AWAY	20232.8
541200	PHILL 7 345.0	5 LEVELS AWAY	18438.8
541202	SIBLEY 5 161.0	5 LEVELS AWAY	30166.5
541204	SMTHVL 5 161.0	5 LEVELS AWAY	20458.8
541212	KCI 5 161.0	5 LEVELS AWAY	12312.8
541247	LBRTYWT5 161.0	5 LEVELS AWAY	14598.3

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541252	ST JOEREA 5 161.0	5 LEVELS AWAY	6368.8
541255	LAKE RD5 161.0	5 LEVELS AWAY	12685.1
541257	COOK 5 161.0	5 LEVELS AWAY	13892.6
541258	WOODBIN5 161.0	5 LEVELS AWAY	16572
541260	RNRDGE 2 69.00	5 LEVELS AWAY	4868.3
541318	NCONGRS5 161.0	5 LEVELS AWAY	17492.2
541360	SIBLEY T 13.80	5 LEVELS AWAY	68131.3
541414	SIB REA1 345.0	5 LEVELS AWAY	18470
541500	KETCHEM7 345.0	5 LEVELS AWAY	8006.9
542951	HAW G5 1 22.00	5 LEVELS AWAY	189758.4
542955	LAC G1 1 22.00	5 LEVELS AWAY	232856.5
542956	LAC G2 1 24.00	5 LEVELS AWAY	211001.1
542961	HAWCT6 1 16.00	5 LEVELS AWAY	80865
542967	HAW G9 1 13.80	5 LEVELS AWAY	77052.6
542969	STILWEL5 161.0	5 LEVELS AWAY	38815.2
542976	LEVEE 5 161.0	5 LEVELS AWAY	46696
542997	LEEDS 5 161.0	5 LEVELS AWAY	31573.3
543000	BLUEVLY5 161.0	5 LEVELS AWAY	35627.2
543011	CHOUTEU5 161.0	5 LEVELS AWAY	32224.9
543016	GLADSTN5 161.0	5 LEVELS AWAY	17178.7
543019	BARRY 5 161.0	5 LEVELS AWAY	17160.8
543020	BRMGHAM5 161.0	5 LEVELS AWAY	25298.9
543022	CLAYCM15 161.0	5 LEVELS AWAY	10628.2
543026	TIFFANY5 161.0	5 LEVELS AWAY	18818
543027	RANDLPH5 161.0	5 LEVELS AWAY	30470.6
543031	SHWNMSN5 161.0	5 LEVELS AWAY	31505.4
543036	OLATHE 5 161.0	5 LEVELS AWAY	25279.9
543047	OVERLPK5 161.0	5 LEVELS AWAY	29649.6
543052	REEDER 5 161.0	5 LEVELS AWAY	18983.1

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
543054	CEDARNL5 161.0	5 LEVELS AWAY	9217
543077	PLSTVAL5 161.0	5 LEVELS AWAY	9737.8
543080	HAWTH 2 69.00	5 LEVELS AWAY	12845
543105	BULLCRK5 161.0	5 LEVELS AWAY	24797.4
543132	BNSF 5 161.0	5 LEVELS AWAY	20067.5
543629	LACYGNE11_7 345.0	5 LEVELS AWAY	24730.8
543632	LACYGNE22_7 345.0	5 LEVELS AWAY	24694.3
543647	STIL T11 13.80	5 LEVELS AWAY	18888.6
543648	STIL T22 13.80	5 LEVELS AWAY	19822.3
548814	SUB M-161 161.0	5 LEVELS AWAY	20057.6
562476	G14-001-TAP 345.0	5 LEVELS AWAY	11138.3
585100	GEN-2015-073345.0	5 LEVELS AWAY	14193.3
587894	G16-112-TAP 345.0	5 LEVELS AWAY	10841.5
588253	G16-174-GEN10.690	5 LEVELS AWAY	1226717.8
588262	G16-176-GSU134.50	5 LEVELS AWAY	24816.2
588271	G16-150XFMR134.50	5 LEVELS AWAY	22152.4
588301	G16-157XFMR134.50	5 LEVELS AWAY	24176
588310	GEN-2016-158345.0	5 LEVELS AWAY	4657.8
635017	ATCHSN 3 345.0	5 LEVELS AWAY	16932.9
640009	COOPER1G 22.00	5 LEVELS AWAY	270040.3
640140	COOPER 5 161.0	5 LEVELS AWAY	17469.9
640142	COOPER T2 913.80	5 LEVELS AWAY	44615.5
640277	MOORE 3 345.0	5 LEVELS AWAY	21048.5
643172	COOPER T5 913.80	5 LEVELS AWAY	25604.2
645458	S3458 3 345.0	5 LEVELS AWAY	28480.3

3.1.4. Short Circuit Result for West Gardner 345kV Substation (542965)

The results of the short circuit analysis for POI i.e., West Gardner 345kV Substation (542965) and five bus levels away are tabulated below in Table 3.1.4.

Table 3.1.4: Short circuit results for West Gardner 345kV Substation (542965)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
542965	W.GRDNR7 345.0	0 LEVELS AWAY	26277
532774	SWISVAL7 345.0	1 LEVELS AWAY	16402.3
542966	WGARDNR5 161.0	1 LEVELS AWAY	27028.7
542968	STILWEL7 345.0	1 LEVELS AWAY	24553
542977	CRAIG 7 345.0	1 LEVELS AWAY	22339.7
542981	LACYGNE7 345.0	1 LEVELS AWAY	25371.3
543649	WGAR T11 13.80	1 LEVELS AWAY	16018.3
588300	GEN-2016-157345.0	1 LEVELS AWAY	4936.2
532768	EMPEC 7 345.0	2 LEVELS AWAY	17334.7
532775	87TH 7 345.0	2 LEVELS AWAY	20829.5
532793	NEOSHO 7 345.0	2 LEVELS AWAY	16064.4
532799	WAVERLY7 345.0	2 LEVELS AWAY	14610.2
532815	SWISV1X1 14.40	2 LEVELS AWAY	36193.5
532819	SWISV2X2 14.40	2 LEVELS AWAY	803272.1
532856	SWISVAL6 230.0	2 LEVELS AWAY	21382.8
541198	PECULR 7 345.0	2 LEVELS AWAY	20232.8
542955	LAC G1 1 22.00	2 LEVELS AWAY	232856.5
542956	LAC G2 1 24.00	2 LEVELS AWAY	211001.1
542969	STILWEL5 161.0	2 LEVELS AWAY	38815.2
542978	CRAIG 5 161.0	2 LEVELS AWAY	39942.7
543049	CEDRCRK5 161.0	2 LEVELS AWAY	27853.7
543054	CEDARNL5 161.0	2 LEVELS AWAY	9217
543077	PLSTVAL5 161.0	2 LEVELS AWAY	9737.8
543105	BULLCRK5 161.0	2 LEVELS AWAY	24797.4
543132	BNSF 5 161.0	2 LEVELS AWAY	20067.5

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
543629	LACYGNE11_7 345.0	2 LEVELS AWAY	24730.8
543632	LACYGNE22_7 345.0	2 LEVELS AWAY	24694.3
543641	CRAI T11 13.80	2 LEVELS AWAY	12282.6
543642	CRAI T22 13.80	2 LEVELS AWAY	19128.2
543643	CRAI T33 13.80	2 LEVELS AWAY	18794.2
543647	STIL T11 13.80	2 LEVELS AWAY	18888.6
543648	STIL T22 13.80	2 LEVELS AWAY	19822.3
588301	G16-157XFMR134.50	2 LEVELS AWAY	24176
588310	GEN-2016-158345.0	2 LEVELS AWAY	4657.8
300739	7BLACKBERRY 345.0	3 LEVELS AWAY	12268.4
510380	DELWARE7 345.0	3 LEVELS AWAY	11522
532740	EMPEC121 13.80	3 LEVELS AWAY	60922.9
532741	EMPEC341 13.80	3 LEVELS AWAY	60922.9
532742	EMPEC5 1 18.00	3 LEVELS AWAY	85445.1
532743	EMPEC6 1 18.00	3 LEVELS AWAY	85445.1
532744	EMPEC7 1 18.00	3 LEVELS AWAY	85445.1
532769	LANG 7 345.0	3 LEVELS AWAY	17122.6
532770	MORRIS 7 345.0	3 LEVELS AWAY	12796.7
532772	STRANGR7 345.0	3 LEVELS AWAY	26127.8
532780	CANEYRV7 345.0	3 LEVELS AWAY	9966.8
532797	WOLFCRK7 345.0	3 LEVELS AWAY	15929
532802	WAVERTX7 345.0	3 LEVELS AWAY	12420.6
532818	87TH 1X1 13.80	3 LEVELS AWAY	71179.1
532824	N345 1 1 13.80	3 LEVELS AWAY	40218.7
532825	N345 2 1 13.80	3 LEVELS AWAY	47364.2
532851	AUBURN 6 230.0	3 LEVELS AWAY	13310.9
532853	LAWHILL6 230.0	3 LEVELS AWAY	13249.8
532857	TECHILL6 230.0	3 LEVELS AWAY	10996.7
532863	MORRIS 6 230.0	3 LEVELS AWAY	13863

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532937	NEOSHO 5 161.0	3 LEVELS AWAY	20933.7
533021	NEOSHO 4 138.0	3 LEVELS AWAY	22628
533283	87TH 3 115.0	3 LEVELS AWAY	26266.9
541200	PHILL 7 345.0	3 LEVELS AWAY	18438.8
541341	S.HARP 5 161.0	3 LEVELS AWAY	22010.1
541342	PECULR 5 161.0	3 LEVELS AWAY	23029.9
541372	PECULRT 13.80	3 LEVELS AWAY	57933.7
542979	PFLUMM 5 161.0	3 LEVELS AWAY	27070.2
542994	HICKMAN5 161.0	3 LEVELS AWAY	18425.8
542995	MONTROS5 161.0	3 LEVELS AWAY	17976.6
543031	SHWNMSN5 161.0	3 LEVELS AWAY	31505.4
543038	LENEXAS5 161.0	3 LEVELS AWAY	26430
543039	LENEXAN5 161.0	3 LEVELS AWAY	27526
543044	MOONLT 5 161.0	3 LEVELS AWAY	16066.7
543048	COLLEGE5 161.0	3 LEVELS AWAY	28031.6
543050	ANTIOCH5 161.0	3 LEVELS AWAY	21906.9
543053	REDEL 5 161.0	3 LEVELS AWAY	23763.6
543055	SEOTTWA5 161.0	3 LEVELS AWAY	6716.1
543057	BUCYRUS5 161.0	3 LEVELS AWAY	19151.4
543106	WG CT 1 13.80	3 LEVELS AWAY	58829.9
543107	WG CT 2 13.80	3 LEVELS AWAY	58581
543108	WG CT 3 13.80	3 LEVELS AWAY	58826.1
543109	WG CT 4 13.80	3 LEVELS AWAY	58539.9
543126	LACKMAN5 161.0	3 LEVELS AWAY	13040.7
543630	LAC11_SWGR1 13.80	3 LEVELS AWAY	28084.2
543631	LAC11_TER1 13.80	3 LEVELS AWAY	19023.2
543633	LAC22_SWGR1 13.80	3 LEVELS AWAY	28242.5
543634	LAC22_TER1 13.80	3 LEVELS AWAY	19132.6
562476	G14-001-TAP 345.0	3 LEVELS AWAY	11138.3

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
585100	GEN-2015-073345.0	3 LEVELS AWAY	14193.3
588302	G16-157-GSU134.50	3 LEVELS AWAY	23756
588311	G16-158XFMR134.50	3 LEVELS AWAY	23667.3
300071	5CLINTN 161.0	4 LEVELS AWAY	15340.6
300740	7SPORTSMAN 345.0	4 LEVELS AWAY	24147.6
300949	7JASPER 345.0	4 LEVELS AWAY	10695.2
510370	DELAWAR1 13.80	4 LEVELS AWAY	19093
510379	DELWARE4 138.0	4 LEVELS AWAY	11014
510406	N.E.S.-7 345.0	4 LEVELS AWAY	19202.6
532710	NSES 2X1 13.20	4 LEVELS AWAY	39853.2
532751	WCGS U1 25.00	4 LEVELS AWAY	207432.4
532765	HOYT 7 345.0	4 LEVELS AWAY	15747.8
532766	JEC N 7 345.0	4 LEVELS AWAY	23639.5
532781	CANEYWF7 345.0	4 LEVELS AWAY	9698.5
532791	BENTON 7 345.0	4 LEVELS AWAY	20462.2
532794	ROSEHIL7 345.0	4 LEVELS AWAY	19526.4
532796	WICHITA7 345.0	4 LEVELS AWAY	25869.2
532800	LATHAMS7 345.0	4 LEVELS AWAY	10570.8
532808	LANG 1 14.40	4 LEVELS AWAY	36156.9
532809	MORRIS1X1 14.40	4 LEVELS AWAY	31464.8
532811	STRAN1 1 14.40	4 LEVELS AWAY	48875.1
532816	STRAN3 1 14.40	4 LEVELS AWAY	41703.9
532852	JEC 6 230.0	4 LEVELS AWAY	24665.4
532854	LEC U5 6 230.0	4 LEVELS AWAY	13127.3
532855	MIDLAND6 230.0	4 LEVELS AWAY	11829.3
532862	MCDOWEL6 230.0	4 LEVELS AWAY	6913.1
532874	UNIONRG6 230.0	4 LEVELS AWAY	8898.3
532880	AUBURN 1 14.40	4 LEVELS AWAY	64890
532882	LAWHILL1 13.80	4 LEVELS AWAY	54229

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
532886	TECHILL1 13.80	4 LEVELS AWAY	55778.7
532890	MORRIS2X1 13.80	4 LEVELS AWAY	39043.8
532934	MARMTNE5 161.0	4 LEVELS AWAY	8078.1
532954	WAVERTX1 34.50	4 LEVELS AWAY	24321.4
532958	NEOSH4 1 13.20	4 LEVELS AWAY	9278.7
532959	NEOSH5 1 13.20	4 LEVELS AWAY	11016.9
532961	WAVETV 1 13.80	4 LEVELS AWAY	37659.1
532962	WOLFCRK1 17.00	4 LEVELS AWAY	8826.9
533020	NEOSHOS4 138.0	4 LEVELS AWAY	22628
533022	NEOSHON4 138.0	4 LEVELS AWAY	22628
533151	AUBURN 3 115.0	4 LEVELS AWAY	21261.4
533182	TECHILE3 115.0	4 LEVELS AWAY	27639.5
533250	LWRNCHL3 115.0	4 LEVELS AWAY	25129.2
533268	STRANGR3 115.0	4 LEVELS AWAY	33535.4
533273	TIMBRLN3 115.0	4 LEVELS AWAY	13153.8
533278	WAVERLY3 115.0	4 LEVELS AWAY	14234.4
533281	MNTCLLO3 115.0	4 LEVELS AWAY	22290.7
533284	95WAJ 3 115.0	4 LEVELS AWAY	14982.9
533304	LANG 3 115.0	4 LEVELS AWAY	14449.1
533305	MORRIS 3 115.0	4 LEVELS AWAY	12437.9
533653	WOLFCRK2 69.00	4 LEVELS AWAY	5808.1
533778	NEOSHOS2 69.00	4 LEVELS AWAY	22105.4
541165	S.HARP#1 13.80	4 LEVELS AWAY	74816.1
541166	S.HARP#2 13.80	4 LEVELS AWAY	38590.9
541167	S.HARP#3 13.80	4 LEVELS AWAY	38590.9
541201	SIBLEY 7 345.0	4 LEVELS AWAY	20773.6
541207	ARCHIE 5 161.0	4 LEVELS AWAY	16708.7
541225	PHILL 5 161.0	4 LEVELS AWAY	33410.9
541245	KCSOUTH5 161.0	4 LEVELS AWAY	16912.1

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541317	NRAYMORE 161.0	4 LEVELS AWAY	7805
541340	BELTONS5 161.0	4 LEVELS AWAY	19151.3
541343	S.HARP 2 69.00	4 LEVELS AWAY	4468.6
541344	PECULRS5 161.0	4 LEVELS AWAY	21889
541361	PHILL T 13.80	4 LEVELS AWAY	68191.1
542952	MONTG1 1 22.00	4 LEVELS AWAY	33792.3
542953	MONTG2 1 22.00	4 LEVELS AWAY	59647.3
542954	MONTG3 1 18.00	4 LEVELS AWAY	66456.8
542982	IATAN 7 345.0	4 LEVELS AWAY	28808.6
542993	STHTOWN5 161.0	4 LEVELS AWAY	32514.5
543002	MARTCIT5 161.0	4 LEVELS AWAY	23826.7
543032	MERRIAM5 161.0	4 LEVELS AWAY	29162.4
543036	OLATHE 5 161.0	4 LEVELS AWAY	25279.9
543037	QUARRY 5 161.0	4 LEVELS AWAY	14764.9
543041	SHAWNEE5 161.0	4 LEVELS AWAY	24290.3
543042	SPRGHL 5 161.0	4 LEVELS AWAY	10844
543046	OXFORD 5 161.0	4 LEVELS AWAY	19939.5
543047	OVERLPK5 161.0	4 LEVELS AWAY	29649.6
543052	REEDER 5 161.0	4 LEVELS AWAY	18983.1
543056	GARDNER5 161.0	4 LEVELS AWAY	14959.5
543058	NLOUISB5 161.0	4 LEVELS AWAY	8710.1
543066	S.OTTWA5 161.0	4 LEVELS AWAY	6604.4
543068	WAGSTAF5 161.0	4 LEVELS AWAY	13377.7
546742	METRO 5 161.0	4 LEVELS AWAY	23119.8
547469	RIV4525 161.0	4 LEVELS AWAY	23376
583850	GEN-2014-001345.0	4 LEVELS AWAY	7586.9
585101	G15-073XFMR134.50	4 LEVELS AWAY	13326.9
585104	G15-073XFMR234.50	4 LEVELS AWAY	13436.1
588240	GEN-2016-149345.0	4 LEVELS AWAY	8633.5

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
588303	G16-157-GEN10.690	4 LEVELS AWAY	1042472.3
588312	G16-158-GSU134.50	4 LEVELS AWAY	23270.8
300045	7MORGAN 345.0	5 LEVELS AWAY	10847.3
300124	5HOLDEN 161.0	5 LEVELS AWAY	9093.3
300692	2CLINTN 69.00	5 LEVELS AWAY	13767.8
300741	5SPORTSMAN 161.0	5 LEVELS AWAY	40970.6
300950	5JASPER 161.0	5 LEVELS AWAY	11821.7
301477	5OSCEOKC 161.0	5 LEVELS AWAY	6310.9
345408	7OVERTON 345.0	5 LEVELS AWAY	12282.4
505502	TRUMAN 5 161.0	5 LEVELS AWAY	7454.6
509807	ONETA--7 345.0	5 LEVELS AWAY	29958.7
509852	T.NO.--7 345.0	5 LEVELS AWAY	25908.8
511840	NES3-1 22.00	5 LEVELS AWAY	151687.2
512650	GRDA1 7 345.0	5 LEVELS AWAY	26599.8
512734	FARML 4 138.0	5 LEVELS AWAY	8325.3
532651	JEC U1 26.00	5 LEVELS AWAY	180327.8
532652	JEC U2 26.00	5 LEVELS AWAY	189412.3
532653	JEC U3 26.00	5 LEVELS AWAY	188706.5
532663	LEC U5 24.00	5 LEVELS AWAY	85987
532711	NEC U3 12.00	5 LEVELS AWAY	21583.5
532767	GEARY 7 345.0	5 LEVELS AWAY	9944.1
532771	RENO 7 345.0	5 LEVELS AWAY	12041
532782	BUFFALO7 345.0	5 LEVELS AWAY	21503.8
532798	VIOLA 7 345.0	5 LEVELS AWAY	14038.8
532801	ELKRVR17 345.0	5 LEVELS AWAY	9321.7
532804	HOYT 1 14.40	5 LEVELS AWAY	31483.4
532805	JEC 13 1 14.40	5 LEVELS AWAY	33403.3
532806	JEC 26 1 14.40	5 LEVELS AWAY	33614.1
532817	UNIONRG1 13.20	5 LEVELS AWAY	18699.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532821	BENTN1 1 13.80	5 LEVELS AWAY	23750.9
532822	BENTN2 1 13.80	5 LEVELS AWAY	45316
532826	ROSEH1 1 13.80	5 LEVELS AWAY	39337.7
532827	ROSEH5 1 13.80	5 LEVELS AWAY	39097.8
532829	WICH11 1 13.80	5 LEVELS AWAY	50198.1
532830	WICH12 1 13.80	5 LEVELS AWAY	50394.9
532831	ROSEH3 1 13.80	5 LEVELS AWAY	39273.6
532861	EMANHAT6 230.0	5 LEVELS AWAY	9598.3
532873	SUMMIT 6 230.0	5 LEVELS AWAY	13746.3
532884	MIDLAND1 18.00	5 LEVELS AWAY	37313.7
532898	MCDOWL 1 13.80	5 LEVELS AWAY	30126
532912	EDWRDVL5 161.0	5 LEVELS AWAY	19726.2
532926	BAKER 2 69.00	5 LEVELS AWAY	4886.8
532938	FRANKLIN5 161.0	5 LEVELS AWAY	7571.5
532948	SPRINGH1 12.47	5 LEVELS AWAY	17465.6
532955	MARMATN1 13.20	5 LEVELS AWAY	10667.2
532960	WAVERGSU1 34.50	5 LEVELS AWAY	18270.5
532986	BENTON 4 138.0	5 LEVELS AWAY	29050.5
533005	NEPARSN4 138.0	5 LEVELS AWAY	11783.5
533008	TV1MNDV4 138.0	5 LEVELS AWAY	6820.7
533040	EVANS N4 138.0	5 LEVELS AWAY	40853.1
533062	ROSEHIL4 138.0	5 LEVELS AWAY	32121.7
533079	CNYWFLV1 34.50	5 LEVELS AWAY	33674.1
533102	CNYWF1 1 13.20	5 LEVELS AWAY	90237.4
533153	COLINE 3 115.0	5 LEVELS AWAY	22096.6
533155	CROOKED3 115.0	5 LEVELS AWAY	20096.1
533163	HOYT 3 115.0	5 LEVELS AWAY	22830.4
533166	INDIANH3 115.0	5 LEVELS AWAY	17243.9
533167	KEENE 3 115.0	5 LEVELS AWAY	9932.3

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533176	SHAWNEE3 115.0	5 LEVELS AWAY	11877.6
533181	TECHILW3 115.0	5 LEVELS AWAY	27639.5
533187	27CROCO3 115.0	5 LEVELS AWAY	19392.8
533194	SHERWOD3 115.0	5 LEVELS AWAY	19413.1
533211	ARNOLD 3 115.0	5 LEVELS AWAY	7267.9
533232	BALDCRK3 115.0	5 LEVELS AWAY	13693.5
533235	CAPTAIN3 115.0	5 LEVELS AWAY	10703.9
533239	ESAAPJ 3 115.0	5 LEVELS AWAY	12522.9
533244	JARBALO3 115.0	5 LEVELS AWAY	25261.3
533248	LEC U3 3 115.0	5 LEVELS AWAY	23817.1
533249	LEC U4 3 115.0	5 LEVELS AWAY	23680
533252	MIDLADN3 115.0	5 LEVELS AWAY	24813.4
533253	MOCKBRD3 115.0	5 LEVELS AWAY	16531
533255	MOONLTJ3 115.0	5 LEVELS AWAY	11518.3
533259	NW LEAV3 115.0	5 LEVELS AWAY	16096
533261	PENTAGN3 115.0	5 LEVELS AWAY	21237.2
533264	6TH ST 3 115.0	5 LEVELS AWAY	17554.9
533265	SOUTHTN3 115.0	5 LEVELS AWAY	10925.3
533267	SPRINGH3 115.0	5 LEVELS AWAY	9596.7
533270	STULL T3 115.0	5 LEVELS AWAY	11710.4
533272	THORNTN3 115.0	5 LEVELS AWAY	15268.4
533280	WREN 3 115.0	5 LEVELS AWAY	12920.3
533301	EAST ST3 115.0	5 LEVELS AWAY	9209.8
533306	READING3 115.0	5 LEVELS AWAY	6381.3
533307	PRAIRIE3 115.0	5 LEVELS AWAY	9256.7
533309	WEMPORI3 115.0	5 LEVELS AWAY	9782.3
533335	MCDOWEL3 115.0	5 LEVELS AWAY	17732.8
533359	UNIONRG3 115.0	5 LEVELS AWAY	3796.6
533626	BURLJCT2 69.00	5 LEVELS AWAY	4775

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533629	CC2SHAR2 69.00	5 LEVELS AWAY	4514.9
533639	MARMATN2 69.00	5 LEVELS AWAY	8262.5
533703	ORDNJCT2 69.00	5 LEVELS AWAY	8244.9
533758	CRAWFOR2 69.00	5 LEVELS AWAY	6911.3
533768	NEOSHON2 69.00	5 LEVELS AWAY	22105.4
533884	INNOVIA1 13.80	5 LEVELS AWAY	3810.3
541150	IATAN 11 13.80	5 LEVELS AWAY	18116.3
541162	DOGWDSTG 18.00	5 LEVELS AWAY	99029.2
541163	DOGWDCT1 18.00	5 LEVELS AWAY	90576
541164	DOGWDCT2 18.00	5 LEVELS AWAY	91750.9
541202	SIBLEY 5 161.0	5 LEVELS AWAY	30166.5
541210	MARTCTY5 161.0	5 LEVELS AWAY	26805.8
541217	WINDSR 5 161.0	5 LEVELS AWAY	7687.6
541224	LNGVW 5 161.0	5 LEVELS AWAY	22062.7
541239	HSNVL 5 161.0	5 LEVELS AWAY	15489.6
541240	ADRIAN 5 161.0	5 LEVELS AWAY	8173.6
541242	CLINTON5 161.0	5 LEVELS AWAY	15271.5
541243	LKWINGB5 161.0	5 LEVELS AWAY	24113.8
541259	TURNER 5 161.0	5 LEVELS AWAY	17848.5
541280	PHILL 2 69.00	5 LEVELS AWAY	13229.7
541290	BELTONS2 69.00	5 LEVELS AWAY	9879.2
541291	FREEMAN2 69.00	5 LEVELS AWAY	4434.1
541313	HARRIS 161.0	5 LEVELS AWAY	25552.3
541350	IATAN5 161.0	5 LEVELS AWAY	16952.6
541360	SIBLEY T 13.80	5 LEVELS AWAY	68131.3
541400	EASTOWN7 345.0	5 LEVELS AWAY	17264.1
541414	SIB REA1 345.0	5 LEVELS AWAY	18470
541500	KETCHEM7 345.0	5 LEVELS AWAY	8006.9
542957	IAT G1 1 24.00	5 LEVELS AWAY	188539.2

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
542962	IAT G2 1 25.00	5 LEVELS AWAY	243639.2
542972	HAWTH 7 345.0	5 LEVELS AWAY	21744.4
542980	NASHUA 7 345.0	5 LEVELS AWAY	21039.4
542992	BENDIX 5 161.0	5 LEVELS AWAY	26942.9
542999	LVISTAW5 161.0	5 LEVELS AWAY	13368.3
543001	FOREST 5 161.0	5 LEVELS AWAY	28511.9
543008	BUNKRDG5 161.0	5 LEVELS AWAY	16270.4
543010	WINJT S5 161.0	5 LEVELS AWAY	21920.4
543033	BRKRIDG5 161.0	5 LEVELS AWAY	22541.6
543034	KNLWRTH5 161.0	5 LEVELS AWAY	24858.8
543040	ROEPARK5 161.0	5 LEVELS AWAY	27360.3
543043	MURLEN 5 161.0	5 LEVELS AWAY	17075.1
543045	SWITZER5 161.0	5 LEVELS AWAY	18459.1
543067	CENTENL5 161.0	5 LEVELS AWAY	9946.8
543069	PAOLA 5 161.0	5 LEVELS AWAY	9972.5
543635	GARDNER2 13.80	5 LEVELS AWAY	17785.4
543650	G15-016T 161.0	5 LEVELS AWAY	7606.1
546651	BARBER 5 161.0	5 LEVELS AWAY	25993.5
546655	KAW W 5 161.0	5 LEVELS AWAY	20486
546722	MAYSOTH5 161.0	5 LEVELS AWAY	18915.9
547467	ORO110 5 161.0	5 LEVELS AWAY	18914.6
547487	HOC404 5 161.0	5 LEVELS AWAY	12847.7
547498	STL439 5 161.0	5 LEVELS AWAY	24039.1
547503	RIV452T 5 161.0	5 LEVELS AWAY	22972.6
547541	RIV167 2 69.00	5 LEVELS AWAY	16923
547725	RIV452 1 12.50	5 LEVELS AWAY	16509.6
560053	G15-052T 345.0	5 LEVELS AWAY	13076.2
577198	G10-003-GSU134.50	5 LEVELS AWAY	22323.2
583851	G14-001XFMR134.50	5 LEVELS AWAY	17327.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
583854	G14-001XFMR234.50	5 LEVELS AWAY	16926.1
585070	GEN-2015-069230.0	5 LEVELS AWAY	6628.9
585102	G15-073-GSU134.50	5 LEVELS AWAY	12321.2
585105	G15-073-GSU234.50	5 LEVELS AWAY	12124.7
588241	G16-149XFMR134.50	5 LEVELS AWAY	32281.1
588250	GEN-2016-174345.0	5 LEVELS AWAY	5671.5
588313	G16-158-GEN10.690	5 LEVELS AWAY	1026017.7
588320	GEN-2016-162345.0	5 LEVELS AWAY	9931.3

3.1.5. Short Circuit Result for Higginsville 69kV Substation (543102)

The results of the short circuit analysis for POI i.e., Higginsville 69kV Substation (543102) and five bus levels away are tabulated below in Table 3.1.5.

Table 3.1.5: Short circuit results for Higginsville 69kV Substation (543102)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
543102	WHGNSVL2 69.0	0 LEVELS AWAY	4516.2
543099	HIGNSVL2 69.0	1 LEVELS AWAY	4561.2
543100	AMOCOPL2 69.0	1 LEVELS AWAY	4788.3
588410	GEN-2016-16869.0	1 LEVELS AWAY	4483.4
543096	MAYVWTP2 69.0	2 LEVELS AWAY	4951
543098	CTY HIG2 69.0	2 LEVELS AWAY	4573.2
588411	G16-168XFMR134.5	2 LEVELS AWAY	3185.8
541265	LEXNTON2 69.0	3 LEVELS AWAY	4351.7
541266	13&40 2 69.0	3 LEVELS AWAY	4357
543097	CORDER 2 69.0	3 LEVELS AWAY	3918.1
588412	G16-168-GSU134.5	3 LEVELS AWAY	3185.6
541264	LEX69 2 69.0	4 LEVELS AWAY	4371.2

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541267	ODESSA 2 69.0	4 LEVELS AWAY	1911.1
541319	CONCORD2 69.0	4 LEVELS AWAY	3398.9
541383	FAYETVLTP2 69.0	4 LEVELS AWAY	4293.7
543101	DOVERPT2 69.0	4 LEVELS AWAY	3888.8
588413	G16-168-GEN10.64	4 LEVELS AWAY	112912.7
541229	ODESSA 5 161.	5 LEVELS AWAY	9493
541232	LEX161 5 161.	5 LEVELS AWAY	7631.9
541268	WBURGP 2 69.0	5 LEVELS AWAY	5682.1
543094	SWAVRLY2 69.0	5 LEVELS AWAY	3616.4

3.2. Short Circuit Result for 2026 Summer Peak Case

The short circuit results for summer-2026 scenario (assumed not outage) at the POI are tabulated below.

3.2.1. Short Circuit Result for Transource Ketchem 345kV Substation (541500)

The results of the short circuit analysis for POI i.e., Transource Ketchem 345kV Substation (541500) and five bus levels away are tabulated below in Table 3.2.1.

Table 3.2.1: Short circuit results for Transource Ketchem 345kV Substation (541500)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541500	KETCHEM7 345.0	0 LEVELS AWAY	8009.4
541197	MULLNCR7 345.0	1 LEVELS AWAY	8168.6
541201	SIBLEY 7 345.0	1 LEVELS AWAY	20797.4
541501	OSBORN7 345.0	1 LEVELS AWAY	7090.1
587730	GEN-2016-088345.0	1 LEVELS AWAY	6928

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
345408	7OVERTON 345.0	2 LEVELS AWAY	12328.1
541200	PHILL 7 345.0	2 LEVELS AWAY	18377.4
541202	SIBLEY 5 161.0	2 LEVELS AWAY	29587
541360	SIBLEY T 13.80	2 LEVELS AWAY	67829.4
541411	MC REAC1 345.0	2 LEVELS AWAY	7786.6
541412	MC REAC2 345.0	2 LEVELS AWAY	7786.6
541413	MC REAC3 345.0	2 LEVELS AWAY	7786.6
541414	SIB REA1 345.0	2 LEVELS AWAY	18488.8
541502	OSBORN_B1_1 34.50	2 LEVELS AWAY	26005.4
541505	OSBORN_TER_113.80	2 LEVELS AWAY	35394.5
541510	HOLT 7 345.0	2 LEVELS AWAY	9669.5
542972	HAWTH 7 345.0	2 LEVELS AWAY	22035.2
587731	G16-088XFMR134.50	2 LEVELS AWAY	18547.4
345088	7MCCREDIE 345.0	3 LEVELS AWAY	16800.5
345409	5OVERTON 161.0	3 LEVELS AWAY	20663.4
541198	PECULR 7 345.0	3 LEVELS AWAY	20150.5
541225	PHILL 5 161.0	3 LEVELS AWAY	33091.5
541250	SIBLEYPL 161.0	3 LEVELS AWAY	32187.8
541361	PHILL T 13.80	3 LEVELS AWAY	68165.2
541504	OSBORN_TX_1 34.50	3 LEVELS AWAY	22477.8
541511	ROCKCK7 345.0	3 LEVELS AWAY	7348.4
541517	HOLT_REACT7 345.0	3 LEVELS AWAY	9613.7
542973	HAWTHRN5 161.0	3 LEVELS AWAY	54550.5
542980	NASHUA 7 345.0	3 LEVELS AWAY	21143.1
543644	HAWT T20 13.80	3 LEVELS AWAY	19738.2
543645	HAWT T22 13.80	3 LEVELS AWAY	20537
587732	G16-088-GSU134.50	3 LEVELS AWAY	15636.2
587920	GEN-2016-115345.0	3 LEVELS AWAY	6905.9
645458	S3458 3 345.0	3 LEVELS AWAY	28598.9

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
300044	7MCCRED 345.0	4 LEVELS AWAY	16770.3
300500	5HUNTSDL 161.0	4 LEVELS AWAY	13476.2
345221	5MOBERLY 161.0	4 LEVELS AWAY	14919
345230	7MONTGMRY 345.0	4 LEVELS AWAY	28032.8
345411	5OVERTON 2 161.0	4 LEVELS AWAY	20663.4
541151	SIBLEY#3 22.00	4 LEVELS AWAY	119823.1
541162	DOGWDSTG 18.00	4 LEVELS AWAY	98907.6
541163	DOGWDCT1 18.00	4 LEVELS AWAY	90509.1
541164	DOGWDCT2 18.00	4 LEVELS AWAY	91680
541199	ST JOE 3 345.0	4 LEVELS AWAY	18628.1
541235	DUNCAN 5 161.0	4 LEVELS AWAY	19453.1
541239	HSNVL 5 161.0	4 LEVELS AWAY	15215.3
541243	LKWINGB5 161.0	4 LEVELS AWAY	23896.2
541244	ORRICK 5 161.0	4 LEVELS AWAY	14338.7
541263	SIBLEY 2 69.00	4 LEVELS AWAY	11537.6
541280	PHILL 2 69.00	4 LEVELS AWAY	13209
541313	HARRIS 161.0	4 LEVELS AWAY	25379.6
541342	PECULR 5 161.0	4 LEVELS AWAY	22856.9
541346	RTCHFLD5 161.0	4 LEVELS AWAY	13187.3
541372	PECULRT 13.80	4 LEVELS AWAY	57824.7
541503	OSBORN_G1_1 0.690	4 LEVELS AWAY	928382.6
541506	OSBORN_G2_1 0.690	4 LEVELS AWAY	228892.2
541512	ROCKCK_B_1 34.50	4 LEVELS AWAY	39782.4
541515	ROCKCK_TR1_113.20	4 LEVELS AWAY	2583869.2
541516	ROCKCK_TR2_113.20	4 LEVELS AWAY	2679412
542951	HAW G5 1 22.00	4 LEVELS AWAY	191719.8
542961	HAWCT6 1 16.00	4 LEVELS AWAY	81012.4
542967	HAW G9 1 13.80	4 LEVELS AWAY	77150.5
542968	STILWEL7 345.0	4 LEVELS AWAY	24460.8

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
542976	LEVEE 5 161.0	4 LEVELS AWAY	48751.5
542982	IATAN 7 345.0	4 LEVELS AWAY	28781.6
542997	LEEDS 5 161.0	4 LEVELS AWAY	32218.7
543000	BLUEVLY5 161.0	4 LEVELS AWAY	37074.1
543011	CHOUTEU5 161.0	4 LEVELS AWAY	34026.7
543020	BRMGHAM5 161.0	4 LEVELS AWAY	25707.8
543027	RANDLPH5 161.0	4 LEVELS AWAY	31471.7
543028	NASHUA-5 161.0	4 LEVELS AWAY	27146.1
543080	HAWTH 2 69.00	4 LEVELS AWAY	12987.6
543640	NASH T11 13.80	4 LEVELS AWAY	11885.2
548808	ECKLES-161 161.0	4 LEVELS AWAY	26690.4
548814	SUB M-161 161.0	4 LEVELS AWAY	20373.4
587733	G16-088-GEN10.690	4 LEVELS AWAY	666972.6
587921	G16-115XFMR134.50	4 LEVELS AWAY	36943.9
640139	COOPER 3 345.0	4 LEVELS AWAY	26705
645011	NEBCTY1G 18.00	4 LEVELS AWAY	219436.7
645012	NEBCTY2G 23.00	4 LEVELS AWAY	188332.7
645456	S3456 3 345.0	4 LEVELS AWAY	30666.7
645740	S3740 3 345.0	4 LEVELS AWAY	17288.7
650189	103&ROKEBY3 345.0	4 LEVELS AWAY	19752
300039	7FAIRPT 345.0	5 LEVELS AWAY	12350.5
300043	7KINGDM 345.0	5 LEVELS AWAY	14372.4
300049	7THOMHL 345.0	5 LEVELS AWAY	14232.2
300098	5MOCITY 161.0	5 LEVELS AWAY	19116.4
300126	5MOBTAP 161.0	5 LEVELS AWAY	14929.2
300320	5LEVASY 161.0	5 LEVELS AWAY	10934.7
300709	2SHARSNV 69.00	5 LEVELS AWAY	6184.7
343004	5PERCHE 161.0	5 LEVELS AWAY	13515.9
344224	7CALAWY 1 345.0	5 LEVELS AWAY	24914.9

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
344233	5CALIF UE 161.0	5 LEVELS AWAY	10065.1
344535	7ENON 345.0	5 LEVELS AWAY	17144.5
344886	7LABADIE3 345.0	5 LEVELS AWAY	37814.9
345071	5MCBAIN T 161.0	5 LEVELS AWAY	15190.9
345222	2MOBERLY 69.00	5 LEVELS AWAY	7082
345231	5MONTGMRY 161.0	5 LEVELS AWAY	17941.7
345992	7SPENCER 345.0	5 LEVELS AWAY	15504.4
532772	STRANGR7 345.0	5 LEVELS AWAY	26146
541150	IATAN 11 13.80	5 LEVELS AWAY	18118.3
541152	SIBLEY#2 13.20	5 LEVELS AWAY	19005.6
541153	SIBLEY#1 13.20	5 LEVELS AWAY	19041.6
541203	NASHUA 5 161.0	5 LEVELS AWAY	27146.1
541205	BLSPE 5 161.0	5 LEVELS AWAY	20511.7
541207	ARCHIE 5 161.0	5 LEVELS AWAY	16250.9
541215	HLLMRK 5 161.0	5 LEVELS AWAY	13301
541218	GRNWD 5 161.0	5 LEVELS AWAY	23594.6
541230	RNRIDGE5 161.0	5 LEVELS AWAY	21661.3
541236	RICHMND5 161.0	5 LEVELS AWAY	7888.2
541241	SEDEAST5 161.0	5 LEVELS AWAY	7311.1
541248	LBRTYST5 161.0	5 LEVELS AWAY	18607.6
541249	HOOKRD 5 161.0	5 LEVELS AWAY	21727
541253	ST JOE 5 161.0	5 LEVELS AWAY	18906.4
541262	LIBERTY2 69.00	5 LEVELS AWAY	9691.2
541279	RGREEN 2 69.00	5 LEVELS AWAY	13278.7
541295	HSNVL 2 69.00	5 LEVELS AWAY	8509.9
541340	BELTONS5 161.0	5 LEVELS AWAY	19040.9
541344	PECULRS5 161.0	5 LEVELS AWAY	21705.1
541347	RAYMORE 69.00	5 LEVELS AWAY	8591.7
541350	IATAN5 161.0	5 LEVELS AWAY	16968.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541370	STJOE 1T 13.80	5 LEVELS AWAY	63298.3
541371	STJOE 2T 13.80	5 LEVELS AWAY	63348.7
541400	EASTOWN7 345.0	5 LEVELS AWAY	16980.2
541513	ROCKCK_T_1 34.50	5 LEVELS AWAY	39458.9
542957	IAT G1 1 24.00	5 LEVELS AWAY	188508.2
542962	IAT G2 1 25.00	5 LEVELS AWAY	243577.4
542963	HAWCT7 1 13.80	5 LEVELS AWAY	51260.1
542964	HAWCT8 1 13.80	5 LEVELS AWAY	52040.2
542965	W.GRDNR7 345.0	5 LEVELS AWAY	26296.7
542969	STILWEL5 161.0	5 LEVELS AWAY	38530.1
542981	LACYGNE7 345.0	5 LEVELS AWAY	25345.3
542985	NEAST 5 161.0	5 LEVELS AWAY	42734.1
543004	BLUMILS5 161.0	5 LEVELS AWAY	17266.8
543009	WINJT N5 161.0	5 LEVELS AWAY	18587.9
543010	WINJT S5 161.0	5 LEVELS AWAY	22153.8
543015	AVONDAL5 161.0	5 LEVELS AWAY	28102.5
543023	CLAYCM25 161.0	5 LEVELS AWAY	13258.8
543029	SHOLCRK5 161.0	5 LEVELS AWAY	16484.3
543062	SALSBRY5 161.0	5 LEVELS AWAY	11385.8
543091	DUNCNRD2 69.00	5 LEVELS AWAY	6466.7
543114	PLUMRRD2 69.00	5 LEVELS AWAY	12389.5
543639	LEEDREAC 161.0	5 LEVELS AWAY	23220.8
543647	STIL T11 13.80	5 LEVELS AWAY	18882.4
543648	STIL T22 13.80	5 LEVELS AWAY	19814.6
548803	SUB F 69.00	5 LEVELS AWAY	14188
548807	BLUVLY-161 161.0	5 LEVELS AWAY	18140.5
548815	SUB M 69.00	5 LEVELS AWAY	23256.2
548820	SUB N-161 161.0	5 LEVELS AWAY	16774.7
587922	G16-115-GSU134.50	5 LEVELS AWAY	36847.7

Bus #	Bus Name	Level Away	Fault Current (Ampere)
			3 PH
635000	CBLUFFS3 345.0	5 LEVELS AWAY	29390.9
635017	ATCHSN 3 345.0	5 LEVELS AWAY	16955.3
640009	COOPER1G 22.00	5 LEVELS AWAY	270211.7
640140	COOPER 5 161.0	5 LEVELS AWAY	17483.7
640142	COOPER T2 913.80	5 LEVELS AWAY	44623.3
640277	MOORE 3 345.0	5 LEVELS AWAY	21329.9
643172	COOPER T5 913.80	5 LEVELS AWAY	25606.8
645041	CASS 1G 15.00	5 LEVELS AWAY	98061.1
645042	CASS 2G 15.00	5 LEVELS AWAY	98345.3
645111	NBAXT1 9 4.200	5 LEVELS AWAY	48501.4
645112	NBAXT2 9 4.200	5 LEVELS AWAY	48207.9
645455	S3455 3 345.0	5 LEVELS AWAY	27766.8
645459	S3459 3 345.0	5 LEVELS AWAY	22439.4
646206	S1206 5 161.0	5 LEVELS AWAY	40434.8
648256	S3456T49 13.80	5 LEVELS AWAY	18610.7
650185	WAGENER 3 345.0	5 LEVELS AWAY	19732.8

3.2.2. Short Circuit Result for Holt County Switching Station 345kV (541197)

The results of the short circuit analysis for POI i.e., Holt County Switching Station 345kV (541197) and five bus levels away are tabulated below in Table 3.2.2.

Table 3.2.2: Short circuit results for Holt County Switching Station 345kV (541197)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541197	MULLNCR7 345.0	0 LEVELS AWAY	8168.6
541411	MC REAC1 345.0	1 LEVELS AWAY	7786.6
541412	MC REAC2 345.0	1 LEVELS AWAY	7786.6
541413	MC REAC3 345.0	1 LEVELS AWAY	7786.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541500	KETCHEM7 345.0	1 LEVELS AWAY	8009.4
541510	HOLT 7 345.0	1 LEVELS AWAY	9669.5
541201	SIBLEY 7 345.0	2 LEVELS AWAY	20797.4
541501	OSBORN7 345.0	2 LEVELS AWAY	7090.1
541511	ROCKCK7 345.0	2 LEVELS AWAY	7348.4
541517	HOLT_REACT7 345.0	2 LEVELS AWAY	9613.7
587730	GEN-2016-088345.0	2 LEVELS AWAY	6928
587920	GEN-2016-115345.0	2 LEVELS AWAY	6905.9
645458	S3458 3 345.0	2 LEVELS AWAY	28598.9
345408	7OVERTON 345.0	3 LEVELS AWAY	12328.1
541200	PHILL 7 345.0	3 LEVELS AWAY	18377.4
541202	SIBLEY 5 161.0	3 LEVELS AWAY	29587
541360	SIBLEY T 13.80	3 LEVELS AWAY	67829.4
541414	SIB REA1 345.0	3 LEVELS AWAY	18488.8
541502	OSBORN_B1_1 34.50	3 LEVELS AWAY	26005.4
541505	OSBORN_TER_113.80	3 LEVELS AWAY	35394.5
541512	ROCKCK_B_1 34.50	3 LEVELS AWAY	39782.4
541515	ROCKCK_TR1_113.20	3 LEVELS AWAY	2583869.2
541516	ROCKCK_TR2_113.20	3 LEVELS AWAY	2679412
542972	HAWTH 7 345.0	3 LEVELS AWAY	22035.2
587731	G16-088XFMR134.50	3 LEVELS AWAY	18547.4
587921	G16-115XFMR134.50	3 LEVELS AWAY	36943.9
640139	COOPER 3 345.0	3 LEVELS AWAY	26705
645011	NEBCTY1G 18.00	3 LEVELS AWAY	219436.7
645012	NEBCTY2G 23.00	3 LEVELS AWAY	188332.7
645456	S3456 3 345.0	3 LEVELS AWAY	30666.7
645740	S3740 3 345.0	3 LEVELS AWAY	17288.7
650189	103&ROKEBY3 345.0	3 LEVELS AWAY	19752
300039	7FAIRPT 345.0	4 LEVELS AWAY	12350.5

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
345088	7MCCREDIE 345.0	4 LEVELS AWAY	16800.5
345409	5OVERTON 161.0	4 LEVELS AWAY	20663.4
541198	PECULR 7 345.0	4 LEVELS AWAY	20150.5
541199	ST JOE 3 345.0	4 LEVELS AWAY	18628.1
541225	PHILL 5 161.0	4 LEVELS AWAY	33091.5
541250	SIBLEYPL 161.0	4 LEVELS AWAY	32187.8
541361	PHILL T 13.80	4 LEVELS AWAY	68165.2
541504	OSBORN_TX_1 34.50	4 LEVELS AWAY	22477.8
541513	ROCKCK_T_1 34.50	4 LEVELS AWAY	39458.9
542973	HAWTHRN5 161.0	4 LEVELS AWAY	54550.5
542980	NASHUA 7 345.0	4 LEVELS AWAY	21143.1
543644	HAWT T20 13.80	4 LEVELS AWAY	19738.2
543645	HAWT T22 13.80	4 LEVELS AWAY	20537
587732	G16-088-GSU134.50	4 LEVELS AWAY	15636.2
587922	G16-115-GSU134.50	4 LEVELS AWAY	36847.7
635000	CBLUFFS3 345.0	4 LEVELS AWAY	29390.9
635017	ATCHSN 3 345.0	4 LEVELS AWAY	16955.3
640009	COOPER1G 22.00	4 LEVELS AWAY	270211.7
640140	COOPER 5 161.0	4 LEVELS AWAY	17483.7
640142	COOPER T2 913.80	4 LEVELS AWAY	44623.3
640277	MOORE 3 345.0	4 LEVELS AWAY	21329.9
643172	COOPER T5 913.80	4 LEVELS AWAY	25606.8
645041	CASS 1G 15.00	4 LEVELS AWAY	98061.1
645042	CASS 2G 15.00	4 LEVELS AWAY	98345.3
645111	NBAXT1 9 4.200	4 LEVELS AWAY	48501.4
645112	NBAXT2 9 4.200	4 LEVELS AWAY	48207.9
645455	S3455 3 345.0	4 LEVELS AWAY	27766.8
645459	S3459 3 345.0	4 LEVELS AWAY	22439.4
646206	S1206 5 161.0	4 LEVELS AWAY	40434.8

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
648256	S3456T49 13.80	4 LEVELS AWAY	18610.7
650185	WAGENER 3 345.0	4 LEVELS AWAY	19732.8
84760	J476 POI 345.0	5 LEVELS AWAY	16870.8
300044	7MCCRED 345.0	5 LEVELS AWAY	16770.3
300076	5FAIRPT 161.0	5 LEVELS AWAY	17628.3
300500	5HUNTSDL 161.0	5 LEVELS AWAY	13476.2
345221	5MOBERLY 161.0	5 LEVELS AWAY	14919
345230	7MONTGMRY 345.0	5 LEVELS AWAY	28032.8
345411	5OVERTON 2 161.0	5 LEVELS AWAY	20663.4
541151	SIBLEY#3 22.00	5 LEVELS AWAY	119823.1
541162	DOGWDSTG 18.00	5 LEVELS AWAY	98907.6
541163	DOGWDCT1 18.00	5 LEVELS AWAY	90509.1
541164	DOGWDCT2 18.00	5 LEVELS AWAY	91680
541235	DUNCAN 5 161.0	5 LEVELS AWAY	19453.1
541239	HSNVL 5 161.0	5 LEVELS AWAY	15215.3
541243	LKWINGB5 161.0	5 LEVELS AWAY	23896.2
541244	ORRICK 5 161.0	5 LEVELS AWAY	14338.7
541253	ST JOE 5 161.0	5 LEVELS AWAY	18906.4
541263	SIBLEY 2 69.00	5 LEVELS AWAY	11537.6
541280	PHILL 2 69.00	5 LEVELS AWAY	13209
541313	HARRIS 161.0	5 LEVELS AWAY	25379.6
541342	PECULR 5 161.0	5 LEVELS AWAY	22856.9
541346	RTCHFLD5 161.0	5 LEVELS AWAY	13187.3
541370	STJOE 1T 13.80	5 LEVELS AWAY	63298.3
541371	STJOE 2T 13.80	5 LEVELS AWAY	63348.7
541372	PECULRT 13.80	5 LEVELS AWAY	57824.7
541400	EASTOWN7 345.0	5 LEVELS AWAY	16980.2
541503	OSBORN_G1_1 0.690	5 LEVELS AWAY	928382.6
541506	OSBORN_G2_1 0.690	5 LEVELS AWAY	228892.2

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541514	ROCKCK_G1_1 0.690	5 LEVELS AWAY	1426244.4
541518	ROCKCK_G2_1 0.690	5 LEVELS AWAY	1426244.4
542951	HAW G5 1 22.00	5 LEVELS AWAY	191719.8
542961	HAWCT6 1 16.00	5 LEVELS AWAY	81012.4
542967	HAW G9 1 13.80	5 LEVELS AWAY	77150.5
542968	STILWEL7 345.0	5 LEVELS AWAY	24460.8
542976	LEVEE 5 161.0	5 LEVELS AWAY	48751.5
542982	IATAN 7 345.0	5 LEVELS AWAY	28781.6
542997	LEEDS 5 161.0	5 LEVELS AWAY	32218.7
543000	BLUEVLY5 161.0	5 LEVELS AWAY	37074.1
543011	CHOUTEU5 161.0	5 LEVELS AWAY	34026.7
543020	BRMGHAM5 161.0	5 LEVELS AWAY	25707.8
543027	RANDLPH5 161.0	5 LEVELS AWAY	31471.7
543028	NASHUA-5 161.0	5 LEVELS AWAY	27146.1
543080	HAWTH 2 69.00	5 LEVELS AWAY	12987.6
543640	NASH T11 13.80	5 LEVELS AWAY	11885.2
548808	ECKLES-161 161.0	5 LEVELS AWAY	26690.4
548814	SUB M-161 161.0	5 LEVELS AWAY	20373.4
560062	G15-088-TAP 345.0	5 LEVELS AWAY	11038
587733	G16-088-GEN10.690	5 LEVELS AWAY	666972.6
587923	G16-115-GEN10.690	5 LEVELS AWAY	1985169.6
635001	CBLUFFS5 161.0	5 LEVELS AWAY	35680.9
635013	PNYCRK 3 345.0	5 LEVELS AWAY	26997
635014	POTTCO 3 345.0	5 LEVELS AWAY	22219
635016	STHLND 3 345.0	5 LEVELS AWAY	26990.7
635019	ATCHSN 9 34.50	5 LEVELS AWAY	28801.2
635023	CBLUF33G 24.00	5 LEVELS AWAY	194436.8
635024	CBLUF4G 26.00	5 LEVELS AWAY	196883
635025	CBLF1XT9 13.80	5 LEVELS AWAY	30085.3

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
635026	CBLF2XT9 13.80	5 LEVELS AWAY	35062.3
640271	MCCOOL 3 345.0	5 LEVELS AWAY	10329.5
640278	SHELDON7 115.0	5 LEVELS AWAY	31425.2
640280	MOORE 9 13.80	5 LEVELS AWAY	31658.1
640446	COOPER 869.00	5 LEVELS AWAY	4558.8
643173	COOPER T6 913.80	5 LEVELS AWAY	6037.9
645033	SARPY 3G 13.80	5 LEVELS AWAY	76429.7
645034	SARPY 4G 13.80	5 LEVELS AWAY	40173.7
645035	SARPY 5G 13.80	5 LEVELS AWAY	40257.1
645451	S3451 3 345.0	5 LEVELS AWAY	19489.1
645454	S3454 3 345.0	5 LEVELS AWAY	23974.1
646201	S1201 5 161.0	5 LEVELS AWAY	29480.5
646209	S1209 5 161.0	5 LEVELS AWAY	40806.9
646216	S1216 5 161.0	5 LEVELS AWAY	28157.6
646232	S1232 5 161.0	5 LEVELS AWAY	24650
646244	S1244 5 161.0	5 LEVELS AWAY	20757.8
646255	S1255 5 161.0	5 LEVELS AWAY	40135.7
646280	S1280 5 161.0	5 LEVELS AWAY	10074.5
647006	S906 N 8 69.00	5 LEVELS AWAY	31609.7
647906	S906 S 8 69.00	5 LEVELS AWAY	31250.4
648206	S1206T19 13.80	5 LEVELS AWAY	17761.6
648255	S3455T19 13.80	5 LEVELS AWAY	17904.8
648259	S3459T39 13.80	5 LEVELS AWAY	4157.5
648306	S1206T29 13.80	5 LEVELS AWAY	30385.2
648355	S3455T39 13.80	5 LEVELS AWAY	4168.4
648359	S3459T69 13.80	5 LEVELS AWAY	27986.7
650114	NW68HOLDRG3 345.0	5 LEVELS AWAY	16496.9
650285	WAGENER 7 115.0	5 LEVELS AWAY	30743
650385	WAGENER1 9 13.80	5 LEVELS AWAY	28002

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
650485	WAGENER2 9 13.80	5 LEVELS AWAY	19718

3.2.3. Short Circuit Result for Stranger Creek 345kV Substation (532772)

The results of the short circuit analysis for POI i.e., Stranger Creek 345kV Substation (532772) and five bus levels away are tabulated below in Table 3.2.3.

Table 3.2.3: Short circuit results for Stranger Creek 345kV Substation (532772)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532772	STRANGR7 345.0	0 LEVELS AWAY	26146
532765	HOYT 7 345.0	1 LEVELS AWAY	15761.5
532775	87TH 7 345.0	1 LEVELS AWAY	20889.4
532811	STRAN1 1 14.40	1 LEVELS AWAY	48877.3
532816	STRAN3 1 14.40	1 LEVELS AWAY	41707.7
533268	STRANGR3 115.0	1 LEVELS AWAY	33554.1
542982	IATAN 7 345.0	1 LEVELS AWAY	28781.6
588240	GEN-2016-149345.0	1 LEVELS AWAY	8634.9
532766	JEC N 7 345.0	2 LEVELS AWAY	23690.4
532804	HOYT 1 14.40	2 LEVELS AWAY	31485.5
532818	87TH 1X1 13.80	2 LEVELS AWAY	71214.4
533163	HOYT 3 115.0	2 LEVELS AWAY	22839.3
533211	ARNOLD 3 115.0	2 LEVELS AWAY	7268.7
533244	JARBALO3 115.0	2 LEVELS AWAY	25277.3
533259	NW LEAV3 115.0	2 LEVELS AWAY	16100.4
533272	THORNTN3 115.0	2 LEVELS AWAY	15272.6
533283	87TH 3 115.0	2 LEVELS AWAY	26306
541150	IATAN 11 13.80	2 LEVELS AWAY	18118.3
541350	IATAN5 161.0	2 LEVELS AWAY	16968.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541400	EASTOWN7 345.0	2 LEVELS AWAY	16980.2
542957	IAT G1 1 24.00	2 LEVELS AWAY	188508.2
542962	IAT G2 1 25.00	2 LEVELS AWAY	243577.4
542977	CRAIG 7 345.0	2 LEVELS AWAY	22417.6
542980	NASHUA 7 345.0	2 LEVELS AWAY	21143.1
588241	G16-149XFMR134.50	2 LEVELS AWAY	32282.5
588250	GEN-2016-174345.0	2 LEVELS AWAY	5671.9
532652	JEC U2 26.00	3 LEVELS AWAY	189507.2
532653	JEC U3 26.00	3 LEVELS AWAY	188799.8
532767	GEARY 7 345.0	3 LEVELS AWAY	10013.2
532770	MORRIS 7 345.0	3 LEVELS AWAY	12820
532805	JEC 13 1 14.40	3 LEVELS AWAY	33406.4
532806	JEC 26 1 14.40	3 LEVELS AWAY	33617.3
532852	JEC 6 230.0	3 LEVELS AWAY	24694
533169	NTHLAND3 115.0	3 LEVELS AWAY	14778.6
533198	HOYTJS 3 115.0	3 LEVELS AWAY	19871.5
533199	HOYTJN 3 115.0	3 LEVELS AWAY	18947
533215	OVRLAND3 115.0	3 LEVELS AWAY	6775.7
533216	KERFORD3 115.0	3 LEVELS AWAY	7294.7
533218	PARALEL3 115.0	3 LEVELS AWAY	5667.6
533219	TONGATP3 115.0	3 LEVELS AWAY	15078
533233	166TH 3 115.0	3 LEVELS AWAY	15922
533242	HALLMRK3 115.0	3 LEVELS AWAY	12123.9
533246	EFAIRMNT3 115.0	3 LEVELS AWAY	10595.2
533251	MIDLNDJ3 115.0	3 LEVELS AWAY	14215.7
533266	SPRUCE 3 115.0	3 LEVELS AWAY	14610.1
533273	TIMBRLN3 115.0	3 LEVELS AWAY	13159.8
533278	WAVERLY3 115.0	3 LEVELS AWAY	14244.8
533281	MNTCLLO3 115.0	3 LEVELS AWAY	22327.7

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533284	95WAJ 3 115.0	3 LEVELS AWAY	14993.7
533449	ARNOLD 1 7.200	3 LEVELS AWAY	20578.2
533471	ARNOLD 2 69.00	3 LEVELS AWAY	7286.6
541199	ST JOE 3 345.0	3 LEVELS AWAY	18628.1
541351	WESTON 5 161.0	3 LEVELS AWAY	12638
541401	EASTOWN5 161.0	3 LEVELS AWAY	16107.7
541402	EASTOWN1 13.80	3 LEVELS AWAY	55457.6
542965	W.GRDNR7 345.0	3 LEVELS AWAY	26296.7
542972	HAWTH 7 345.0	3 LEVELS AWAY	22035.2
542978	CRAIG 5 161.0	3 LEVELS AWAY	40319.1
543028	NASHUA-5 161.0	3 LEVELS AWAY	27146.1
543640	NASH T11 13.80	3 LEVELS AWAY	11885.2
543641	CRAI T11 13.80	3 LEVELS AWAY	12282.7
543642	CRAI T22 13.80	3 LEVELS AWAY	19135.6
543643	CRAI T33 13.80	3 LEVELS AWAY	18801.4
588242	G16-149-GSU134.50	3 LEVELS AWAY	31631.3
588251	G16-174XFMR134.50	3 LEVELS AWAY	28253.9
588260	GEN-2016-176345.0	3 LEVELS AWAY	4231.5
300039	7FAIRPT 345.0	4 LEVELS AWAY	12350.5
532651	JEC U1 26.00	4 LEVELS AWAY	180407.5
532768	EMPEC 7 345.0	4 LEVELS AWAY	17361.7
532773	SUMMIT 7 345.0	4 LEVELS AWAY	11674.7
532774	SWISVAL7 345.0	4 LEVELS AWAY	16416.3
532809	MORRIS1X1 14.40	4 LEVELS AWAY	31478
532834	GEARY1X1 13.80	4 LEVELS AWAY	68050.2
532851	AUBURN 6 230.0	4 LEVELS AWAY	13280.8
532861	EMANHAT6 230.0	4 LEVELS AWAY	9611.5
532863	MORRIS 6 230.0	4 LEVELS AWAY	13900.9
533156	54&MERI3 115.0	4 LEVELS AWAY	16393.8

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533162	INDNOLA3 115.0	4 LEVELS AWAY	19314.9
533165	HTI JCT3 115.0	4 LEVELS AWAY	16610.9
533220	WALNUT 3 115.0	4 LEVELS AWAY	5070.6
533235	CAPTAIN3 115.0	4 LEVELS AWAY	10707.5
533239	ESAAPJ 3 115.0	4 LEVELS AWAY	12530.6
533243	JAGGARD3 115.0	4 LEVELS AWAY	15968.5
533249	LEC U4 3 115.0	4 LEVELS AWAY	23685.2
533255	MOONLTJ3 115.0	4 LEVELS AWAY	11523.4
533260	MIDLADS3 115.0	4 LEVELS AWAY	24820
533261	PENTAGN3 115.0	4 LEVELS AWAY	21285.2
533265	SOUTHTN3 115.0	4 LEVELS AWAY	10927.7
533336	GEARY 3 115.0	4 LEVELS AWAY	17217.2
533456	COLINE 2 69.00	4 LEVELS AWAY	8259.8
533479	ARNOJCT2 69.00	4 LEVELS AWAY	7286.6
533481	NORTONV2 69.00	4 LEVELS AWAY	3175.5
541201	SIBLEY 7 345.0	4 LEVELS AWAY	20797.4
541203	NASHUA 5 161.0	4 LEVELS AWAY	27146.1
541221	PLTCTY 5 161.0	4 LEVELS AWAY	15655
541230	RNRIDGE5 161.0	4 LEVELS AWAY	21661.3
541253	ST JOE 5 161.0	4 LEVELS AWAY	18906.4
541254	EAST 5 161.0	4 LEVELS AWAY	14746.9
541256	IND PRK5 161.0	4 LEVELS AWAY	14128.4
541370	STJOE 1T 13.80	4 LEVELS AWAY	63298.3
541371	STJOE 2T 13.80	4 LEVELS AWAY	63348.7
542966	WGARDNR5 161.0	4 LEVELS AWAY	27583.5
542968	STILWEL7 345.0	4 LEVELS AWAY	24460.8
542973	HAWTHRN5 161.0	4 LEVELS AWAY	54550.5
542979	PFLUMM 5 161.0	4 LEVELS AWAY	27293.6
542981	LACYGNE7 345.0	4 LEVELS AWAY	25345.3

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
543029	SHOLCRK5 161.0	4 LEVELS AWAY	16484.3
543038	LENEXAS5 161.0	4 LEVELS AWAY	26601.6
543039	LENEXAN5 161.0	4 LEVELS AWAY	27772.6
543048	COLLEGE5 161.0	4 LEVELS AWAY	28349.9
543049	CEDRCRK5 161.0	4 LEVELS AWAY	28012
543644	HAWT T20 13.80	4 LEVELS AWAY	19738.2
543645	HAWT T22 13.80	4 LEVELS AWAY	20537
543649	WGAR T11 13.80	4 LEVELS AWAY	16039.3
588243	G16-149-GEN10.690	4 LEVELS AWAY	1353490.2
588252	G16-174-GSU134.50	4 LEVELS AWAY	27799.1
588261	G16-176XFMR134.50	4 LEVELS AWAY	25141.7
588270	GEN-2016-150345.0	4 LEVELS AWAY	3227.5
588300	GEN-2016-157345.0	4 LEVELS AWAY	4936.7
640139	COOPER 3 345.0	4 LEVELS AWAY	26705
300076	5FAIRPT 161.0	5 LEVELS AWAY	17628.3
300307	2PLATCTY 69.00	5 LEVELS AWAY	8715.8
345408	7OVERTON 345.0	5 LEVELS AWAY	12328.1
532662	LEC U4 14.40	5 LEVELS AWAY	87310
532740	EMPEC121 13.80	5 LEVELS AWAY	60926
532741	EMPEC341 13.80	5 LEVELS AWAY	60926
532742	EMPEC5 1 18.00	5 LEVELS AWAY	85457
532743	EMPEC6 1 18.00	5 LEVELS AWAY	85457
532744	EMPEC7 1 18.00	5 LEVELS AWAY	85457
532769	LANG 7 345.0	5 LEVELS AWAY	17149.1
532793	NEOSHO 7 345.0	5 LEVELS AWAY	15908.5
532799	WAVERLY7 345.0	5 LEVELS AWAY	14611.2
532813	SUMMIT 1 14.40	5 LEVELS AWAY	30804.9
532815	SWISV1X1 14.40	5 LEVELS AWAY	36196.6
532819	SWISV2X2 14.40	5 LEVELS AWAY	802122.4

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
532856	SWISVAL6 230.0	5 LEVELS AWAY	21400.3
532862	MCDOWEL6 230.0	5 LEVELS AWAY	6920.3
532865	NMANHT6 230.0	5 LEVELS AWAY	8810.2
532873	SUMMIT 6 230.0	5 LEVELS AWAY	14193.8
532874	UNIONRG6 230.0	5 LEVELS AWAY	8961.5
532880	AUBURN 1 14.40	5 LEVELS AWAY	64591
532888	EMANHAT1 18.00	5 LEVELS AWAY	30047.5
532890	MORRIS2X1 13.80	5 LEVELS AWAY	39061.6
533151	AUBURN 3 115.0	5 LEVELS AWAY	21030.4
533152	CIRCLVL3 115.0	5 LEVELS AWAY	6111.9
533153	COLINE 3 115.0	5 LEVELS AWAY	22072.3
533164	HTI 3 115.0	5 LEVELS AWAY	13439.5
533166	INDIANH3 115.0	5 LEVELS AWAY	17116.6
533168	N TYLER3 115.0	5 LEVELS AWAY	16117.1
533196	EDUCATE3 115.0	5 LEVELS AWAY	15647.1
533226	TCSEVRN3 115.0	5 LEVELS AWAY	3147
533234	BISMARK3 115.0	5 LEVELS AWAY	18120.7
533240	EUDORA 3 115.0	5 LEVELS AWAY	11054.8
533248	LEC U3 3 115.0	5 LEVELS AWAY	23822.4
533250	LWRNCHL3 115.0	5 LEVELS AWAY	25134.9
533252	MIDLADN3 115.0	5 LEVELS AWAY	24820
533254	MOONLIT3 115.0	5 LEVELS AWAY	10142.5
533262	BONITA 3 115.0	5 LEVELS AWAY	9642.2
533282	MUND 3 115.0	5 LEVELS AWAY	15986.8
533305	MORRIS 3 115.0	5 LEVELS AWAY	12453
533326	EMANHAT3 115.0	5 LEVELS AWAY	13133.2
533328	FT JCT 3 115.0	5 LEVELS AWAY	14589.9
533335	MCDOWEL3 115.0	5 LEVELS AWAY	17741.5
533362	CHAPMAN3 115.0	5 LEVELS AWAY	10432.2

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533443	COLINE 1 34.50	5 LEVELS AWAY	3253.3
533451	WALNUT 1 34.50	5 LEVELS AWAY	2173.2
533458	ROCKCRK2 69.00	5 LEVELS AWAY	3634.5
533477	MW SOLV2 69.00	5 LEVELS AWAY	6172.5
533480	MUSCOTA2 69.00	5 LEVELS AWAY	1543.8
533483	VALLEY22 69.00	5 LEVELS AWAY	2988.5
533484	WALNUT 2 69.00	5 LEVELS AWAY	5861.6
539805	ELMCREEK7 345.0	5 LEVELS AWAY	5240.4
541198	PECULR 7 345.0	5 LEVELS AWAY	20150.5
541200	PHILL 7 345.0	5 LEVELS AWAY	18377.4
541202	SIBLEY 5 161.0	5 LEVELS AWAY	29587
541204	SMTHVL 5 161.0	5 LEVELS AWAY	20618.3
541212	KCI 5 161.0	5 LEVELS AWAY	12382.8
541247	LBRTYWT5 161.0	5 LEVELS AWAY	14627.3
541252	ST JOEREA 5 161.0	5 LEVELS AWAY	6450.5
541255	LAKE RD5 161.0	5 LEVELS AWAY	11316.5
541257	COOK 5 161.0	5 LEVELS AWAY	13063.9
541258	WOODBIN5 161.0	5 LEVELS AWAY	15946.9
541260	RNRDGE 2 69.00	5 LEVELS AWAY	4858.9
541318	NCONGRS5 161.0	5 LEVELS AWAY	17687.9
541360	SIBLEY T 13.80	5 LEVELS AWAY	67829.4
541414	SIB REA1 345.0	5 LEVELS AWAY	18488.8
541500	KETCHEM7 345.0	5 LEVELS AWAY	8009.4
542951	HAW G5 1 22.00	5 LEVELS AWAY	191719.8
542955	LAC G1 1 22.00	5 LEVELS AWAY	232778.1
542956	LAC G2 1 24.00	5 LEVELS AWAY	210938.8
542961	HAWCT6 1 16.00	5 LEVELS AWAY	81012.4
542967	HAW G9 1 13.80	5 LEVELS AWAY	77150.5
542969	STILWEL5 161.0	5 LEVELS AWAY	38530.1

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
542976	LEVEE 5 161.0	5 LEVELS AWAY	48751.5
542997	LEEDS 5 161.0	5 LEVELS AWAY	32218.7
543000	BLUEVLY5 161.0	5 LEVELS AWAY	37074.1
543011	CHOUTEU5 161.0	5 LEVELS AWAY	34026.7
543016	GLADSTN5 161.0	5 LEVELS AWAY	17483.8
543019	BARRY 5 161.0	5 LEVELS AWAY	17423.1
543020	BRMGHAM5 161.0	5 LEVELS AWAY	25707.8
543022	CLAYCM15 161.0	5 LEVELS AWAY	10714.9
543026	TIFFANY5 161.0	5 LEVELS AWAY	19075.3
543027	RANDLPH5 161.0	5 LEVELS AWAY	31471.7
543031	SHWNMSN5 161.0	5 LEVELS AWAY	31974.8
543036	OLATHE 5 161.0	5 LEVELS AWAY	25916.6
543047	OVERLPK5 161.0	5 LEVELS AWAY	29973.2
543052	REEDER 5 161.0	5 LEVELS AWAY	19084
543054	CEDARNL5 161.0	5 LEVELS AWAY	13704.9
543077	PLSTVAL5 161.0	5 LEVELS AWAY	9784.3
543080	HAWTH 2 69.00	5 LEVELS AWAY	12987.6
543105	BULLCRK5 161.0	5 LEVELS AWAY	25236.7
543132	BNSF 5 161.0	5 LEVELS AWAY	20085.6
543629	LACYGNE11_7 345.0	5 LEVELS AWAY	24706
543632	LACYGNE22_7 345.0	5 LEVELS AWAY	24669.7
543647	STIL T11 13.80	5 LEVELS AWAY	18882.4
543648	STIL T22 13.80	5 LEVELS AWAY	19814.6
548814	SUB M-161 161.0	5 LEVELS AWAY	20373.4
562476	G14-001-TAP 345.0	5 LEVELS AWAY	11163.7
585100	GEN-2015-073345.0	5 LEVELS AWAY	14211.3
587894	G16-112-TAP 345.0	5 LEVELS AWAY	11084.4
588253	G16-174-GEN10.690	5 LEVELS AWAY	1226743.8
588262	G16-176-GSU134.50	5 LEVELS AWAY	24816.7

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
588271	G16-150XFMR134.50	5 LEVELS AWAY	22152.7
588301	G16-157XFMR134.50	5 LEVELS AWAY	24176.8
588310	GEN-2016-158345.0	5 LEVELS AWAY	4658.2
635017	ATCHSN 3 345.0	5 LEVELS AWAY	16955.3
640009	COOPER1G 22.00	5 LEVELS AWAY	270211.7
640140	COOPER 5 161.0	5 LEVELS AWAY	17483.7
640142	COOPER T2 913.80	5 LEVELS AWAY	44623.3
640277	MOORE 3 345.0	5 LEVELS AWAY	21329.9
643172	COOPER T5 913.80	5 LEVELS AWAY	25606.8
645458	S3458 3 345.0	5 LEVELS AWAY	28598.9

3.2.4. Short Circuit Result for West Gardner 345kV Substation (542965)

The results of the short circuit analysis for POI i.e., West Gardner 345kV Substation (542965) and five bus levels away are tabulated below in Table 3.2.4.

Table 3.2.4: Short circuit results for West Gardner 345kV Substation (542965)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
542965	W.GRDNR7 345.0	0 LEVELS AWAY	26296.7
532774	SWISVAL7 345.0	1 LEVELS AWAY	16416.3
542966	WGARDNR5 161.0	1 LEVELS AWAY	27583.5
542968	STILWEL7 345.0	1 LEVELS AWAY	24460.8
542977	CRAIG 7 345.0	1 LEVELS AWAY	22417.6
542981	LACYGNE7 345.0	1 LEVELS AWAY	25345.3
543649	WGAR T11 13.80	1 LEVELS AWAY	16039.3
588300	GEN-2016-157345.0	1 LEVELS AWAY	4936.7
532768	EMPEC 7 345.0	2 LEVELS AWAY	17361.7
532775	87TH 7 345.0	2 LEVELS AWAY	20889.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532793	NEOSHO 7 345.0	2 LEVELS AWAY	15908.5
532799	WAVERLY7 345.0	2 LEVELS AWAY	14611.2
532815	SWISV1X1 14.40	2 LEVELS AWAY	36196.6
532819	SWISV2X2 14.40	2 LEVELS AWAY	802122.4
532856	SWISVAL6 230.0	2 LEVELS AWAY	21400.3
541198	PECULR 7 345.0	2 LEVELS AWAY	20150.5
542955	LAC G1 1 22.00	2 LEVELS AWAY	232778.1
542956	LAC G2 1 24.00	2 LEVELS AWAY	210938.8
542969	STILWEL5 161.0	2 LEVELS AWAY	38530.1
542978	CRAIG 5 161.0	2 LEVELS AWAY	40319.1
543049	CEDRCRK5 161.0	2 LEVELS AWAY	28012
543054	CEDARNL5 161.0	2 LEVELS AWAY	13704.9
543077	PLSTVAL5 161.0	2 LEVELS AWAY	9784.3
543105	BULLCRK5 161.0	2 LEVELS AWAY	25236.7
543132	BNSF 5 161.0	2 LEVELS AWAY	20085.6
543629	LACYGNE11_7 345.0	2 LEVELS AWAY	24706
543632	LACYGNE22_7 345.0	2 LEVELS AWAY	24669.7
543641	CRAI T11 13.80	2 LEVELS AWAY	12282.7
543642	CRAI T22 13.80	2 LEVELS AWAY	19135.6
543643	CRAI T33 13.80	2 LEVELS AWAY	18801.4
543647	STIL T11 13.80	2 LEVELS AWAY	18882.4
543648	STIL T22 13.80	2 LEVELS AWAY	19814.6
588301	G16-157XFMR134.50	2 LEVELS AWAY	24176.8
588310	GEN-2016-158345.0	2 LEVELS AWAY	4658.2
300739	7BLACKBERRY 345.0	3 LEVELS AWAY	12238.8
510380	DELWARE7 345.0	3 LEVELS AWAY	10962.2
532740	EMPEC121 13.80	3 LEVELS AWAY	60926
532741	EMPEC341 13.80	3 LEVELS AWAY	60926
532742	EMPEC5 1 18.00	3 LEVELS AWAY	85457

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532743	EMPEC6 1 18.00	3 LEVELS AWAY	85457
532744	EMPEC7 1 18.00	3 LEVELS AWAY	85457
532769	LANG 7 345.0	3 LEVELS AWAY	17149.1
532770	MORRIS 7 345.0	3 LEVELS AWAY	12820
532772	STRANGR7 345.0	3 LEVELS AWAY	26146
532780	CANEYRV7 345.0	3 LEVELS AWAY	9960.5
532797	WOLFCRK7 345.0	3 LEVELS AWAY	15931.3
532802	WAVERTX7 345.0	3 LEVELS AWAY	12421.3
532818	87TH 1X1 13.80	3 LEVELS AWAY	71214.4
532824	N345 1 1 13.80	3 LEVELS AWAY	40180.7
532825	N345 2 1 13.80	3 LEVELS AWAY	47334
532851	AUBURN 6 230.0	3 LEVELS AWAY	13280.8
532853	LAWHILL6 230.0	3 LEVELS AWAY	13253.5
532857	TECHILL6 230.0	3 LEVELS AWAY	10990.1
532863	MORRIS 6 230.0	3 LEVELS AWAY	13900.9
532937	NEOSHO 5 161.0	3 LEVELS AWAY	20855.2
533021	NEOSHO 4 138.0	3 LEVELS AWAY	22547.4
533283	87TH 3 115.0	3 LEVELS AWAY	26306
541200	PHILL 7 345.0	3 LEVELS AWAY	18377.4
541341	S.HARP 5 161.0	3 LEVELS AWAY	21776.8
541342	PECULR 5 161.0	3 LEVELS AWAY	22856.9
541372	PECULRT 13.80	3 LEVELS AWAY	57824.7
542979	PFLUMM 5 161.0	3 LEVELS AWAY	27293.6
542994	HICKMAN5 161.0	3 LEVELS AWAY	18447.8
542995	MONTROS5 161.0	3 LEVELS AWAY	13631.2
543031	SHWNMSN5 161.0	3 LEVELS AWAY	31974.8
543038	LENEXAS5 161.0	3 LEVELS AWAY	26601.6
543039	LENEXAN5 161.0	3 LEVELS AWAY	27772.6
543044	MOONLT 5 161.0	3 LEVELS AWAY	16537.7

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
543048	COLLEGE5 161.0	3 LEVELS AWAY	28349.9
543050	ANTIOCH5 161.0	3 LEVELS AWAY	21940.3
543053	REDEL 5 161.0	3 LEVELS AWAY	23653.6
543055	SEOTTWA5 161.0	3 LEVELS AWAY	6725.6
543057	BUCYRUS5 161.0	3 LEVELS AWAY	19089.4
543106	WG CT 1 13.80	3 LEVELS AWAY	58894.4
543107	WG CT 2 13.80	3 LEVELS AWAY	58644.4
543108	WG CT 3 13.80	3 LEVELS AWAY	58890.5
543109	WG CT 4 13.80	3 LEVELS AWAY	58603.2
543126	LACKMAN5 161.0	3 LEVELS AWAY	13015.9
543131	CLARE 5 161.0	3 LEVELS AWAY	14062
543630	LAC11_SWGR1 13.80	3 LEVELS AWAY	28082.9
543631	LAC11_TER1 13.80	3 LEVELS AWAY	19022.6
543633	LAC22_SWGR1 13.80	3 LEVELS AWAY	28241.2
543634	LAC22_TER1 13.80	3 LEVELS AWAY	19132
562476	G14-001-TAP 345.0	3 LEVELS AWAY	11163.7
585100	GEN-2015-073345.0	3 LEVELS AWAY	14211.3
588302	G16-157-GSU134.50	3 LEVELS AWAY	23756.9
588311	G16-158XFMR134.50	3 LEVELS AWAY	23668.1
300071	5CLINTN 161.0	4 LEVELS AWAY	14075.8
300740	7SPORTSMAN 345.0	4 LEVELS AWAY	24251.7
300949	7JASPER 345.0	4 LEVELS AWAY	10686.4
510370	DELAWAR1 13.80	4 LEVELS AWAY	19048.2
510379	DELWARE4 138.0	4 LEVELS AWAY	10859.6
510406	N.E.S.-7 345.0	4 LEVELS AWAY	16281.5
532710	NSES 2X1 13.20	4 LEVELS AWAY	39841.8
532751	WCGS U1 25.00	4 LEVELS AWAY	207446.9
532765	HOYT 7 345.0	4 LEVELS AWAY	15761.5
532766	JEC N 7 345.0	4 LEVELS AWAY	23690.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532781	CANEYWF7 345.0	4 LEVELS AWAY	9692.5
532791	BENTON 7 345.0	4 LEVELS AWAY	20515.6
532794	ROSEHIL7 345.0	4 LEVELS AWAY	19562.5
532796	WICHITA7 345.0	4 LEVELS AWAY	26115
532800	LATHAMS7 345.0	4 LEVELS AWAY	10567.7
532808	LANG 1 14.40	4 LEVELS AWAY	36166.4
532809	MORRIS1X1 14.40	4 LEVELS AWAY	31478
532811	STRAN1 1 14.40	4 LEVELS AWAY	48877.3
532816	STRAN3 1 14.40	4 LEVELS AWAY	41707.7
532852	JEC 6 230.0	4 LEVELS AWAY	24694
532854	LEC U5 6 230.0	4 LEVELS AWAY	13130.9
532855	MIDLAND6 230.0	4 LEVELS AWAY	11832.3
532862	MCDOWEL6 230.0	4 LEVELS AWAY	6920.3
532874	UNIONRG6 230.0	4 LEVELS AWAY	8961.5
532880	AUBURN 1 14.40	4 LEVELS AWAY	64591
532882	LAWHILL1 13.80	4 LEVELS AWAY	54231.8
532886	TECHILL1 13.80	4 LEVELS AWAY	55669.6
532890	MORRIS2X1 13.80	4 LEVELS AWAY	39061.6
532934	MARMTNE5 161.0	4 LEVELS AWAY	8077.5
532954	WAVERTX1 34.50	4 LEVELS AWAY	24321.6
532958	NEOSH4 1 13.20	4 LEVELS AWAY	9277.4
532959	NEOSH5 1 13.20	4 LEVELS AWAY	11015.1
532961	WAVETV 1 13.80	4 LEVELS AWAY	37659.3
532962	WOLFCRK1 17.00	4 LEVELS AWAY	8826.9
533020	NEOSHOS4 138.0	4 LEVELS AWAY	22547.4
533022	NEOSHON4 138.0	4 LEVELS AWAY	22547.4
533151	AUBURN 3 115.0	4 LEVELS AWAY	21030.4
533182	TECHILE3 115.0	4 LEVELS AWAY	27481
533250	LWRNCHL3 115.0	4 LEVELS AWAY	25134.9

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533268	STRANGR3 115.0	4 LEVELS AWAY	33554.1
533273	TIMBRLN3 115.0	4 LEVELS AWAY	13159.8
533278	WAVERLY3 115.0	4 LEVELS AWAY	14244.8
533281	MNTCLLO3 115.0	4 LEVELS AWAY	22327.7
533284	95WAJ 3 115.0	4 LEVELS AWAY	14993.7
533304	LANG 3 115.0	4 LEVELS AWAY	14460.5
533305	MORRIS 3 115.0	4 LEVELS AWAY	12453
533653	WOLFCRK2 69.00	4 LEVELS AWAY	5808
533778	NEOSHOS2 69.00	4 LEVELS AWAY	22084.3
541165	S.HARP#1 13.80	4 LEVELS AWAY	74744.9
541166	S.HARP#2 13.80	4 LEVELS AWAY	38529
541167	S.HARP#3 13.80	4 LEVELS AWAY	38529
541201	SIBLEY 7 345.0	4 LEVELS AWAY	20797.4
541207	ARCHIE 5 161.0	4 LEVELS AWAY	16250.9
541225	PHILL 5 161.0	4 LEVELS AWAY	33091.5
541245	KCSOUTH5 161.0	4 LEVELS AWAY	16697.2
541317	NRAYMORE 161.0	4 LEVELS AWAY	7671.2
541340	BELTONS5 161.0	4 LEVELS AWAY	19040.9
541343	S.HARP 2 69.00	4 LEVELS AWAY	4463.5
541344	PECULRS5 161.0	4 LEVELS AWAY	21705.1
541361	PHILL T 13.80	4 LEVELS AWAY	68165.2
542952	MONTG1 1 22.00	4 LEVELS AWAY	31253.3
542953	MONTG2 1 22.00	4 LEVELS AWAY	29511.3
542954	MONTG3 1 18.00	4 LEVELS AWAY	34816.1
542982	IATAN 7 345.0	4 LEVELS AWAY	28781.6
542993	STHTOWN5 161.0	4 LEVELS AWAY	32728.2
543002	MARTCIT5 161.0	4 LEVELS AWAY	23714.7
543032	MERRIAM5 161.0	4 LEVELS AWAY	29568.3
543036	OLATHE 5 161.0	4 LEVELS AWAY	25916.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
543037	QUARRY 5 161.0	4 LEVELS AWAY	17114.8
543041	SHAWNEE5 161.0	4 LEVELS AWAY	24641.8
543042	SPRGHL 5 161.0	4 LEVELS AWAY	10828.8
543046	OXFORD 5 161.0	4 LEVELS AWAY	20127.1
543047	OVERLPK5 161.0	4 LEVELS AWAY	29973.2
543052	REEDER 5 161.0	4 LEVELS AWAY	19084
543056	GARDNER5 161.0	4 LEVELS AWAY	15367.5
543058	NLOUISB5 161.0	4 LEVELS AWAY	8697.2
543066	S.OTTWA5 161.0	4 LEVELS AWAY	6611.9
543068	WAGSTAF5 161.0	4 LEVELS AWAY	13351.9
546742	METRO 5 161.0	4 LEVELS AWAY	24104.5
547469	RIV4525 161.0	4 LEVELS AWAY	23424.3
583850	GEN-2014-001345.0	4 LEVELS AWAY	7597.8
585101	G15-073XFMR134.50	4 LEVELS AWAY	13328.1
585104	G15-073XFMR234.50	4 LEVELS AWAY	13437.4
588240	GEN-2016-149345.0	4 LEVELS AWAY	8634.9
588303	G16-157-GEN10.690	4 LEVELS AWAY	1042499.7
588312	G16-158-GSU134.50	4 LEVELS AWAY	23271.6
300045	7MORGAN 345.0	5 LEVELS AWAY	10883.9
300124	5HOLDEN 161.0	5 LEVELS AWAY	10528.7
300692	2CLINTN 69.00	5 LEVELS AWAY	13433.5
300741	5SPORTSMAN 161.0	5 LEVELS AWAY	41054.6
300950	5JASPER 161.0	5 LEVELS AWAY	11812.4
301477	5OSCEOKC 161.0	5 LEVELS AWAY	6210.2
345408	7OVERTON 345.0	5 LEVELS AWAY	12328.1
505502	TRUMAN 5 161.0	5 LEVELS AWAY	6981.5
509807	ONETA--7 345.0	5 LEVELS AWAY	27462.8
509852	T.NO.--7 345.0	5 LEVELS AWAY	24960.6
512650	GRDA1 7 345.0	5 LEVELS AWAY	26747.6

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
512734	FARML 4 138.0	5 LEVELS AWAY	8293
532651	JEC U1 26.00	5 LEVELS AWAY	180407.5
532652	JEC U2 26.00	5 LEVELS AWAY	189507.2
532653	JEC U3 26.00	5 LEVELS AWAY	188799.8
532663	LEC U5 24.00	5 LEVELS AWAY	85993.8
532711	NEC U3 12.00	5 LEVELS AWAY	21581
532767	GEARY 7 345.0	5 LEVELS AWAY	10013.2
532771	RENO 7 345.0	5 LEVELS AWAY	12538.3
532782	BUFFALO7 345.0	5 LEVELS AWAY	21654.8
532798	VIOLA 7 345.0	5 LEVELS AWAY	14282.2
532801	ELKRVR17 345.0	5 LEVELS AWAY	9319.4
532804	HOYT 1 14.40	5 LEVELS AWAY	31485.5
532805	JEC 13 1 14.40	5 LEVELS AWAY	33406.4
532806	JEC 26 1 14.40	5 LEVELS AWAY	33617.3
532817	UNIONRG1 13.20	5 LEVELS AWAY	18715.3
532821	BENTN1 1 13.80	5 LEVELS AWAY	23754.5
532822	BENTN2 1 13.80	5 LEVELS AWAY	45329.5
532826	ROSEH1 1 13.80	5 LEVELS AWAY	39360.4
532827	ROSEH5 1 13.80	5 LEVELS AWAY	39120.2
532829	WICH11 1 13.80	5 LEVELS AWAY	50216.1
532830	WICH12 1 13.80	5 LEVELS AWAY	50413.5
532831	ROSEH3 1 13.80	5 LEVELS AWAY	39296.3
532861	EMANHAT6 230.0	5 LEVELS AWAY	9611.5
532873	SUMMIT 6 230.0	5 LEVELS AWAY	14193.8
532884	MIDLAND1 18.00	5 LEVELS AWAY	37315.9
532898	MCDOWL 1 13.80	5 LEVELS AWAY	30126.4
532912	EDWRDVL5 161.0	5 LEVELS AWAY	20402.6
532926	BAKER 2 69.00	5 LEVELS AWAY	4889.1
532938	FRANKLIN5 161.0	5 LEVELS AWAY	7579.2

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
532948	SPRINGH1 12.47	5 LEVELS AWAY	17465.2
532955	MARMATN1 13.20	5 LEVELS AWAY	10667.1
532960	WAVERGSU1 34.50	5 LEVELS AWAY	18270.6
532986	BENTON 4 138.0	5 LEVELS AWAY	29103.1
533005	NEPARSN4 138.0	5 LEVELS AWAY	11762.7
533008	TV1MNDV4 138.0	5 LEVELS AWAY	6811.8
533040	EVANS N4 138.0	5 LEVELS AWAY	40990.1
533062	ROSEHIL4 138.0	5 LEVELS AWAY	32252.1
533079	CNYWFLV1 34.50	5 LEVELS AWAY	33670.6
533102	CNYWF1 1 13.20	5 LEVELS AWAY	90226.5
533153	COLINE 3 115.0	5 LEVELS AWAY	22072.3
533155	CROOKED3 115.0	5 LEVELS AWAY	19889.7
533163	HOYT 3 115.0	5 LEVELS AWAY	22839.3
533166	INDIANH3 115.0	5 LEVELS AWAY	17116.6
533167	KEENE 3 115.0	5 LEVELS AWAY	9845.1
533176	SHAWNEE3 115.0	5 LEVELS AWAY	11853
533181	TECHILW3 115.0	5 LEVELS AWAY	27481
533187	27CROCO3 115.0	5 LEVELS AWAY	18840.1
533194	SHERWOD3 115.0	5 LEVELS AWAY	19156.4
533211	ARNOLD 3 115.0	5 LEVELS AWAY	7268.7
533232	BALDCRK3 115.0	5 LEVELS AWAY	13694.8
533235	CAPTAIN3 115.0	5 LEVELS AWAY	10707.5
533239	ESAAPJ 3 115.0	5 LEVELS AWAY	12530.6
533244	JARBALO3 115.0	5 LEVELS AWAY	25277.3
533248	LEC U3 3 115.0	5 LEVELS AWAY	23822.4
533249	LEC U4 3 115.0	5 LEVELS AWAY	23685.2
533252	MIDLADN3 115.0	5 LEVELS AWAY	24820
533253	MOCKBRD3 115.0	5 LEVELS AWAY	16530.8
533255	MOONLTJ3 115.0	5 LEVELS AWAY	11523.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
533259	NW LEAV3 115.0	5 LEVELS AWAY	16100.4
533261	PENTAGN3 115.0	5 LEVELS AWAY	21285.2
533264	6TH ST 3 115.0	5 LEVELS AWAY	17557.9
533265	SOUTHTN3 115.0	5 LEVELS AWAY	10927.7
533267	SPRINGH3 115.0	5 LEVELS AWAY	9594.3
533270	STULL T3 115.0	5 LEVELS AWAY	11703.3
533272	THORNTN3 115.0	5 LEVELS AWAY	15272.6
533280	WREN 3 115.0	5 LEVELS AWAY	12921.9
533301	EAST ST3 115.0	5 LEVELS AWAY	9216
533306	READING3 115.0	5 LEVELS AWAY	6382.5
533307	PRAIRIE3 115.0	5 LEVELS AWAY	9263.4
533309	WEMPORI3 115.0	5 LEVELS AWAY	9791.2
533335	MCDOWEL3 115.0	5 LEVELS AWAY	17741.5
533359	UNIONRG3 115.0	5 LEVELS AWAY	3802.3
533626	BURLJCT2 69.00	5 LEVELS AWAY	4774.9
533629	CC2SHAR2 69.00	5 LEVELS AWAY	4514.8
533639	MARMATN2 69.00	5 LEVELS AWAY	8262.2
533703	ORDNJCT2 69.00	5 LEVELS AWAY	8282.6
533758	CRAWFOR2 69.00	5 LEVELS AWAY	6926.9
533768	NEOSHON2 69.00	5 LEVELS AWAY	22084.3
533884	INNOVIA1 13.80	5 LEVELS AWAY	3809.9
541150	IATAN 11 13.80	5 LEVELS AWAY	18118.3
541162	DOGWDSTG 18.00	5 LEVELS AWAY	98907.6
541163	DOGWDCT1 18.00	5 LEVELS AWAY	90509.1
541164	DOGWDCT2 18.00	5 LEVELS AWAY	91680
541202	SIBLEY 5 161.0	5 LEVELS AWAY	29587
541210	MARTCTY5 161.0	5 LEVELS AWAY	26663.7
541217	WINDSR 5 161.0	5 LEVELS AWAY	7499.9
541224	LNGVW 5 161.0	5 LEVELS AWAY	21800.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
541239	HSNVL 5 161.0	5 LEVELS AWAY	15215.3
541240	ADRIAN 5 161.0	5 LEVELS AWAY	8075.3
541242	CLINTON5 161.0	5 LEVELS AWAY	14017.4
541243	LKWINGB5 161.0	5 LEVELS AWAY	23896.2
541259	TURNER 5 161.0	5 LEVELS AWAY	17762.6
541280	PHILL 2 69.00	5 LEVELS AWAY	13209
541290	BELTONS2 69.00	5 LEVELS AWAY	9865.9
541291	FREEMAN2 69.00	5 LEVELS AWAY	4428.8
541313	HARRIS 161.0	5 LEVELS AWAY	25379.6
541350	IATAN5 161.0	5 LEVELS AWAY	16968.6
541360	SIBLEY T 13.80	5 LEVELS AWAY	67829.4
541400	EASTOWN7 345.0	5 LEVELS AWAY	16980.2
541414	SIB REA1 345.0	5 LEVELS AWAY	18488.8
541500	KETCHEM7 345.0	5 LEVELS AWAY	8009.4
542957	IAT G1 1 24.00	5 LEVELS AWAY	188508.2
542962	IAT G2 1 25.00	5 LEVELS AWAY	243577.4
542972	HAWTH 7 345.0	5 LEVELS AWAY	22035.2
542980	NASHUA 7 345.0	5 LEVELS AWAY	21143.1
542992	BENDIX 5 161.0	5 LEVELS AWAY	27102.7
542999	LVISTAW5 161.0	5 LEVELS AWAY	13288.3
543001	FOREST 5 161.0	5 LEVELS AWAY	28981.5
543008	BUNKRDG5 161.0	5 LEVELS AWAY	16215.9
543010	WINJT S5 161.0	5 LEVELS AWAY	22153.8
543033	BRKRIDG5 161.0	5 LEVELS AWAY	22747.1
543034	KNLWRTH5 161.0	5 LEVELS AWAY	25048.4
543040	ROEPARK5 161.0	5 LEVELS AWAY	27874.2
543043	MURLEN 5 161.0	5 LEVELS AWAY	18192.9
543045	SWITZER5 161.0	5 LEVELS AWAY	18699.1
543067	CENTENL5 161.0	5 LEVELS AWAY	9939.5

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
543069	PAOLA 5 161.0	5 LEVELS AWAY	9967
543635	GARDNER2 13.80	5 LEVELS AWAY	17833.2
543650	G15-016T 161.0	5 LEVELS AWAY	7605.3
546212	MORRIS 5 161.0	5 LEVELS AWAY	17114.9
546651	BARBER 5 161.0	5 LEVELS AWAY	27244.5
546655	KAW W 5 161.0	5 LEVELS AWAY	22692.8
546722	MAYSOTH5 161.0	5 LEVELS AWAY	20077.6
547467	ORO110 5 161.0	5 LEVELS AWAY	18936.7
547487	HOC404 5 161.0	5 LEVELS AWAY	12854.7
547498	STL439 5 161.0	5 LEVELS AWAY	24069.3
547503	RIV452T 5 161.0	5 LEVELS AWAY	23018.7
547541	RIV167 2 69.00	5 LEVELS AWAY	17920.1
547725	RIV452 1 12.50	5 LEVELS AWAY	14548.8
560053	G15-052T 345.0	5 LEVELS AWAY	13083.3
577198	G10-003-GSU134.50	5 LEVELS AWAY	22323.3
583851	G14-001XFMR134.50	5 LEVELS AWAY	17330
583854	G14-001XFMR234.50	5 LEVELS AWAY	16928.7
585070	GEN-2015-069230.0	5 LEVELS AWAY	6656.1
585102	G15-073-GSU134.50	5 LEVELS AWAY	12322.3
585105	G15-073-GSU234.50	5 LEVELS AWAY	12125.7
588241	G16-149XFMR134.50	5 LEVELS AWAY	32282.5
588250	GEN-2016-174345.0	5 LEVELS AWAY	5671.9
588313	G16-158-GEN10.690	5 LEVELS AWAY	1026043.8
588320	GEN-2016-162345.0	5 LEVELS AWAY	9942.6

3.2.5. Short Circuit Result for Higginsville 69kV Substation (543102)

The results of the short circuit analysis for POI i.e., Higginsville 69kV Substation (543102) and five bus levels away are tabulated below in Table 3.2.5.

Table 3.2.5: Short circuit results for Higginsville 69kV Substation (543102)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
543102	WHGNSVL2 69.0	0 LEVELS AWAY	4514.1
543099	HIGNSVL2 69.0	1 LEVELS AWAY	4559.4
543100	AMOCOPL2 69.0	1 LEVELS AWAY	4785
588410	GEN-2016-16869.0	1 LEVELS AWAY	4481.3
543096	MAYVWTP2 69.0	2 LEVELS AWAY	4947.2
543098	CTY HIG2 69.0	2 LEVELS AWAY	4571.4
588411	G16-168XFMR134.5	2 LEVELS AWAY	3185.2
541265	LEXNTON2 69.0	3 LEVELS AWAY	4348.8
541266	13&40 2 69.0	3 LEVELS AWAY	4353
543097	CORDER 2 69.0	3 LEVELS AWAY	3917
588412	G16-168-GSU134.5	3 LEVELS AWAY	3185
541264	LEX69 2 69.0	4 LEVELS AWAY	4368.1
541267	ODESSA 2 69.0	4 LEVELS AWAY	1910.5
541319	CONCORD2 69.0	4 LEVELS AWAY	3396.4
541383	FAYETVLTP2 69.0	4 LEVELS AWAY	4287.7
543101	DOVERPT2 69.0	4 LEVELS AWAY	3887.7
588413	G16-168-GEN10.64	4 LEVELS AWAY	112900.2
541229	ODESSA 5 161.	5 LEVELS AWAY	9456.5
541232	LEX161 5 161.	5 LEVELS AWAY	7605
541268	WBURGP 2 69.0	5 LEVELS AWAY	5667.7
543094	SWAVRLY2 69.0	5 LEVELS AWAY	3615.8

4. Stability Analysis for Cluster Scenario

4.1. Faults Simulated

Eighty nine (89) faults were considered for the transient stability simulations which included three phase faults, as well as single phase line faults. Single-phase line faults were simulated by applying fault impedance to the positive sequence network at the fault location. As per the SPP current practice to compute the fault levels, the fault impedance was computed to give a positive sequence voltage at the specified fault location of approximately 60% of pre-fault voltage.

Concurrently and previously queued projects as respectively shown in Table-1 and Table-2 of the study request i.e., KCPL Distributed: Osawatomie, GEN-2008-129, GEN-2010-036, GEN-2011-011/GEN-2004-008, ASGI-2013-007, GEN-2014-021, GEN-2015-005, ASGI-2016-003, ASGI-2017-006 as well as areas number 536, 540, 541, 542, 544, 545, 635, 640, 645, 650, 652, 330, and 356 were monitored during all the simulations. Table 4.1.1 shows the list of simulated contingencies. This Table also shows the fault clearing time and the time delay before re-closing for all the study contingencies.

Simulations were performed with a 0.1-second steady-state run followed by the appropriate disturbance as described in Table 4.1.1. Simulations were run for minimum 20-second duration to confirm proper machine damping.

Table 4.1.1 summarizes the overall results for all faults simulations of cluster scenario. Complete sets of plots for Winter-2017, Summer-2018, and Summer-2026 peak seasons for each fault are included in Appendices A, B and C respectively.

Since the machines under study are more in numbers, as well as the prior queued projects and requested monitored areas are also include in the plotting. Therefore for each contingency description, five (5) plots sheets are included i.e., Page-1, , Page-2, Page-3, page-4, and Page-5 that respectively represents the machines quantities under this project, prior queued machine quantities, and machine and bus voltages for different areas. Overall for each scenario there are 455 plots sheets for eighty nine (89) contingency description along-with two repetition of FLT01-3PHA and FLT20-3PHA, which shows stable results for FLT01-3PH, and FLT20-3PH after modifications in network.

Table 4.1.1: List of simulated faults for cluster scenario stability analysis

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
1	FLT01-3PH	3 phase fault on the WHGNSVL (543102) to HIGNSVL (543099) 69kV line circuit 1, near WHGNSVL. a. Apply fault at the WHGNSVL 69kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable except GEN-2016-168	Stable except GEN-2016-168	Stable except GEN-2016-168
1A	FLT01-3PHA	3 phase fault on the WHGNSVL (543102) to HIGNSVL (543099) 69kV line circuit 1, near WHGNSVL. a. Apply fault at the WHGNSVL 69kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault. With Modification on protection model “FRQTPAT” for GEN-2016-168.	Stable (1)	Stable (1)	Stable (1)
2	FLT02-3PH	3 phase fault on the WHGNSVL (543102) to AMOCOPL (543100) 69kV line circuit 1, near WHGNSVL. a. Apply fault at the WHGNSVL 69kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
3	FLT03-3PH	3 phase fault on the HGNSVL (543099) to CTYHIG (543098) 69kV line circuit 1, near HGNSVL. a. Apply fault at the HGNSVL 69kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
4	FLT04-3PH	3 phase fault on the CTYHIG (543098) to HIGNSVL (543099) 69kV line circuit 1, near WHGNSVL. a. Apply fault at the CTYHIG 69kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
5	FLT05-3PH	3 phase fault on the SWAVERLY 69/161kV (543094/543063) transformer, near SWAVERLY. a. Apply fault at the SWAVERLY 69kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable
6	FLT06-3PH	3 phase fault on the AMOCOPL (543100) to MAYVWTP (543096) 69kV line circuit 1, near AMOCOPL. a. Apply fault at the AMOCOPL 69kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
7	FLT07-3PH	3 phase fault on the MAYVWTP (543096) to LEXTON (541265) 69kV line circuit 1, near MAYVWTP. a. Apply fault at the MAYVWTP 69kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
8	FLT08-3PH	3 phase fault on the MAYVWTP (543096) to 13&40 (541266) 69kV line circuit 1, near MAYVWTP. a. Apply fault at the MAYVWTP 69kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
9	FLT09-3PH	3 phase fault on the LEX161 (541232) to ODESSA (541229) 161kV line circuit 1, near LEX161. a. Apply fault at the LEX161 161kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
10	FLT10-3PH	3 phase fault on the LEX161 (541232) to RICHMND (541236) 161kV line circuit 1, near LEX161. a. Apply fault at the LEX161 161kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
11	FLT11-3PH	3 phase fault on the 13&40 (541266) to ODESSA (541267) 69kV line circuit 1, near 13&40. a. Apply fault at the 13&40 69kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
12	FLT12-3PH	3 phase fault on the 13&40 (541266) to CONCORD (541319) 69kV line circuit 1, near 13&40. a. Apply fault at the 13&40 69kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
13	FLT13-3PH	3 phase fault on the 13&40 (541266) to FAYETVLTP (541383) 69kV line circuit 1, near 13&40. a. Apply fault at the 13&40 69kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
14	FLT14-3PH	3 phase fault on the NORTON (543064) to 5NORTON (300105) 69kV line circuit Z1, near NORTON. a. Apply fault at the NORTON 69kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
15	FLT15-3PH	3 phase fault on the NORTON (543064) to MALTABAN (543059) 69kV line circuit 1, near NORTON. a. Apply fault at the NORTON 69kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
16	FLT16-3PH	3 phase fault on the NORTON (543064) to SALSBRY (543062) 69kV line circuit 1, near NORTON. a. Apply fault at the NORTON 69kVkV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
17	FLT17-3PH	3 phase fault on the KETCHEM (541500) to MULCLNCR (541197) 345kV line circuit 1, near KETCHEM. a. Apply fault at the KETCHEM 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
18	FLT18-3PH	3 phase fault on the KETCHEM (541500) to SIBLEY (541201) 345kV line circuit 1, near KETCHEM. a. Apply fault at the KETCHEM 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
19	FLT19-3PH	3 phase fault on the MULCLNCR (541197) to HOLT (541510) 345kV line circuit 1, near MULCLNCR. a. Apply fault at the MULCLNCR 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
20	FLT20-3PH	3 phase fault on the HOLT (541510) to S3458 (645458) 345kV line circuit 1, near HOLT. a. Apply fault at the HOLT 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Un-Stable	Un-Stable	Un-Stable
20A	FLT20-3PHA	3 phase fault on the HOLT (541510) to S3458 (645458) 345kV line circuit 1, near HOLT. a. Apply fault at the HOLT 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault. With adjusting the output of the GEN-2014-021 units to +0.98 pf at 30 MVAR each along-with the switching OFF the Bus Reactors (100MVAR) at MULLNCR7 (541197) after tripping of the said circuit HOLT (541510) to S3458 (645458).	Stable (2)	Stable (2)	Stable (2)
21	FLT21-3PH	3 phase fault on the HOLT (541510) to ROCKCK (541511) 345kV line circuit 1, near HOLT. a. Apply fault at the HOLT 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
22	FLT22-3PH	3 phase fault on the SIBLEY (541201) to OVERTON (345408) 345kV line circuit 1, near SIBLEY. a. Apply fault at the SIBLEY 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
23	FLT23-3PH	3 phase fault on the SIBLEY (541201) to PHILL (541200) 345kV line circuit 1, near SIBLEY. a. Apply fault at the SIBLEY 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
24	FLT24-3PH	3 phase fault on the SIBLEY (541201) to HAWTH (542972) 345kV line circuit 1, near SIBLEY. a. Apply fault at the SIBLEY 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
25	FLT25-3PH	3 phase fault on the SIBLEY 345/161/13.8kV (541201/541202/541360) transformer, near SIBLEY. a. Apply fault at the SIBLEY 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable
26	FLT26-3PH	3 phase fault on the OVERTON (345408) to MCCREDIE (345088) 345kV line circuit 1, near OVERTON. a. Apply fault at the OVERTON 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
27	FLT27-3PH	3 phase fault on the OVERTON 345/161kV (345408/345409) transformer, near SIBLEY. a. Apply fault at the SIBLEY 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
28	FLT28-3PH	3 phase fault on the PHILL (541200) to PECULR (541198) 345kV line circuit 1, near PHILL. a. Apply fault at the PHILL 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
29	FLT29-3PH	3 phase fault on the PHILL 345/161/13.8kV (541200/541225/541361) transformer, near PHILL. a. Apply fault at the PHILL 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable
30	FLT30-3PH	3 phase fault on the PECULR (541198) to STILWEL (542968) 345kV line circuit 1, near PECULR. a. Apply fault at the PECULR 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
31	FLT31-3PH	3 phase fault on the PECULR 345/161/13.8kV (541198/541342/541372) transformer, near PECULR. a. Apply fault at the PECULR 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable
32	FLT32-3PH	3 phase fault on the STILWEL (542968) to W.GRDNR (542965) 345kV line circuit 1, near STILWEL. a. Apply fault at the STILWEL 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
33	FLT33-3PH	3 phase fault on the STILWEL (542968) to LACYGNE (542981) 345kV line circuit 1, near STILWEL. a. Apply fault at the STILWEL 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
34	FLT34-3PH	3 phase fault on the STILWEL 345/161/13.8kV (542968/542969/543648) transformer, near STILWEL. a. Apply fault at the STILWEL 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable
35	FLT35-3PH	3 phase fault on the W.GRDNR (542965) to SWISVAL (532774) 345kV line circuit 1, near W.GRDNR. a. Apply fault at the W.GRDNR 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
36	FLT36-3PH	3 phase fault on the W.GRDNR (542965) to CRAIG (542977) 345kV line circuit 1, near W.GRDNR. a. Apply fault at the W.GRDNR 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
37	FLT37-3PH	3 phase fault on the W.GRDNR (542965) to LACYGNE (542981) 345kV line circuit 1, near W.GRDNR. a. Apply fault at the W.GRDNR 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
38	FLT38-3PH	3 phase fault on the W.GRDNR 345/161/13.8kV (542965/542966/543649) transformer, near W.GRDNR. a. Apply fault at the W.GRDNR 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
39	FLT39-3PH	3 phase fault on the SWISVAL (532774) to EMPEC (532768) 345kV line circuit 1, near SWISVAL. a. Apply fault at the SWISVAL 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
40	FLT40-3PH	3 phase fault on the SWISVAL 345/161/13.8kV (532774/532856/532819) transformer, near SWISVAL. a. Apply fault at the SWISVAL 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable
41	FLT41-3PH	3 phase fault on the SWISVAL (532856) to AUBURN (532851) 230kV line circuit 1, near SWISVAL. a. Apply fault at the SWISVAL 230kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
42	FLT42-3PH	3 phase fault on the SWISVAL (532856) to LAWHILL (532853) 230kV line circuit 1, near SWISVAL. a. Apply fault at the SWISVAL 230kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
43	FLT43-3PH	3 phase fault on the SWISVAL (532856) to TECHILL (532857) 230kV line circuit 1, near SWISVAL. a. Apply fault at the SWISVAL 230kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
44	FLT44-3PH	3 phase fault on the SWISVAL (532856) to MORRIS (532863) 230kV line circuit 1, near SWISVAL. a. Apply fault at the SWISVAL 230kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
45	FLT45-3PH	3 phase fault on the EMPEC (532768) to MORRIS (532770) 345kV line circuit 1, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
46	FLT46-3PH	3 phase fault on the EMPEC (532768) to LANG (532769) 345kV line circuit 1, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
47	FLT47-3PH	3 phase fault on the EMPEC (532768) to G14-001-TAP (562476) 345kV line circuit 1, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
48	FLT48-3PH	3 phase fault on the MORRIS (532770) to JEC N (532766) 345kV line circuit 1, near MORRIS. a. Apply fault at the MORRIS 345kV bus. b. Clear fault after 5 cycles and trip the faulted line.	Stable	Stable	Stable
49	FLT49-3PH	3 phase fault on the MORRIS 345/230/13.8kV (532770/532863/532809) transformer, near MORRIS. a. Apply fault at the MORRIS 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
50	FLT50-3PH	3 phase fault on the JEC N (532766) to HOYT (532765) 345kV line circuit 1, near JEC N. a. Apply fault at the JEC N 345kV bus. b. Clear fault after 5 cycles and trip the faulted line.	Stable	Stable	Stable
51	FLT51-3PH	3 phase fault on the JEC N (532766) to GEARY (532767) 345kV line circuit 1, near JEC N (for Summer-2017 and 2026 cases). For Winter-2017 case JEC N 7 (532766) to SUMMIT 7 (532773) a. Apply fault at the JEC N 345kV bus. b. Clear fault after 5 cycles and trip the faulted line.	Stable	Stable	Stable
52	FLT52-3PH	3 phase fault on the JEC N 345/230/13.8kV (532766/532852/532805) transformer, near JEC N. a. Apply fault at the JEC N 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable
53	FLT53-3PH	3 phase fault on the GEARY (532767) to SUMMIT (532773) 345kV line circuit 1, near GEARY . (for Summer-2017 and 2026 cases). For Winter-2017 case JEC N 7 (532766) to SUMMIT 7 (532773) a. Apply fault at the GEARY 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
54	FLT54-3PH	3 phase fault on the HOYT (532765) to STRANGR (532772) 345kV line circuit 1, near HOYT. a. Apply fault at the HOYT 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
55	FLT55-3PH	3 phase fault on the HOYT 345/115/13.8kV (532765/533163/532804) transformer, near HOYT. a. Apply fault at the HOYT 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
56	FLT56-3PH	3 phase fault on the STRANGR (532772) to 87TH (532775) 345kV line circuit 1, near STRANGR. a. Apply fault at the STRANGR 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
57	FLT57-3PH	3 phase fault on the STRANGR (532772) to IATAN (542982) 345kV line circuit 1, near STRANGR. a. Apply fault at the STRANGR 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
58	FLT58-3PH	3 phase fault on the STRANGR 345/115/13.8kV (532772/533268/532816) transformer, near STRANGR. a. Apply fault at the STRANGR 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable
59	FLT59-3PH	3 phase fault on the 87TH (532775) to CRAIG (542977) 345kV line circuit 1, near 87TH. a. Apply fault at the 87TH 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
60	FLT60-3PH	3 phase fault on the 87TH 345/115/13.8kV (532775/533283/532818) transformer, near 87TH. a. Apply fault at the 87TH 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable
61	FLT61-3PH	3 phase fault on the IATAN (542982) to EASTOWN (541400) 345kV line circuit 1, near IATAN. a. Apply fault at the IATAN 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
62	FLT62-3PH	3 phase fault on the IATAN (542982) to NASHUA (542980) 345kV line circuit 1, near IATAN. a. Apply fault at the IATAN 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
63	FLT63-3PH	3 phase fault on the IATAN 345/161/13.8kV (542982/541350/541150) transformer, near IATAN. a. Apply fault at the IATAN 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable
64	FLT64-3PH	3 phase fault on the EASTOWN (541400) to ST JOE (541199) 345kV line circuit 1, near EASTOWN. a. Apply fault at the EASTOWN 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
65	FLT65-3PH	3 phase fault on the EASTOWN 345/161/13.8kV (541400/541401/541402) transformer, near EASTOWN. a. Apply fault at the EASTOWN 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable
66	FLT66-3PH	3 phase fault on the NASHUA (542980) to ST JOE (541199) 345kV line circuit 1, near NASHUA. a. Apply fault at the NASHUA 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
67	FLT67-3PH	3 phase fault on the NASHUA (542980) to HAWTH (542972) 345kV line circuit 1, near NASHUA. a. Apply fault at the NASHUA 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
68	FLT68-3PH	3 phase fault on the NASHUA 345/161/13.8kV (542980/543028/543640) transformer, near NASHUA. a. Apply fault at the NASHUA 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable
69	FLT69-3PH	3 phase fault on the ST JOE (541199) to FAIRPORT (300039) 345kV line circuit 1, near ST JOE. a. Apply fault at the ST JOE 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
70	FLT70-3PH	3 phase fault on the ST JOE (541199) to COOPER (640139) 345kV line circuit 1, near ST JOE. a. Apply fault at the ST JOE 345kV bus. b. Clear fault after 4.5 cycles and trip the faulted line.	Stable	Stable	Stable
71	FLT71-3PH	3 phase fault on the ST JOE 345/161/13.8kV (541199/541253/541370) transformer, near ST JOE. a. Apply fault at the ST JOE 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable
72	FLT72-3PH	3 phase fault on the COOPER (640139) to FAIRPORT (300039) 345kV line circuit 1, near COOPER. a. Apply fault at COOPER 345kV bus. b. Clear fault after 4.5 cycles and trip the faulted line.	Stable	Stable	Stable
73	FLT73-3PH	3 phase fault on the COOPER (640139) to ATCHSN (635017) 345kV line circuit 1, near COOPER. a. Apply fault at COOPER 345kV bus. b. Clear fault after 4.5 cycles and trip the faulted line.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
74	FLT74-3PH	3 phase fault on the COOPER (640139) to S3458 (645458) 345kV line circuit 1, near COOPER. a. Apply fault at COOPER 345kV bus. b. Clear fault after 4.5 cycles and trip the faulted line.	Stable	Stable	Stable
75	FLT75-3PH	3 phase fault on the COOPER (640139) to MOORE (640277) 345kV line circuit 1, near COOPER. a. Apply fault at COOPER 345kV bus. b. Clear fault after 4.5 cycles and trip the faulted line.	Stable	Stable	Stable
76	FLT76-3PH	3 phase fault on the CRAIG 345/161/13.8kV (542977/542978/543641) transformer, near CRAIG. a. Apply fault at the CRAIG 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.	Stable	Stable	Stable
77	FLT77-3PH	3 phase fault on the LACYGNE (542981) to NEOSHO (532793) 345kV line circuit 1, near LACYGNE. a. Apply fault at the LACYGNE 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
78	FLT78-3PH	3 phase fault on the LACYGNE (542981) to WAVERLY (532799) 345kV line circuit 1, near LACYGNE. a. Apply fault at the LACYGNE 345kV bus. b. Clear fault after 5 cycles and trip the faulted line.	Stable	Stable	Stable
79	FLT79-3PH	3 phase fault on the NEOSHO (532793) to BLACKBERRY (300739) 345kV line circuit 1, near NEOSHO. a. Apply fault at the NEOSHO 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
80	FLT80-3PH	3 phase fault on the NEOSHO (532793) to DELWARE (510380) 345kV line circuit 1, near NEOSHO. a. Apply fault at the NEOSHO 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
81	FLT81-3PH	3 phase fault on the NEOSHO (532793) to CANEYRV (532780) 345kV line circuit 1, near NEOSHO. a. Apply fault at the NEOSHO 345kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
82	FLT82-3PH	3 phase fault on the BENTON (532791) to WOLFCRK (532797) 345kV line circuit 1, near BENTON. a. Apply fault at BENTON 345kV bus. b. Clear fault after 3.6 cycles and trip the faulted line.	Stable	Stable	Stable
83	FLT83-3PH	3 phase fault on the ROSEHIL (532794) to WOLFCRK (532797) 345kV line circuit 1, near ROSEHIL. a. Apply fault at ROSEHIL 345kV bus. b. Clear fault after 3.6 cycles and trip the faulted line.	Stable	Stable	Stable
84	FLT84-3PH	3 phase fault on the WAVERLY (532799) to WOLFCRK (532797) 345kV line circuit 1, near WAVERLY. a. Apply fault at WAVERLY 345kV bus. b. Clear fault after 3.6 cycles and trip the faulted line.	Stable	Stable	Stable
85	FLT85-SB	**W.GARDNR (542965) 345KV Stuck Breaker Scenario 1** a. Apply single line to ground fault at the W.GARDNR 345kV bus. b. Clear fault after 11 cycles c. Trip W.GARDNR (542965) – CRAIG (542977) 345kV line d. Trip W.GARDNR 345/161/13.8kV (542965/542966/543649) transformer	Stable	Stable	Stable
86	FLT86-SB	**W.GARDNR (542965) 345KV Stuck Breaker Scenario 2** a. Apply single line to ground fault at the W.GARDNR 345kV bus. b. Clear fault after 11 cycles c. Trip W.GARDNR (542965) – CRAIG (542977) 345kV line d. Trip W.GARDNR (542965) – SWISVAL (532774) 345kV line	Stable	Stable	Stable
87	FLT87-SB	**W.GARDNR (542965) 345KV Stuck Breaker Scenario 3** a. Apply single line to ground fault at the W.GARDNR 345kV bus. b. Clear fault after 11 cycles c. Trip W.GARDNR (542965) – STILWEL (542968) 345kV line d. Trip W.GARDNR (542965) – SWISVAL (532774) 345kV line	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
88	FLT88-SB	**STRANGR (532772) 345KV Stuck Breaker Scenario** a. Apply single line to ground fault at the STRANGR 345kV bus. b. Run 4.6 cycles, then trip STRANGR (532772 TO IATAN (542982) 345kV line c. Run 10 cycles, then trip STRANGR (532772) – 87TH (532775) 345kV line d. Clear fault	Stable	Stable	Stable
89	FLT89-PO	**Prior outage of STRANGR (532772) to HOYT (532765) 345kV circuit 1 line** 3 phase fault on the JEC N (532766) to MORRIS (532770) 345kV line circuit 1, near JEC N a. Apply fault at JEC N 345kV bus. b. Clear fault after 3.6 cycles and trip the faulted line.	Stable	Stable	Stable

Notes:

(1)-. By changing the pickup time (one second) for over frequency relay "FRQTPAT", the GEN-2016-168 machine response become stable.

(2)-. With adjusting the output of the GEN-2014-021 units to +0.98 pf (at 30 MVAR each) along-with the switching OFF the Bus Reactors (100MVAR) at MULLNCR7 (541197) after tripping of the said circuit HOLT (541510) to S3458 (645458). The reactor switching is very important following the tripping of the circuit when both requests are near maximum rated output.

4.2. Simulation Results for Cluster Scenario

For cluster scenario, there are no impacts on the stability performance of the SPP system for the contingencies tested on the SPP provided base cases, except for FLT01-3PH, and FLT20-3PH. The following are the recommendations for these two contingencies:

- **FLT01-3PH**: By changing the pickup time (one second) for over frequency relay "FRQTPAT", the GEN-2016-168 machine response become stable.
- **FLT20-3PH:** With adjusting the output of the GEN-2014-021 units to +0.98 pf (at 30 MVAR each) along-with the switching OFF the Bus Reactors (100MVAR) at MULLNCR7 (541197) after tripping of the said circuit HOLT (541510) to S3458 (645458). The response for GEN-2016-115, and GEN-2016-088 quantities as well as the voltages in the respective areas become stable. The reactor switching is very important following the tripping of the circuit when both requests are near maximum rated output.

5. Conclusions

The findings of the impact study for the proposed interconnection projects under DISIS-2016-002 (Group 13) considered 100% of their proposed installed capacity is as follows:

1. Except for FLT01-3PH, and FLT20-3PH, there are no impacts on the stability performance of the SPP system during cluster scenarios for the contingencies tested on the provided base cases. The following are the recommendations for these two contingencies:
   - **FLT01-3PH**: By changing the pickup time (one second) for over frequency relay "FRQTPAT", the GEN-2016-168 machine response become stable.
   - **FLT20-3PH:** With adjusting the output of the GEN-2014-021 units to +0.98 pf (at 30 MVAR each) along-with the switching OFF the Bus Reactors (100MVAR) at MULLNCR7 (541197) after tripping of the said circuit HOLT (541510) to S3458 (645458). The response for GEN-2016-115, and GEN-2016-088 quantities as well as the voltages in the respective areas become stable. The reactor switching is very important following the tripping of the circuit when both requests are near maximum rated output.
2. For all other contingencies, the study machines stayed on-line and stable for all simulated faults. The project stability simulations with eighty nine (89) specified test disturbances did not show instability problems in the SPP system. Any oscillations were damped out.

6. **Appendix A: 2017 Winter Peak Case Stability Run Plots – Cluster**

7. **Appendix B: 2018 Summer Peak Case Stability Run Plots – Cluster**

8. **Appendix C: 2026 Summer Peak Case Stability Run Plots – Cluster**

9. **Appendix D: Project Model Data**

(Appendices available from SPP upon request.)

J14: GROUP 14 DYNAMIC STABILITY ANALYSIS REPORT

S&C ELECTRIC COMPANY
Excellence Through Innovation

DISIS-2016-002 (GROUP 14)

LITTLE ROCK, AR

SOUTHWEST POWER POOL

DEFINITIVE INTERCONNECTION SYSTEM IMPACT STUDY

S&C PROJECT NUMBER: 12651

DOCUMENT NUMBER: E-857

REVISION: 0

FINAL REPORT

CONFIDENTIAL

APRIL 18, 2018

S&C ELECTRIC COMPANY
Excellence Through Innovation

DISCLAIMER

REPORT REVISION HISTORY:

REV	DATE	PREPARED BY	REVIEWED BY	APPROVED BY	DESCRIPTION
A	04/9/2018	ME	MFK	SK	Preliminary report issued.
0	04/18/2018	ME	MFK	SK	Final Report

AUTHORS:

Prepared By:

Mohamed Elkhatib, Ph.D.
Project Engineer
S&C Electric Company

Reviewed By:

M. Fareed Kandlawala
Assistant Manager – Consulting and Analytical Services
S&C Electric Company

Approved By:

Saeed Kamalinia, Ph.D.
Manager – Consulting and Analytical Services
S&C Electric Company

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Appendix A
SPP Group 14 Fault Definitions
Appendix B
Southwest Power Pool Disturbance Performance Requirements (Submitted in a Separate File)
Appendix C
Dynamic Stability Plots For Cluster Scenario (Submitted in Separate Files from Appendix C-1 to C-3 which will be available upon request from SPP)
Appendix D
Interconnection requests Dynamic Data for Group 14 (Submitted in a Separate File which will be available on request from spp)
Appendix E
Short-Circuit Study Results

1. Executive Summary

S&C Electric Company (S&C) has performed a Definitive Interconnection System Impact Study, DISIS-2016-002 (Group 14), in response to a request through Southwest Power Pool (SPP) Tariff. Group 14 consists of six (6) new interconnection requests (ASGI-2016-011, ASGI-2016-012, ASGI-2016-013, GEN-2016-102, GEN-2016-126, and GEN-2016-129).

S&C has performed dynamic stability analysis for Group 14 under Cluster scenarios. The cluster studies were performed using three (3) cluster base cases (2017 Winter Peak (WP), 2018 Summer Peak (SP), and 2026 SP) provided by SPP. For each base case, all six new interconnection requests and prior-queued projects were studied at 100% of nameplate MW capacity.

The dynamics stability analysis demonstrated that the system remains stable under all studied contingencies and all interconnection requests projects remain connected during and after the contingency. Post analysis of the results, however, showed that for some contingencies, the voltages in the area close to interconnection requests, GEN-2016-126 and GEN-2016-102 reaches high voltages of 1.37 p.u. at the point of interconnection (POI) for GEN-2016-126 and other nearby buses, immediately following fault clearing. Additionally, network solution convergence issues were also observed for the same contingencies. The issue was traced back to GEN-2016-126 interconnection request which was set to inject 35 MVAR of reactive power in power flow. To mitigate the observed overvoltage instances, the base cases were updated to set GEN-2016-126 to inject 0 MVAR in the power flow case. The dynamic analysis was repeated with this change and no overvoltage instances on high voltage buses were observed. Note GEN-2016-126 is represented in PSS/E as a user written model which requires the user to set the reactive power manually.

S&C has performed a short-circuit analysis for the 2018 Summer Peak, and 2026 Summer Peak cases of Group 14 and reported short-circuit results at all buses up to five (5) levels away from the Point of Interconnection (POI) of the study projects.

2. Introduction

S&C has performed several analyses as part of the Definitive Interconnection System Impact Study, DISIS-2016-002 (Group 14), in response to a request through SPP. Group 14 consist of six (6) new interconnection requests listed in Table 1 and fourteen (14) previously queued projects listed in Table 2.

Table 1: Group 14 Generation Interconnection Requests

Request	Size (MW)	Generator Model	Point of Interconnection
ASGI-2016-011	7.407	reciprocating internal combustion engine	Buzzard Flop/Gerty (Using Allen Tap 138 kV, 505598)
ASGI-2016-012	61.725	reciprocating internal combustion engine	Centrahoma/Coalgate (Using Tupelo 138 kV, 505600)
ASGI-2016-013	4.938	reciprocating internal combustion engine	Ashland/Stuart (Ashland 138 kV, 520818)
GEN-2016-102	150.9	GE 2.3MW and GE 2.5MW	Blue River 138 kV Substation (515133)
GEN-2016-126	172.5	Vestas V126 Gridstreamer 3.45MW	Tap Arbuckle - Blue River 138 kV (588184)
GEN-2016-129	132	GE 2.0MW	Valliant 345 kV substation (510911)

Table 2: Prior Queued Projects

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2011-040/GEN-2012-004	300	Vestas V100 VCSS 2.0MW (599143, 599144)	Tap Ratliff – Poolville 138 kV (CARTRCO4 138 kV, 515561)
GEN-2011-050	108	Vestas V90 VCSS 2.0MW (583103)	Tap on the Rushspt4 to Ommarlo4 138 kV line (SANTAFE4 138 kV, 511492)
GEN-2013-007	100	Vestas V100 VCSS 2.0MW (599134)	Price Falls to Carter 138 kV (ARBWIND4 138 kV, 515575)
GEN-2014-057	249.9	GE 2.1MW (584073)	LES (511468) to Sunnyside (515136) 345 kV (Proposed AEP Terry Road 345 kV, 560013)
ASGI-2015-006	9	Eaton Xpert Solar 1.5MW Inverter (solar) (585333)	Tupelo 138 kV (505600)
GEN-2015-036	303.6	Siemens VS 2.3MW (584783, 584786)	Johnston County 345 kV (514809)
GEN-2015-045	20	Parker 890GT-B 2.0MW inverters (battery storage)	LES (511468) to Sunnyside (515136) 345 kV (Proposed AEP Terry Road 345 kV, 560013)
GEN-2015-092	250	GE 2.0MW	LES (511468) to Sunnyside (515136) 345 kV (Proposed AEP Terry Road 345 kV, 560013)
ASGI-2016-011	7.407	Caterpiller G3520H 2.469MW	Allen 138 kV (505598)
ASGI-2016-012	61.725	Caterpiller G3520H 2.469MW	Tupelo 138 kV (505600)
ASGI-2016-013	4.938	Caterpiller G3520H 2.469MW	Ashland 138 kV (520818)
GEN-2016-028	100	Vestas V110 VCSS 2.0MW	Clayton 138 kV (510919)
GEN-2016-030	99.9	Power Electronics HEC-US FS28000CU15 2.7MW	Brown 138 kV (515157)
GEN-2016-063	200	Vestas V110 VCSS 2.0MW	Tap Hugo (521157) – Sunnyside (515136) 345 kV (G16-064-TAP, 560088)

3. Transmission System and Study Area

Group 14 will be connected to the South Central Oklahoma Area. For the dynamic stability studies, the following areas were monitored in the analysis:

- American Electric Power West (AEPW, Area #520)
- Oklahoma Gas & Electric (OKGE, Area #524)
- West Farm Electric Cooperative (WFEC, Area #525)
- Southwestern Public Service (SPS, Area #526)
- Midwest Energy (MIDW, Area #531)
- Sunflower Electric Power Corporation (SUNC, Area #534)
- Westar Energy, Inc. (WERE, Area #536)

4. Power Flow Base Cases

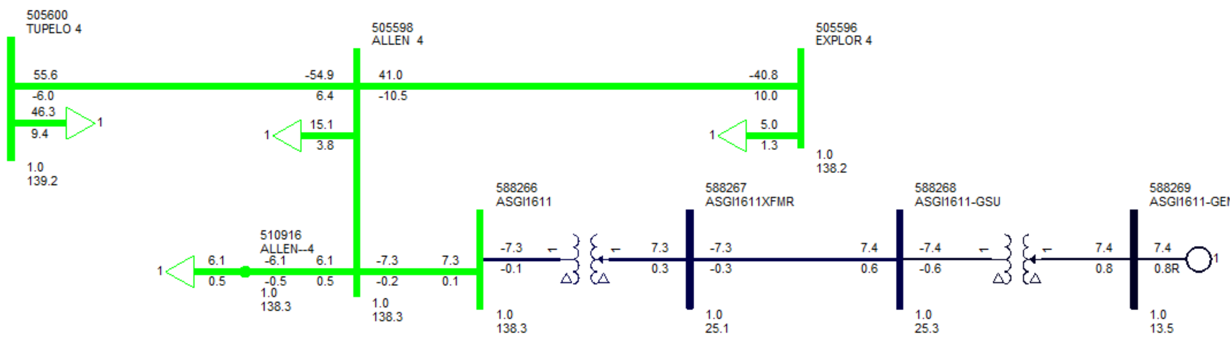
DISIS-2016-002 (Group 14) and prior-queued projects were modeled as aggregated generating units in the base cases from SPP.

Cluster Scenario Base Cases

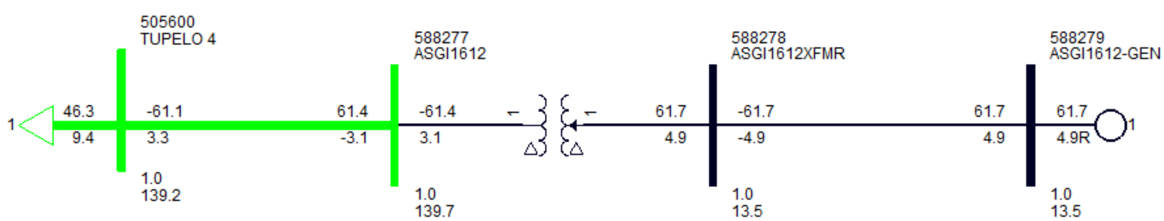
- **MDWG16-17WP_DIS1602_G14_Base.sav** – 2017 Winter Peak Cluster Base Case for Group 14. New interconnection requests and prior queued projects at 100% output power.
- **MDWG16-18SP_DIS1602_G14.sav** – 2018 Summer Peak Cluster Base Case for Group 14. New interconnection requests and prior queued projects at 100% output power.
- **MDWG16-26SP_DIS1602_G14.sav** – 2026 Summer Peak Cluster Base Case for Group 14. New interconnection requests and prior queued projects at 100% output power.

5. Power Flow Model

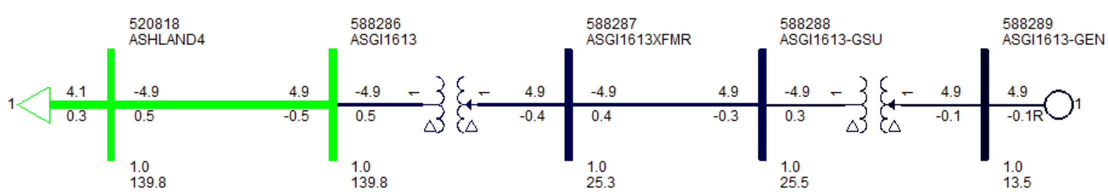
SPP's base case power flow models were built in PSS/E 33.0.7. S&C created one-line diagrams for each interconnect request are depicted in Figure 1.



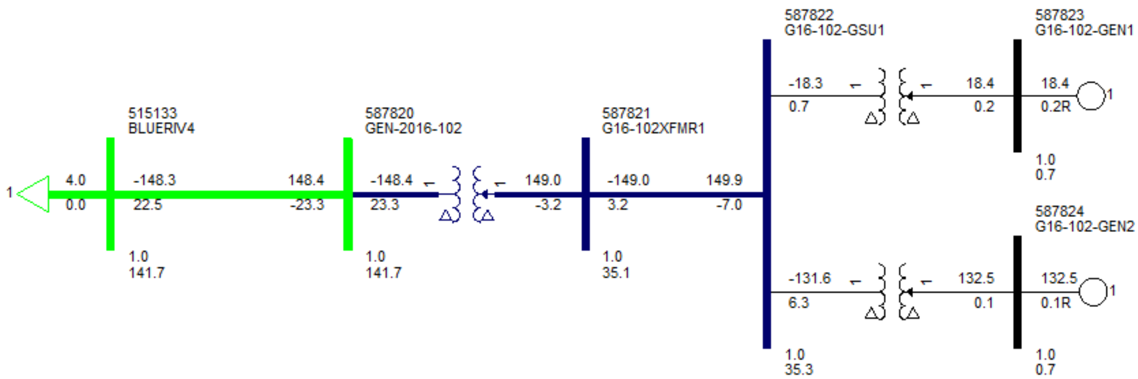
(a) Interconnection request ASGI-2016-011



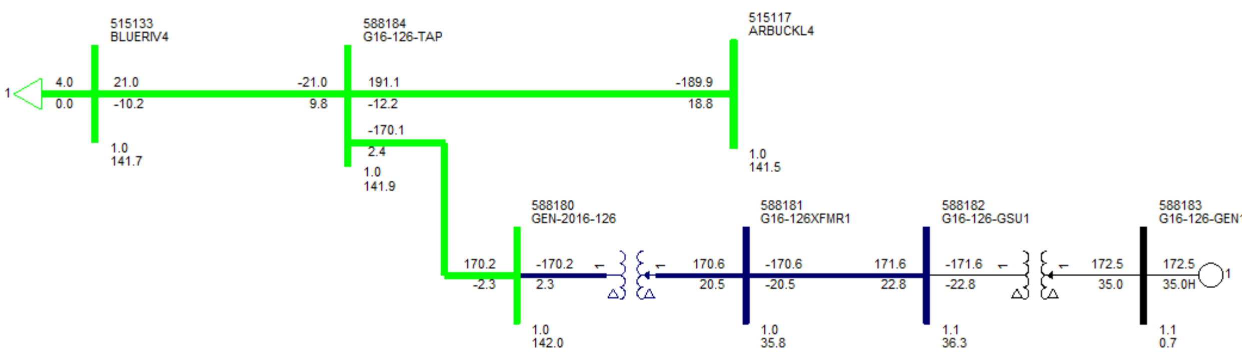
(b) Interconnection request ASGI-2016-012



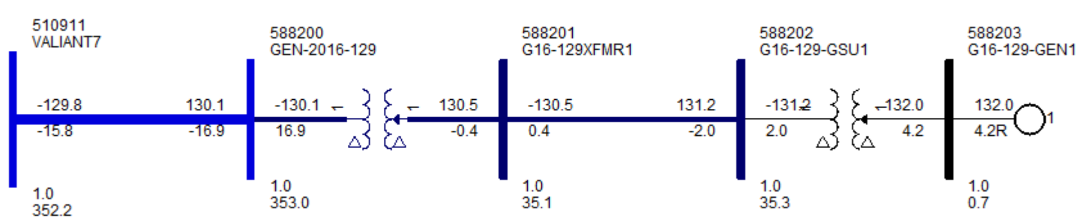
(c) Interconnection request ASGI-2016-013



(d) Interconnection request GEN-2016-102



(e) Interconnection request GEN-2016-126



(f) Interconnection request GEN-2016-129

Figure 1: One-line Diagrams of the Interconnection Request Projects

6. Dynamic Stability Analysis

6.1. Assumptions

Dynamic stability analysis was performed for all the SPP contingencies listed in Appendix A. Three-phase faults were simulated as bolted faults, while single line-to-ground faults were simulated under the assumption that a single line-to-ground fault will cause a 40% drop in the positive-sequence voltage at the fault location.

6.2. Stability Criteria

Dynamic stability studies were performed to ensure system stability following critical faults on the system. The system is considered stable if the following conditions are met:

(1) Disturbances including three-phase and single-phase to ground faults, should not cause synchronous and asynchronous plants to disconnect from the transmission grid.

(2) The angular positions of synchronous machine rotor become constant following an aperiodic system disturbance.

(3) Voltage magnitudes and frequencies at terminals of asynchronous generators should not exceed magnitudes and durations that will cause protection elements to operate. Furthermore, the response after the disturbance needs to be studied at the terminals of the machine to ensure that there are no sustained oscillations in power output, speed, frequency, etc.

(4) Voltage magnitudes and angles after the disturbance should settle to a constant and acceptable operating level. Frequencies should settle to the acceptable range within nominal 60 Hz power frequency.

In addition, performance of the transmission system is measured against the SPP Disturbance Criteria Requirements on Angular oscillations and Transient Voltage Recovery, detailed in Appendix B. Dynamic stability plots for all the Cluster scenarios are provided in Appendix C. Dynamic data for all study interconnection requests for Group 14 is provided in Appendix D.

6.3. DYNAMIC STABILITY RESULTS

The dynamic stability study was performed for the three base case scenarios; 2017 WP, 2018 SP, and 2026 SP. Initially, the base case dynamic data was analyzed and stable initial runs were obtained. Then, the study was performed for all the SPP contingencies listed in Appendix A. Time-domain simulations were performed to evaluate the dynamic performance of the system under identified contingencies. System dynamic voltage recovery and post-disturbance steady state performance under identified contingencies were also checked against SPP voltage recovery criteria. Additionally, simulation logs were scanned to identify any tripped generators during simulations.

Post analysis of the results showed that for some contingencies, the voltages in the area close to interconnection requests, GEN-2016-126 and GEN-2016-102, reach high voltages of 1.37 p.u. at the POI of GEN-2016-126 and other nearby buses immediately following fault clearing. It is worth noting that at that instance, the network solution of the dynamic simulation did not converge even when repeating the simulation using different acceleration factors ranging from 0.05 to 1. The issue was traced back to GEN-2016-126 interconnection request which was set to inject 35 MVAR reactive power in power flow.

To mitigate the observed overvoltage instances, the base cases were updated to set GEN 2016-126 to inject 0 MVAR in the power flow case. The dynamic analysis was repeated with this change and no overvoltage instances on high voltage buses were observed. The dynamic results presented in Appendix C is for the case with GEN-2016-126 is set to inject 0 MVAR in the power flow case. Note that the PSS/E model for the Vestas wind turbine used in GEN-2016-126 is a user written model that requires the user to set the reactive power manually.

Detailed plots of dynamic stability results for each contingency and each peak season are given in Appendices C-1 to C-3. These results demonstrate that the system remains stable under each studied contingency and all studied interconnection projects stay online during and after the contingency. Table 3 below summarizes the dynamic stability results.

Table 3: Group 1 Dynamic Stability Results
(YES = STABLE, NO = UNSTABLE)

Cont. No.	Cont. Name	17WP Case	18SP Case	26SP Case	Cont. No.	Cont. Name	17WP Case	18SP Case	26SP Case
1	FLT1-3PH	YES	YES	YES	43	FLT43-3PH	YES	YES	YES
2	FLT2-3PH	YES	YES	YES	44	FLT44-3PH	YES	YES	YES
3	FLT3-3PH	YES	YES	YES	45	FLT45-3PH	YES	YES	YES
4	FLT4-3PH	YES	YES	YES	46	FLT46-SB	YES	YES	YES
5	FLT5-3PH	YES	YES	YES	47	FLT47-SB	YES	YES	YES
6	FLT6-3PH	YES	YES	YES	48	FLT48-SB	YES	YES	YES
7	FLT7-3PH	YES	YES	YES	49	FLT49-SB	YES	YES	YES
8	FLT8-3PH	YES	YES	YES	50	FLT50-3PH	YES	YES	YES
9	FLT9-3PH	YES	YES	YES	51	FLT51-SB	YES	YES	YES
10	FLT10-3PH	YES	YES	YES	52	FLT52-SB	YES	YES	YES
11	FLT11-3PH	YES	YES	YES	53	FLT53-PO	YES	YES	YES
12	FLT12-SB	YES	YES	YES	54	FLT54-PO	YES	YES	YES
13	FLT13-SB	YES	YES	YES	55	FLT55-PO	YES	YES	YES
14	FLT14-SB	YES	YES	YES	56	FLT56-PO	YES	YES	YES
15	FLT15-3PH	YES	YES	YES	57	FLT57-PO	YES	YES	YES
16	FLT16-SB	YES	YES	YES	58	FLT58-PO	YES	YES	YES
17	FLT17-3PH	YES	YES	YES	59	FLT59-3PH	YES	YES	YES
18	FLT18-3PH	YES	YES	YES	60	FLT60-3PH	YES	YES	YES
19	FLT19-3PH	YES	YES	YES	61	FLT61-3PH	YES	YES	YES
20	FLT20-3PH	YES	YES	YES	62	FLT62-3PH	YES	YES	YES
21	FLT21-SB	YES	YES	YES	63	FLT63-3PH	YES	YES	YES
22	FLT22-3PH	YES	YES	YES	64	FLT64-3PH	YES	YES	YES
23	FLT23-3PH	YES	YES	YES	65	FLT65-3PH	YES	YES	YES
24	FLT24-SB	YES	YES	YES	66	FLT66-3PH	YES	YES	YES
25	FLT25-SB	YES	YES	YES	67	FLT67-3PH	YES	YES	YES
26	FLT26-PO	YES	YES	YES	68	FLT68-3PH	YES	YES	YES
27	FLT27-PO	YES	YES	YES	69	FLT69-3PH	YES	YES	YES
28	FLT28-PO	YES	YES	YES	70	FLT70-3PH	YES	YES	YES
29	FLT29-PO	YES	YES	YES	71	FLT71-3PH	YES	YES	YES
30	FLT30-PO	YES	YES	YES	72	FLT72-SB	YES	YES	YES
31	FLT31-PO	YES	YES	YES	73	FLT73-SB	YES	YES	YES
32	FLT32-PO	YES	YES	YES	74	FLT74-3PH	YES	YES	YES
33	FLT33-PO	YES	YES	YES	75	FLT75-3PH	YES	YES	YES
34	FLT34-3PH	YES	YES	YES	76	FLT76-SB	YES	YES	YES
35	FLT35-3PH	YES	YES	YES	77	FLT77-PO	YES	YES	YES
36	FLT36-3PH	YES	YES	YES	78	FLT78-PO	YES	YES	YES
37	FLT37-3PH	YES	YES	YES	79	FLT79-PO	YES	YES	YES
38	FLT38-3PH	YES	YES	YES	80	FLT80-PO	YES	YES	YES
39	FLT39-3PH	YES	YES	YES	81	FLT81-PO	YES	YES	YES
40	FLT40-3PH	YES	YES	YES	82	FLT82-PO	YES	YES	YES
41	FLT41-3PH	YES	YES	YES	83	FLT83-PO	YES	YES	YES
42	FLT42-3PH	YES	YES	YES					

7. Short-Circuit Study

A short-circuit study has been performed on the power flow models for the 2018 SP, and 2026 SP seasons for each generator using the Cluster Scenario model. The short-circuit analysis includes applying a 3-phase fault on buses up to 5 levels away from the POI of each interconnection request project. PSS/E "Automatic Sequence Fault Calculation (ASCC)" fault analysis module was used for short-circuit analysis. The results of the short-circuit analysis have been recorded for all the buses up to five levels away from the point of interconnection of each interconnection request project. Summary tables for the results of the short-circuit study are provided in Appendix E.

8. Conclusions and Recommendations

Analysis of Group 14 dynamic simulation results showed that for some contingencies, the voltages in the area close to interconnection requests, GEN-2016-126 and GEN-2016-102, reach high voltages of 1.37 p.u. at the POI of GEN-2016-126 and other nearby buses, immediately following fault clearing. Additionally, network solution convergence issues were also observed for the same contingencies. The issue was traced back to GEN-2016-126 interconnection request which was set to inject 35 MVAR reactive power in power flow. To mitigate the observed overvoltage instances, the base cases were updated to set GEN-2016-126 to inject 0 MVAR in the power flow case. The dynamic analysis was repeated with this change and no overvoltage instances on high voltage buses were observed. The system remains stable under all studied contingencies and all interconnection requests projects remain connected during and after the contingencies.

A short-circuit study has been performed on the power flow models for the 2018 Summer Peak Season and 2026 Summer Peak Season for each generator using the Cluster Scenario model. A 3-phase fault is applied on buses up to 5 levels away from the POI of each interconnection request project and the results of the study have been presented.

APPENDIX A

SPP GROUP 14 FAULT DEFINITIONS

Table 4: Group 14 Fault Definitions

Cont. No.	Cont. Name	Description
1	FLT1-3PH	3 phase fault on VALIANT7 345.0 kV (510911) to PITTSB-7 345.0 kV (510907) line CKT 1, near VALIANT7. a. Apply fault at the VALIANT7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT2-3PH	3 phase fault on VALIANT7 345.0 kV (510911) to LYDIA 345.0 kV (508298) line CKT 1, near VALIANT7. a. Apply fault at the VALIANT7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
3	FLT3-3PH	3 phase fault on VALIANT7 345.0 kV (510911) to NWTXARK7 345.0 kV (508072) line CKT 1, near VALIANT7. a. Apply fault at the VALIANT7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT4-3PH	3 phase fault on VALIANT7 345.0 kV (510911) to HUGO 345.0 kV (521157) line CKT 1, near VALIANT7. a. Apply fault at the VALIANT7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
5	FLT5-3PH	3 phase fault on VALIANT4 138.0 kV (510918) to VALIANT7 345.0 kV (510911) to VALN2-1 13.80 kV (510938) transformer CKT 2, near VALIANT7. a. Apply fault at the VALIANT7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line.

6	FLT6-3PH	3 phase fault on HUGO 345.0 kV (521157) to G16-063-TAP 345.0 kV (560088) line CKT 1, near HUGO. a. Apply fault at the HUGO 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
7	FLT7-3PH	3 phase fault on HUGO 345.0 kV (521157) to HUGO PP4 138.0 kV (520948) to HUGO TERTA 13.80 kV (521189) transformer CKT 1, near HUGO. a. Apply fault at the HUGO 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
8	FLT8-3PH	3 phase fault on LYDIA 345.0 kV (508298) to WELSH 345.0 kV (508359) line CKT 1, near LYDIA. a. Apply fault at the LYDIA 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
9	FLT9-3PH	3 phase fault on NWTXARK7 345.0 kV (508072) to LYDIA 345.0 kV (508298) line CKT 1, near LYDIA. a. Apply fault at the LYDIA 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT10-3PH	3 phase fault on NWTXARK4 138.0 kV (508071) to NWTXARK7 345.0 kV (508072) to NWTEX1-1 13.80 kV (508100) transformer CKT 1, near NWTXARK7. a. Apply fault at the NWTXARK7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
11	FLT11-3PH	3 phase fault on PITTSB-7 345.0 kV (510907) to SEMINOL7 345.0 kV (515045) line CKT 1, near PITTSB-7. a. Apply fault at the PITTSB-7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

12	FLT12-SB	**Stuck Breaker at NWTXARK7 (508072)** a. Apply single phase fault at the NWTXARK7 345.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - VALIANT7 345.0 kV (510911) to NWTXARK7 345.0 kV (508072) line CKT 1 - NWTXARK7 345.0 kV (508072) to LYDIA 345.0 kV (508298) line CKT 1
13	FLT13-SB	**Stuck Breaker at VALIANT7 (510911)** a. Apply single phase fault at the VALIANT7 345.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - VALIANT4 138.0 kV (510918) to VALIANT7 345.0 kV (510911) to VALN2-1 13.80 kV (510938) transformer CKT 2 - VALIANT4 138.0 kV (510918) to VALIANT7 345.0 kV (510911) to VALN3-1 13.80 kV (510939) transformer CKT 1
14	FLT14-SB	**Stuck Breaker at WELSH (508359)** a. Apply single phase fault at the WELSH 345.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - WELSH 345.0 kV (508359) to DIANA 345.0 kV (508832) line CKT 1 - WELSH 345.0 kV (508359) to DIANA 345.0 kV (508832) line CKT 2
15	FLT15-3PH	3 phase fault on PITTSB-7 345.0 kV (510907) to JOHNCO 7 345.0 kV (514809) line CKT 1, near PITTSB-7. a. Apply fault at the PITTSB-7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT16-SB	**Stuck Breaker at PITTSB-7 (510907)** a. Apply single phase fault at the PITTSB-7 345.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - PITTSB-7 345.0 kV (510907) to JOHNCO 7 345.0 kV (514809) line CKT 1 - PITTSB-7 345.0 kV (510907) to SEMINOL7 345.0 kV (515045) line CKT 1
17	FLT17-3PH	3 phase fault on NWTXARK7 345.0 kV (508072) to WELSH 345.0 kV (508359) line CKT 1, near NWTXARK7. a. Apply fault at the NWTXARK7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

18	FLT18-3PH	3 phase fault on FROGVIL4 138.0 kV (520918) to HUGO PP4 138.0 kV (520948) line CKT 1, near HUGO PP4. a. Apply fault at the HUGO PP4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
19	FLT19-3PH	3 phase fault on SUNNYSD7 345.0 kV (515136) to JOHNCO 7 345.0 kV (514809) line CKT 1, near SUNNYSD7. a. Apply fault at the SUNNYSD7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT20-3PH	3 phase fault on G16-063-TAP 345.0 kV (560088) to SUNNYSD7 345.0 kV (515136) line CKT 1, near G16-063-TAP . a. Apply fault at the G16-063-TAP 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
21	FLT21-SB	**Stuck Breaker at SUNNYSD7 (515136)** a. Apply single phase fault at the SUNNYSD7 345.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - SUNNYSD7 345.0 kV (515136) to JOHNCO 7 345.0 kV (514809) line CKT 1 - SUNNYSD7 345.0 kV (515136) to TERRYRD7 345.0 kV (511568) line CKT 1
22	FLT22-3PH	3 phase fault on PITTSB-7 345.0 kV (510907) to C-RIVER7 345.0 kV (515422) line CKT 1, near PITTSB-7. a. Apply fault at the PITTSB-7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
23	FLT23-3PH	3 phase fault on NWTXARK7 345.0 kV (508072) to TURK 345.0 kV (507455) line CKT 1, near NWTXARK7. a. Apply fault at the NWTXARK7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

24	FLT24-SB	**Stuck Breaker at WELSH (508359)** a. Apply single phase fault at the WELSH 345.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - LYDIA 345.0 kV (508298) to WELSH 345.0 kV (508359) line CKT 1 - NWTXARK7 345.0 kV (508072) to WELSH 345.0 kV (508359) line CKT 1
25	FLT25-SB	**Stuck Breaker at NWTXARK7 (508072)** a. Apply single phase fault at the NWTXARK7 345.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - TURK 345.0 kV (507455) to NWTXARK7 345.0 kV (508072) line CKT 1 - NWTXARK4 138.0 kV (508071) to NWTXARK7 345.0 kV (508072) to NWTEX1-1 13.80 kV (508100) transformer CKT 1
26	FLT26-PO	**Prior Outage of VALIANT4 138.0 kV (510918) to VALIANT7 345.0 kV (510911) to VALN2-1 13.80 kV (510938) transformer CKT 2;** 3 phase fault on VALIANT4 138.0 kV (510918) to VALIANT7 345.0 kV (510911) to VALN3-1 13.80 kV (510939) transformer CKT 1, near VALIANT7. a. Apply fault at the VALIANT7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
27	FLT27-PO	**Prior Outage of VALIANT7 345.0 kV (510911) to HUGO 345.0 kV (521157) line CKT 1;** 3 phase fault on VALIANT7 345.0 kV (510911) to PITTSB-7 345.0 kV (510907) line CKT 1, near VALIANT7. a. Apply fault at the VALIANT7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
28	FLT28-PO	**Prior Outage of VALIANT7 345.0 kV (510911) to NWTXARK7 345.0 kV (508072) line CKT 1;** 3 phase fault on VALIANT7 345.0 kV (510911) to LYDIA 345.0 kV (508298) line CKT 1, near VALIANT7. a. Apply fault at the VALIANT7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

29	FLT29-PO	**Prior Outage of NWTXARK4 138.0 kV (508071) to NWTXARK7 345.0 kV (508072) to NWTEX1-1 13.80 kV (508100) transformer CKT 1;** 3 phase fault on NWTXARK4 138.0 kV (508071) to NWTXARK7 345.0 kV (508072) to NWTEX2-1 13.80 kV (508101) transformer CKT 2, near NWTXARK7. a. Apply fault at the NWTXARK7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
30	FLT30-PO	**Prior Outage of VALIANT4 138.0 kV (510918) to HUGO PP4 138.0 kV (520948) line CKT 1;** 3 phase fault on HUGO PP4 138.0 kV (520948) to VALLANT4 138.0 kV (521079) line CKT 1, near HUGO PP4. a. Apply fault at the HUGO PP4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
31	FLT31-PO	**Prior Outage of LYDIA 345.0 kV (508298) to WELSH 345.0 kV (508359) line CKT 1;** 3 phase fault on NWTXARK7 345.0 kV (508072) to WELSH 345.0 kV (508359) line CKT 1, near NWTXARK7. a. Apply fault at the NWTXARK7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
32	FLT32-PO	**Prior Outage of PITTSB-7 345.0 kV (510907) to JOHNCO 7 345.0 kV (514809) line CKT 1;** 3 phase fault on PITTSB-7 345.0 kV (510907) to VALIANT7 345.0 kV (510911) line CKT 1, near VALIANT7. a. Apply fault at the VALIANT7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
33	FLT33-PO	**Prior Outage of NWTXARK4 138.0 kV (508071) to NWTXARK7 345.0 kV (508072) to NWTEX2-1 13.80 kV (508101) transformer CKT 2;** 3 phase fault on TURK 345.0 kV (507455) to NWTXARK7 345.0 kV (508072) line CKT 1, near NWTXARK7. a. Apply fault at the NWTXARK7 345.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

34	FLT34-3PH	3 phase fault on BLUERIV4 138.0 kV (515133) to PARKLN 4 138.0 kV (515178) line CKT 1, near BLUERIV4. a. Apply fault at the BLUERIV4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
35	FLT35-3PH	3 phase fault on ARBUCKL4 138.0 kV (515117) to G16-126-TAP 138.0 kV (588184) line CKT 1, near G16-126-TAP . a. Apply fault at the G16-126-TAP 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
36	FLT36-3PH	3 phase fault on G16-126-TAP 138.0 kV (588184) to BLUERIV4 138.0 kV (515133) line CKT 1, near BLUERIV4. a. Apply fault at the BLUERIV4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
37	FLT37-3PH	3 phase fault on ARBUCKL4 138.0 kV (515117) to VANOSTP4 138.0 kV (515531) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
38	FLT38-3PH	3 phase fault on VANOSS 4 138.0 kV (515174) to PARKLN 4 138.0 kV (515178) line CKT 1, near PARKLN 4. a. Apply fault at the PARKLN 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
39	FLT39-3PH	3 phase fault on SEMINOL4 138.0 kV (515044) to PARKLN 4 138.0 kV (515178) line CKT 1, near PARKLN 4. a. Apply fault at the PARKLN 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

40	FLT40-3PH	3 phase fault on PARKLN 4 138.0 kV (515178) to SOTHADA4 138.0 kV (515318) line CKT 1, near PARKLN 4. a. Apply fault at the PARKLN 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
41	FLT41-3PH	3 phase fault on ARBUCKL4 138.0 kV (515117) to SULPHR 4 138.0 kV (515559) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
42	FLT42-3PH	3 phase fault on ARBUCKL4 138.0 kV (515117) to BERWYN 4 138.0 kV (515173) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
43	FLT43-3PH	3 phase fault on ARBUCKL4 138.0 kV (515117) to MILLCKT4 138.0 kV (515121) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT44-3PH	3 phase fault on ARBUCKL4 138.0 kV (515117) to OAKLAW-4 138.0 kV (515123) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
45	FLT45-3PH	3 phase fault on PARKLN 2 69.0 kV (515177) to PARKLN 4 138.0 kV (515178) to PARKLN11 13.19 kV (515747) transformer CKT 1, near PARKLN4. a. Apply fault at the PARKLN 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line.

46	FLT46-SB	**Stuck Breaker at PARKLN 4 (515178)** a. Apply single phase fault at the PARKLN 4 138.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - PARKLN 2 69.0 kV (515177) to PARKLN 4 138.0 kV (515178) to PARKLN11 13.19 kV (515747) transformer CKT 1 - PARKLN 2 69.0 kV (515177) to PARKLN 4 138.0 kV (515178) to PARKLN21 13.19 kV (515748) transformer CKT 1
47	FLT47-SB	**Stuck Breaker at ARBUCKL4 (515117)** a. Apply single phase fault at the ARBUCKL4 138.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - ARBUCKL4 138.0 kV (515117) to SULPHR 4 138.0 kV (515559) line CKT 1 - ARBUCKL4 138.0 kV (515117) to MILLCKT4 138.0 kV (515121) line CKT 1
48	FLT48-SB	**Stuck Breaker at ARBUCKL4 (515117)** a. Apply single phase fault at the ARBUCKL4 138.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - ARBUCKL4 138.0 kV (515117) to SULPHR 4 138.0 kV (515559) line CKT 1 - ARBUCKL4 138.0 kV (515117) to BERWYN 4 138.0 kV (515173) line CKT 1
49	FLT49-SB	**Stuck Breaker at PARKLN 4 (515178)** a. Apply single phase fault at the PARKLN 4 138.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - VANOSS 4 138.0 kV (515174) to PARKLN 4 138.0 kV (515178) line CKT 1 - SEMINOL4 138.0 kV (515044) to PARKLN 4 138.0 kV (515178) line CKT 1
50	FLT50-3PH	3 phase fault on SEMINOL4 138.0 kV (515044) to VANOSTP4 138.0 kV (515531) line CKT 1, near VANOSTP4. a. Apply fault at the VANOSTP4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
51	FLT51-SB	**Stuck Breaker at SUNNYSD4 (515135)** a. Apply single phase fault at the SUNNYSD4 138.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - SUNNYSD4 138.0 kV (515135) to SUNNYSD7 345.0 kV (515136) to SUNNYSD1 13.80 kV (515762) transformer CKT 1 - SUNNYSD7 345.0 kV (515136) to SUNNYSD4 138.0 kV (515135) to SUNYSD 1 13.80 kV (515405) transformer CKT 1

52	FLT52-SB	**Stuck Breaker at ARBUCKL4 (515117)** a. Apply single phase fault at the ARBUCKL4 138.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - ARBUCKL4 138.0 kV (515117) to MILLCKT4 138.0 kV (515121) line CKT 1 - ARBUCKL4 138.0 kV (515117) to OAKLAW-4 138.0 kV (515123) line CKT 1
53	FLT53-PO	**Prior Outage of SEMINOL4 138.0 kV (515044) to PARKLN 4 138.0 kV (515178) line CKT 1;** 3 phase fault on ARBUCKL4 138.0 kV (515117) to G16-126-TAP 138.0 kV (588184) line CKT 1, near G16-126-TAP . a. Apply fault at the G16-126-TAP 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
54	FLT54-PO	**Prior Outage of SEMINOL4 138.0 kV (515044) to PARKLN 4 138.0 kV (515178) line CKT 1;** 3 phase fault on VANOSS 4 138.0 kV (515174) to PARKLN 4 138.0 kV (515178) line CKT 1, near PARKLN 4. a. Apply fault at the PARKLN 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
55	FLT55-PO	**Prior Outage of SEMINOL4 138.0 kV (515044) to PARKLN 4 138.0 kV (515178) line CKT 1;** 3 phase fault on ARBUCKL4 138.0 kV (515117) to VANOSTP4 138.0 kV (515531) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
56	FLT56-PO	**Prior Outage of ARBUCKL4 138.0 kV (515117) to SULPHR 4 138.0 kV (515559) line CKT 1;** 3 phase fault on ARBUCKL4 138.0 kV (515117) to BERWYN 4 138.0 kV (515173) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

57	FLT57-PO	**Prior Outage of BLUERIV4 138.0 kV (515133) to PARKLN 4 138.0 kV (515178) line CKT 1;** 3 phase fault on ARBUCKL4 138.0 kV (515117) to VANOSTP4 138.0 kV (515531) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
58	FLT58-PO	**Prior Outage of ARBUCKL4 138.0 kV (515117) to OAKLAW-4 138.0 kV (515123) line CKT 1;** 3 phase fault on ARBUCKL4 138.0 kV (515117) to MILLCKT4 138.0 kV (515121) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
59	FLT59-3PH	3 phase fault on TUPELO 4 138.0 kV (505600) to TUPLOTP4 138.0 kV (521071) line CKT 1, near TUPELO 4. a. Apply fault at the TUPELO 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
60	FLT60-3PH	3 phase fault on TUPELO 4 138.0 kV (505600) to ATKWEST4 138.0 kV (521188) line CKT 1, near TUPELO 4. a. Apply fault at the TUPELO 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
61	FLT61-3PH	3 phase fault on TUPELO 4 138.0 kV (505600) to TUPELO4 138.0 kV (520406) line CKT 1, near TUPELO 4. a. Apply fault at the TUPELO 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
62	FLT62-3PH	3 phase fault on EXPLOR 4 138.0 kV (505596) to ALLEN 138.0 kV (505598) line CKT 1, near ALLEN. a. Apply fault at the ALLEN 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

63	FLT63-3PH	3 phase fault on ALLEN 138.0 kV (505598) to TUPELO 4 138.0 kV (505600) line CKT 1, near TUPELO 4. a. Apply fault at the TUPELO 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
64	FLT64-3PH	3 phase fault on TUPELO 4 138.0 kV (505600) to S BROWN4 138.0 kV (505602) line CKT 1, near TUPELO 4. a. Apply fault at the TUPELO 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
65	FLT65-3PH	3 phase fault on TUPELO 4 138.0 kV (505600) to ALLENGT4 138.0 kV (510881) line CKT 1, near TUPELO 4. a. Apply fault at the TUPELO 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
66	FLT66-3PH	3 phase fault on GREASYC4 138.0 kV (505595) to EXPLOR 4 138.0 kV (505596) line CKT 1, near EXPLOR 4. a. Apply fault at the EXPLOR 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
67	FLT67-3PH	3 phase fault on WELEETK4 138.0 kV (505592) to WELETK4 138.0 kV (510902) line CKT 1, near WELEETK4. a. Apply fault at the WELEETK4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
68	FLT68-3PH	3 phase fault on WELEETK4 138.0 kV (505592) to CHECOTA4 138.0 kV (505594) line CKT 1, near WELEETK4. a. Apply fault at the WELEETK4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

69	FLT69-3PH	3 phase fault on WELEETK4 138.0 kV (505592) to PHAROAH4 138.0 kV (521026) line CKT 1, near WELEETK4. a. Apply fault at the WELEETK4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
70	FLT70-3PH	3 phase fault on ASHLAND4 138.0 kV (520818) to PITTSBG4 138.0 kV (521030) line CKT 1, near ASHLAND4. a. Apply fault at the ASHLAND4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
71	FLT71-3PH	3 phase fault on WELEETK5 161.0 kV (505590) to WELEETK4 138.0 kV (505592) to WLK X1 1 13.80 kV (505591) transformer CKT 1, near WELEETK4. a. Apply fault at the WELEETK4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
72	FLT72-SB	**Stuck Breaker at WELEETK4 (505592)** a. Apply single phase fault at the WELEETK4 138.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - WELEETK4 138.0 kV (505592) to WELETK4 138.0 kV (510902) line CKT 1 - WELEETK4 138.0 kV (505592) to CHECOTA4 138.0 kV (505594) line CKT 1
73	FLT73-SB	**Stuck Breaker at TUPELO 4 (505600)** a. Apply single phase fault at the TUPELO 4 138.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - TUPELO 4 138.0 kV (505600) to TUPLOTP4 138.0 kV (521071) line CKT 1 - TUPELO 4 138.0 kV (505600) to ATKWEST4 138.0 kV (521188) line CKT 1
74	FLT74-3PH	3 phase fault on ATOKA--4 138.0 kV (510887) to ATKEAST4 138.0 kV (521187) line CKT 1, near TUPELO 4. a. Apply fault at the TUPELO 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
75	FLT75-3PH	3 phase fault on LONEOAK4 138.0 kV (510897) to HARTSHN4 138.0 kV (520934) line CKT 1, near HARTSHN4. a. Apply fault at the HARTSHN4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

76	FLT76-SB	**Stuck Breaker at TUPELO 4 (505600)** a. Apply single phase fault at the TUPELO 4 138.0 kV bus. b. Clear fault after 16 cycles and trip the following elements. - ALLEN 138.0 kV (505598) to TUPELO 4 138.0 kV (505600) line CKT 1 - TUPELO 4 138.0 kV (505600) to S BROWN4 138.0 kV (505602) line CKT 1
77	FLT77-PO	**Prior Outage of TUPELO 4 138.0 kV (505600) to TUPLOTP4 138.0 kV (521071) line CKT 1;** 3 phase fault on TUPELO 4 138.0 kV (505600) to ALLENGT4 138.0 kV (510881) line CKT 1, near TUPELO 4. a. Apply fault at the TUPELO 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
78	FLT78-PO	**Prior Outage of TUPELO 4 138.0 kV (505600) to ALLENGT4 138.0 kV (510881) line CKT 1;** 3 phase fault on TUPELO 4 138.0 kV (505600) to S BROWN4 138.0 kV (505602) line CKT 1, near TUPELO 4. a. Apply fault at the TUPELO 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
79	FLT79-PO	**Prior Outage of GREASYC4 138.0 kV (505595) to EXPLOR 4 138.0 kV (505596) line CKT 1;** 3 phase fault on ASHLAND4 138.0 kV (520818) to PITTSBG4 138.0 kV (521030) line CKT 1, near ASHLAND4. a. Apply fault at the ASHLAND4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
80	FLT80-PO	**Prior Outage of TUPELO 4 138.0 kV (505600) to ATKWEST4 138.0 kV (521188) line CKT 1;** 3 phase fault on TUPELO 4 138.0 kV (505600) to ATKWEST4 138.0 kV (521188) line CKT 1, near TUPELO 4. a. Apply fault at the TUPELO 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

81	FLT81-PO	**Prior Outage of TUPELO 4 138.0 kV (505600) to ATKWEST4 138.0 kV (521188) line CKT 1;** 3 phase fault on TUPELO 4 138.0 kV (505600) to TUPELO4 138.0 kV (520406) line CKT 1, near TUPELO 4. a. Apply fault at the TUPELO 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
82	FLT82-PO	**Prior Outage of TUPELO 4 138.0 kV (505600) to TUPELO4 138.0 kV (520406) line CKT 1;** 3 phase fault on TUPELO 4 138.0 kV (505600) to ALLEN 138.0 kV (505598) line CKT 1, near TUPELO 4. a. Apply fault at the TUPELO 4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
83	FLT83-PO	**Prior Outage of WELEETK4 138.0 kV (505592) to PHAROAH4 138.0 kV (521026) line CKT 1;** 3 phase fault on ASHLAND4 138.0 kV (520818) to PITTSBG4 138.0 kV (521030) line CKT 1, near ASHLAND4. a. Apply fault at the ASHLAND4 138.0 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

APPENDIX B

SOUTHWEST POWER POOL DISTURBANCE PERFORMANCE REQUIREMENTS (SUBMITTED IN A SEPARATE FILE)

APPENDIX C

DYNAMIC STABILITY PLOTS FOR CLUSTER SCENARIO (SUBMITTED IN SEPARATE FILES FROM APPENDIX C-1 TO C-3 WHICH WILL BE AVAILABLE UPON REQUEST FROM SPP)

C-1 Group 14 Cluster Dynamic Stability Plots For 2017 Winter Peak Case

C-2 Group 14 Cluster Dynamic Stability Plots For 2018 Summer Peak Case

C-3 Group 14 Cluster Dynamic Stability Plots For 2026 Summer Peak Case

Each contingency consists of forty-six (46) subplots:

- Subplot #1 is the system phase angle channels in the snapshot file provided by SPP.
- Subplot #2 to Subplot #26 are results for twenty-five (25) generators in the scope of study.
- Subplots #27 to Subplot #36 are frequencies at the POI buses in the scope of study.
- Subplots #37 to Subplot #46 are voltages at the POI buses in the scope of study.

APPENDIX D

INTERCONNECTION REQUESTS DYNAMIC DATA FOR GROUP 14 (SUBMITTED IN A SEPARATE FILE WHICH WILL BE AVAILABLE ON REQUEST FROM SPP)

APPENDIX E

SHORT-CIRCUIT STUDY RESULTS

Table 5: GROUP 14 18SP Short-Circuit Study Results

Bus No	Bus Name	Short Circuit Current (A)	Bus No	Bus Name	Short Circuit Current (A)
MDWG16-18S_DIS1602_G14					
ASGI-2016-011					
300686	4WOODY 138.00	6963.3	515172	SPRNDAL4 138.00	11247.5
300895	2CHECOTA 69.000	4906.8	515176	BUTRFLD4 138.00	5638.1
505574	EUFAULA4 138.00	8552.9	515192	LULA 4 138.00	9189.1
505592	WELEETK4 138.00	13574.0	515193	COLBRT-4 138.00	4768.0
505594	CHECOTA4 138.00	6058.5	515362	HARDEN 4 138.00	8085.4
505595	GREASYC4 138.00	6583.1	515500	FRISCCO4 138.00	7944.6
505596	EXPLOR 4 138.00	5211.7	520406	TUPELO4 138.00	9758.0
505598	ALLEN 4 138.00	5349.2	520818	ASHLAND4 138.00	4598.5
505600	TUPELO 4 138.00	10732.8	520860	COLBERT4 138.00	4762.1
505602	S BROWN4 138.00	8225.0	520862	COLGATE4 138.00	5940.2
505604	DENISON4 138.00	3067.8	520884	DURANT 4 138.00	5455.5
505606	DEN #1 1 13.800	12629.2	520886	DUSTIN 4 138.00	6765.8
505608	DEN #2 1 13.800	12629.2	520963	KIERSEY4 138.00	5463.8
510862	COALGAT4 138.00	5817.1	520968	LANE 4 138.00	4809.5
510863	ALLENNG4 138.00	5507.0	520969	LASALLE4 138.00	6384.8
510877	FIXCT4 138.00	6771.4	520971	LATTAJT4 138.00	5415.8
510880	COALGTP4 138.00	6041.6	521026	PHAROAH4 138.00	13342.4
510881	ALLENGT4 138.00	10374.5	521030	PITTSBG4 138.00	4324.9
510884	HOLDEXP4 138.00	5088.0	521044	RUSSETT4 138.00	11043.8
510887	ATOKA--4 138.00	5781.9	521049	SCOLEMN4 138.00	7106.4
510892	HENRYET4 138.00	7892.4	521071	TUPLOTP4 138.00	10416.1

510895	LEHIGH-4 138.00	5654.7	521075	STONEWAL LH138.00	8584.9
510902	WELETK4 138.00	13273.9	521084	WETUMKA4 138.00	8025.1
510916	ALLEN--4 138.00	5341.7	521108	KRSYJCTN4 138.00	7863.3
510921	DUSTIN-4 138.00	8127.9	521109	KRSYJCTS4 138.00	7638.7
510923	EC.HEN-4 138.00	7933.6	521187	ATKEAST4 138.00	5079.4
510935	EXPCOLT4 138.00	7485.6	521188	ATKWEST4 138.00	5162.4
510936	EXPCOLG4 138.00	7381.1	585330	ASGI2015-006138.00	4633.6
510949	WAPANUCKA 4138.00	5741.7	585331	A15-006-XF-125.500	6003.3
511859	WEL 4-1 13.800	16553.1	585332	A15-006-GSU125.500	1304.9
511860	WEL 5-1 13.800	16549.7	585333	A15-006-GEN10.3200	77845.9
511861	WEL 6-1 13.800	16549.7	587200	GEN-2016-030138.00	5956.5
514808	JOHNCO 4 138.00	14961.9	587201	G16-030-XFMR34.500	9036.7
515120	RUSSET-4 138.00	11113.2	588266	ASGI1611 138.00	4053.4
515147	GLASSES4 138.00	7998.6	588267	ASGI1611XFMR25.000	5243.3
515152	BROWNTP4 138.00	8108.3	588268	ASGI1611-GSU25.000	3381.7
515153	COLEMNT4 138.00	8159.7	588269	ASGI1611-GEN13.200	5306.0
515154	EXPLRPL4 138.00	4436.9	588277	ASGI1612 138.00	5934.5
515155	BODLE 4 138.00	6115.7	588278	ASGI1612XFMR13.200	34492.8
515157	BROWN 4 138.00	8183.9	588279	ASGI1612-GEN13.200	34492.8
515159	COLBRTP4 138.00	6229.7	588286	ASGI1613 138.00	4598.5
ASGI-2016-012					
505592	WELEETK4 138.00	13574.0	515500	FRISCCO4 138.00	7944.6
505594	CHECOTA4 138.00	6058.5	520406	TUPELO4 138.00	9758.0
505595	GREASYC4 138.00	6583.1	520426	SEAWAY4 138.00	3986.5
505596	EXPLOR 4 138.00	5211.7	520818	ASHLAND4 138.00	4598.5
505598	ALLEN 4 138.00	5349.2	520826	BENNGTN4 138.00	4755.4
505600	TUPELO 4 138.00	10732.8	520860	COLBERT4 138.00	4762.1

505602	S BROWN4 138.00	8225.0	520862	COLGATE4 138.00	5940.2
505604	DENISON4 138.00	3067.8	520874	DARWIN 4 138.00	4685.9
505606	DEN #1 1 13.800	12629.2	520884	DURANT 4 138.00	5455.5
505608	DEN #2 1 13.800	12629.2	520963	KIERSEY4 138.00	5463.8
510862	COALGAT4 138.00	5817.1	520968	LANE 4 138.00	4809.5
510863	ALLENNG4 138.00	5507.0	520969	LASALLE4 138.00	6384.8
510880	COALGTP4 138.00	6041.6	520970	LATTA 4 138.00	4465.0
510881	ALLENGT4 138.00	10374.5	520971	LATTAJT4 138.00	5415.8
510884	HOLDEXP4 138.00	5088.0	521014	OILCNTR4 138.00	4885.9
510887	ATOKA--4 138.00	5781.9	521026	PHAROAH4 138.00	13342.4
510895	LEHIGH-4 138.00	5654.7	521030	PITTSBG4 138.00	4324.9
510902	WELETK4 138.00	13273.9	521044	RUSSETT4 138.00	11043.8
510916	ALLEN--4 138.00	5341.7	521047	SAVANNA4 138.00	4954.8
510935	EXPCOLT4 138.00	7485.6	521049	SCOLEMN4 138.00	7106.4
510936	EXPCOLG4 138.00	7381.1	521071	TUPLOTP4 138.00	10416.1
510949	WAPANUCKA 4138.00	5741.7	521075	STONEWAL LH138.00	8584.9
514808	JOHNCO 4 138.00	14961.9	521108	KRSYJCTN4 138.00	7863.3
515120	RUSSET-4 138.00	11113.2	521109	KRSYJCTS4 138.00	7638.7
515122	SXMLCKT4 138.00	10942.9	521187	ATKEAST4 138.00	5079.4
515147	GLASSES4 138.00	7998.6	521188	ATKWEST4 138.00	5162.4
515149	MADINDT4 138.00	7989.8	585330	ASGI2015-006138.00	4633.6
515150	CANEYCK4 138.00	8433.5	585331	A15-006-XF-125.500	6003.3
515151	LTLCITY4 138.00	7053.9	585332	A15-006-GSU125.500	1304.9
515152	BROWNTP4 138.00	8108.3	585333	A15-006-GEN10.3200	77845.9
515153	COLEMNT4 138.00	8159.7	587200	GEN-2016-030138.00	5956.5
515154	EXPLRPL4 138.00	4436.9	587201	G16-030-XFMR34.500	9036.7
515155	BODLE 4 138.00	6115.7	587202	G16-030-GSU134.500	8551.0
515157	BROWN 4 138.00	8183.9	588266	ASGI1611 138.00	4053.4

515159	COLBRTP4 138.00	6229.7	588267	ASGI1611XFMR25.000	5243.3
515162	FNDTION4 138.00	11445.4	588268	ASGI1611-GSU25.000	3381.7
515164	ROCKYPT4 138.00	10234.0	588269	ASGI1611-GEN13.200	5306.0
515172	SPRNDAL4 138.00	11247.5	588277	ASGI1612 138.00	5934.5
515176	BUTRFLD4 138.00	5638.1	588278	ASGI1612XFMR13.200	34492.8
515192	LULA 4 138.00	9189.1	588279	ASGI1612-GEN13.200	34492.8
515193	COLBRT-4 138.00	4768.0	588286	ASGI1613 138.00	4598.5
515318	SOTHADA4 138.00	11158.6	588287	ASGI1613XFMR25.000	4805.4
515362	HARDEN 4 138.00	8085.4			
ASGI-2016-013					
505596	EXPLOR 4 138.00	5211.7	520862	COLGATE4 138.00	5940.2
505598	ALLEN 4 138.00	5349.2	520934	HARTSHN4 138.00	8127.9
505600	TUPELO 4 138.00	10732.8	520986	MANNING4 138.00	4161.0
505602	S BROWN4 138.00	8225.0	521030	PITTSBG4 138.00	4324.9
505604	DENISON4 138.00	3067.8	521044	RUSSETT4 138.00	11043.8
510880	COALGTP4 138.00	6041.6	521047	SAVANNA4 138.00	4954.8
510881	ALLENGT4 138.00	10374.5	521071	TUPLOTP4 138.00	10416.1
510887	ATOKA--4 138.00	5781.9	521075	STONEWAL LH138.00	8584.9
510897	LONEOAK4 138.00	8328.0	521108	KRSYJCTN4 138.00	7863.3
510906	SMCALTP4 138.00	8079.4	521109	KRSYJCTS4 138.00	7638.7
510908	MCALEST4 138.00	9350.6	521188	ATKWEST4 138.00	5162.4
510916	ALLEN--4 138.00	5341.7	585330	ASGI2015-006138.00	4633.6
510935	EXPCOLT4 138.00	7485.6	585331	A15-006-XF-125.500	6003.3
510944	ENOWILT4 138.00	8162.3	588266	ASGI1611 138.00	4053.4
515157	BROWN 4 138.00	8183.9	588277	ASGI1612 138.00	5934.5
515159	COLBRTP4 138.00	6229.7	588278	ASGI1612XFMR13.200	34492.8
515192	LULA 4 138.00	9189.1	588286	ASGI1613 138.00	4598.5
520406	TUPELO4 138.00	9758.0	588287	ASGI1613XFMR25.000	4805.4

520418	LIMESTONEJ4 138.00	3461.5	588288	ASGI1613-GSU25.000	2516.0
520818	ASHLAND4 138.00	4598.5	588289	ASGI1613-GEN13.200	3997.2
520844	CARBON 4 138.00	6447.0			
GEN-2016-102					
510877	FIXCT4 138.00	6771.4	515174	VANOSS 4 138.00	13017.2
510948	EARLSBORO 4138.00	7187.6	515178	PARKLN 4 138.00	16187.4
511449	CORNVIL4 138.00	15753.2	515192	LULA 4 138.00	9189.1
511508	BLANCHD4 138.00	5588.1	515196	MILLCRK4 138.00	8895.7
514808	JOHNCO 4 138.00	14961.9	515286	STRLGTP4 138.00	13342.3
514814	PRICESF4 138.00	8879.9	515318	SOTHADA4 138.00	11158.6
515040	SEMINL1G 20.900	185519.8	515362	HARDEN 4 138.00	8085.4
515044	SEMINOL4 138.00	38069.9	515475	PURCELL4 138.00	9600.1
515055	MAUD 4 138.00	19213.4	515500	FRISCCO4 138.00	7944.6
515075	FRSTHIL4 138.00	13395.9	515531	VANOSTP4 138.00	13139.7
515097	WLNUTCK4 138.00	9042.9	515559	SULPHR 4 138.00	14230.7
515100	PAOLI- 4 138.00	10057.4	515570	MAYSVLT4 138.00	5653.5
515114	CHIGLEY4 138.00	8022.0	521019	OAKLAWN4 138.00	12435.7
515117	ARBUCKL4 138.00	15611.6	521122	HOWE 4 138.00	10839.8
515118	JOLLYVL4 138.00	9124.4	587820	GEN-2016-102138.00	9878.8
515121	MILLCKT4 138.00	10800.6	587821	G16-102XFMR134.500	15480.3
515122	SXMLCKT4 138.00	10942.9	587822	G16-102-GSU134.500	15058.9
515123	OAKLAW-4 138.00	12637.9	587823	G16-102-GEN10.6900	252866.0
515124	MAYSVIL4 138.00	6014.0	587824	G16-102-GEN20.6900	634888.1
515133	BLUERIV4 138.00	10788.4	588180	GEN-2016-126138.00	11719.8
515161	AIRPARK4 138.00	7322.2	588181	G16-126XFMR134.500	17626.3
515165	TOTAL 4 138.00	10901.5	588182	G16-126-GSU134.500	14958.6
515169	AIRPRKT4 138.00	8515.1	588183	G16-126-GEN10.6500	688438.4
515173	BERWYN 4 138.00	8140.7	588184	G16-126-TAP 138.00	11951.2

GEN-2016-126					
510948	EARLSBORO 4138.00	7187.6	515171	CHIKSAW4 138.00	12069.0
511508	BLANCHD4 138.00	5588.1	515173	BERWYN 4 138.00	8140.7
514808	JOHNCO 4 138.00	14961.9	515174	VANOSS 4 138.00	13017.2
514814	PRICESF4 138.00	8879.9	515178	PARKLN 4 138.00	16187.4
515040	SEMINL1G 20.900	185519.8	515196	MILLCRK4 138.00	8895.7
515044	SEMINOL4 138.00	38069.9	515318	SOTHADA4 138.00	11158.6
515055	MAUD 4 138.00	19213.4	515362	HARDEN 4 138.00	8085.4
515075	FRSTHIL4 138.00	13395.9	515500	FRISCCO4 138.00	7944.6
515097	WLNUTCK4 138.00	9042.9	515531	VANOSTP4 138.00	13139.7
515100	PAOLI- 4 138.00	10057.4	515559	SULPHR 4 138.00	14230.7
515114	CHIGLEY4 138.00	8022.0	515643	HONEYCK4 138.00	9010.1
515117	ARBUCKL4 138.00	15611.6	521019	OAKLAWN4 138.00	12435.7
515118	JOLLYVL4 138.00	9124.4	521122	HOWE 4 138.00	10839.8
515120	RUSSET-4 138.00	11113.2	587820	GEN-2016-102138.00	9878.8
515121	MILLCKT4 138.00	10800.6	587821	G16-102XFMR134.500	15480.3
515122	SXMLCKT4 138.00	10942.9	587822	G16-102-GSU134.500	15058.9
515123	OAKLAW-4 138.00	12637.9	587823	G16-102-GEN10.6900	252866.0
515124	MAYSVIL4 138.00	6014.0	587824	G16-102-GEN20.6900	634888.1
515133	BLUERIV4 138.00	10788.4	588180	GEN-2016-126138.00	11719.8
515150	CANEYCK4 138.00	8433.5	588181	G16-126XFMR134.500	17626.3
515161	AIRPARK4 138.00	7322.2	588182	G16-126-GSU134.500	14958.6
515165	TOTAL 4 138.00	10901.5	588183	G16-126-GEN10.6500	688438.4
515169	AIRPRKT4 138.00	8515.1	588184	G16-126-TAP 138.00	11951.2
GEN-2016-129					
337376	7SAREPTA% 345.00	8324.8	515041	SEMINL2G 17.100	184058.1
500250	DOLHILL7 345.00	11794.8	515042	SEMINL3G 20.900	179903.1

506945	CHAMSPR7 345.00	8901.6	515045	SEMINOL7 345.00	25529.9
507455	TURK 7 345.00	8854.7	515136	SUNNYSD7 345.00	10706.5
507760	SW SHV 7 345.00	15041.0	515223	MUSKOG4G 18.000	220744.8
508072	NWTXARK7 345.00	12805.2	515224	MUSKOGE7 345.00	27069.3
508298	LYDIA 7 345.00	12288.3	515225	MUSKOG5G 18.000	217349.0
508359	WELSH 7 345.00	19781.9	515226	MUSKOG6G 24.000	181292.7
508563	PIRKEY 7 345.00	15930.4	515235	PECANCK7 345.00	20306.5
508572	LEBROCK7 345.00	14860.7	515302	FTSMITH7 345.00	9669.5
508809	LONGWD 7 345.00	14543.7	515422	C-RIVER7 345.00	9270.3
508832	DIANA 7 345.00	17902.4	515497	MATHWSN7 345.00	30772.1
508841	WILKES 7 345.00	14477.8	515610	FSHRTAP7 345.00	16324.4
509404	WELSH1-1 18.000	173326.8	521157	HUGO 7 345.00	11087.0
509406	WELSH3-1 18.000	175099.9	560088	G16-063-TAP 345.00	7488.7
509409	WILKE3-1 22.000	104581.1	584780	GEN-2015-036345.00	7649.1
509745	CLARKSV7 345.00	18798.7	584781	G15-036-XF-134.500	50768.5
509782	R.S.S.-7 345.00	29037.2	584782	G15-036-GSU134.500	42357.3
509807	ONETA--7 345.00	27757.9	584784	G15-036-XF-234.500	50731.6
510907	PITTSB-7 345.00	13197.4	584785	G15-036-GSU234.500	39429.6
510911	VALIANT7 345.00	13131.7	587430	GEN-2016-063345.00	7401.3
510925	KIOWA 7 345.00	12970.0	587431	G16-063XFMR134.500	17753.8
511468	L.E.S.-7 345.00	12562.8	587432	G16-063-GSU134.500	17174.0
511568	TERRYRD7 345.00	9732.7	587434	G16-063XFMR234.500	17784.6
511571	RUSHSPR7 345.00	6345.6	587435	G16-063-GSU234.500	17269.6
511944	KIOWA G1 18.000	55707.1	588200	GEN-2016-129345.00	5244.7
511945	KIOWA G2 18.000	55707.1	588201	G16-129XFMR134.500	15762.5
511946	KIOWA S1 18.000	30125.9	588202	G16-129-GSU134.500	15463.2
511947	KIOWA S2 18.000	30125.9	588203	G16-129-GEN10.6900	655737.9
511948	KIOWA G3 18.000	55707.1	590005	MOSES 345.00	10290.9

511949	KIOWA G4 18.000	55707.1	590006	FARM SW 345.00	4976.1
514801	MINCO 7 345.00	16869.2	590007	PARIS SS 345.00	4057.3
514809	JOHNCO 7 345.00	9727.8	590008	MOSES-T 345.00	10290.9
514880	NORTWST7 345.00	31401.5	590009	SULSP SS 345.00	5268.1
514881	SPRNGCK7 345.00	22477.9	590010	MOSES1 G 18.000	155490.1
514901	CIMARON7 345.00	31914.9	590011	MOSES2 G 18.000	155475.5
514908	ARCADIA7 345.00	25050.9	590012	MOSES3 G 24.000	163164.1
514909	REDBUD 7 345.00	23940.5	599892	EASTDC 7 345.00	6150.5
514934	DRAPER 7 345.00	20389.6			

Table 6: GROUP 14 26 SP Short-Circuit Study Results

Bus No	Bus Name	Short Circuit Current (A)	Bus No	Bus Name	Short Circuit Current (A)
MDWG16-26S_DIS1602_G14					
ASGI-2016-011					
300686	4WOODY 138.00	7078.4	515172	SPRNDAL4 138.00	11215.3
300895	2CHECOTA 69.000	4797.4	515176	BUTRFLD4 138.00	5608.2
505574	EUFAULA4 138.00	8231.4	515192	LULA 4 138.00	9148.1
505592	WELEETK4 138.00	14622.2	515193	COLBRT-4 138.00	4744.3
505594	CHECOTA4 138.00	5939.5	515362	HARDEN 4 138.00	8044.3
505595	GREASYC4 138.00	6702.7	515500	FRISCCO4 138.00	7903.9
505596	EXPLOR 4 138.00	5235.2	520406	TUPELO4 138.00	9724.0
505598	ALLEN 4 138.00	5340.1	520818	ASHLAND4 138.00	4568.2
505600	TUPELO 4 138.00	10703.0	520860	COLBERT4 138.00	4738.6
505602	S BROWN4 138.00	8183.5	520862	COLGATE4 138.00	5904.1
505604	DENISON4 138.00	3051.7	520884	DURANT 4 138.00	5421.9
505606	DEN #1 1 13.800	12562.3	520886	DUSTIN 4 138.00	6922.6
505608	DEN #2 1 13.800	12562.3	520963	KIERSEY4 138.00	5438.3
510862	COALGAT4 138.00	5785.1	520968	LANE 4 138.00	4776.4
510863	ALLENNG4 138.00	5472.1	520969	LASALLE4 138.00	6347.7
510877	FIXCT4 138.00	6777.5	520971	LATTAJT4 138.00	5382.5
510880	COALGTP4 138.00	6009.6	521026	PHAROAH4 138.00	14322.9
510881	ALLENGT4 138.00	10343.3	521030	PITTSBG4 138.00	4298.2
510884	HOLDEXP4 138.00	5109.0	521044	RUSSETT4 138.00	11000.3
510887	ATOKA--4 138.00	5760.7	521049	SCOLEMN4 138.00	7069.1

510892	HENRYET4 138.00	8176.8	521071	TUPLOTP4 138.00	10382.3
510895	LEHIGH-4 138.00	5626.2	521075	STONEWAL LH138.00	8546.1
510902	WELETK4 138.00	14865.5	521084	WETUMKA4 138.00	8268.2
510916	ALLEN--4 138.00	5332.6	521108	KRSYJCTN4 138.00	7823.1
510921	DUSTIN-4 138.00	8494.1	521109	KRSYJCTS4 138.00	7600.5
510923	EC.HEN-4 138.00	8244.6	521187	ATKEAST4 138.00	5049.3
510935	EXPCOLT4 138.00	7448.6	521188	ATKWEST4 138.00	5135.3
510936	EXPCOLG4 138.00	7344.1	585330	ASGI2015-006138.00	4601.4
510949	WAPANUCKA 4138.00	5705.7	585331	A15-006-XF-125.500	5946.3
511859	WEL 4-1 13.800	35631.2	585332	A15-006-GSU125.500	1291.5
511860	WEL 5-1 13.800	16609.5	585333	A15-006-GEN10.3200	77038.9
511861	WEL 6-1 13.800	35620.3	587200	GEN-2016-030138.00	5923.8
514808	JOHNCO 4 138.00	14907.1	587201	G16-030-XFMR34.500	8966.6
515120	RUSSET-4 138.00	11069.4	588266	ASGI1611 138.00	4036.6
515147	GLASSES4 138.00	7966.6	588267	ASGI1611XFMR25.000	5195.6
515152	BROWNTP4 138.00	8067.3	588268	ASGI1611-GSU25.000	3356.7
515153	COLEMNT4 138.00	8118.5	588269	ASGI1611-GEN13.200	5278.9
515154	EXPLRPL4 138.00	4414.0	588277	ASGI1612 138.00	5901.8
515155	BODLE 4 138.00	6082.9	588278	ASGI1612XFMR13.200	34385.3
515157	BROWN 4 138.00	8142.5	588279	ASGI1612-GEN13.200	34385.3
515159	COLBRTP4 138.00	6196.6	588286	ASGI1613 138.00	4568.2
ASGI-2016-012					
505592	WELEETK4 138.00	14622.2	515500	FRISCCO4 138.00	7903.9
505594	CHECOTA4 138.00	5939.5	520406	TUPELO4 138.00	9724.0
505595	GREASYC4 138.00	6702.7	520426	SEAWAY4 138.00	3966.5
505596	EXPLOR 4 138.00	5235.2	520818	ASHLAND4 138.00	4568.2
505598	ALLEN 4 138.00	5340.1	520826	BENNGTN4 138.00	4718.1
505600	TUPELO 4 138.00	10703.0	520860	COLBERT4 138.00	4738.6

505602	S BROWN4 138.00	8183.5	520862	COLGATE4 138.00	5904.1
505604	DENISON4 138.00	3051.7	520874	DARWIN 4 138.00	4640.9
505606	DEN #1 1 13.800	12562.3	520884	DURANT 4 138.00	5421.9
505608	DEN #2 1 13.800	12562.3	520963	KIERSEY4 138.00	5438.3
510862	COALGAT4 138.00	5785.1	520968	LANE 4 138.00	4776.4
510863	ALLENNG4 138.00	5472.1	520969	LASALLE4 138.00	6347.7
510880	COALGTP4 138.00	6009.6	520970	LATTA 4 138.00	4435.2
510881	ALLENGT4 138.00	10343.3	520971	LATTAJT4 138.00	5382.5
510884	HOLDEXP4 138.00	5109.0	521014	OILCNTR4 138.00	4856.2
510887	ATOKA--4 138.00	5760.7	521026	PHAROAH4 138.00	14322.9
510895	LEHIGH-4 138.00	5626.2	521030	PITTSBG4 138.00	4298.2
510902	WELETK4 138.00	14865.5	521044	RUSSETT4 138.00	11000.3
510916	ALLEN--4 138.00	5332.6	521047	SAVANNA4 138.00	4931.3
510935	EXPCOLT4 138.00	7448.6	521049	SCOLEMN4 138.00	7069.1
510936	EXPCOLG4 138.00	7344.1	521071	TUPLOTP4 138.00	10382.3
510949	WAPANUCKA 4138.00	5705.7	521075	STONEWAL LH138.00	8546.1
514808	JOHNCO 4 138.00	14907.1	521108	KRSYJCTN4 138.00	7823.1
515120	RUSSET-4 138.00	11069.4	521109	KRSYJCTS4 138.00	7600.5
515122	SXMLCKT4 138.00	10904.0	521187	ATKEAST4 138.00	5049.3
515147	GLASSES4 138.00	7966.6	521188	ATKWEST4 138.00	5135.3
515149	MADINDT4 138.00	7957.8	585330	ASGI2015-006138.00	4601.4
515150	CANEYCK4 138.00	8394.0	585331	A15-006-XF-125.500	5946.3
515151	LTLCITY4 138.00	7021.7	585332	A15-006-GSU125.500	1291.5
515152	BROWNTP4 138.00	8067.3	585333	A15-006-GEN10.3200	77038.9
515153	COLEMNT4 138.00	8118.5	587200	GEN-2016-030138.00	5923.8
515154	EXPLRPL4 138.00	4414.0	587201	G16-030-XFMR34.500	8966.6
515155	BODLE 4 138.00	6082.9	587202	G16-030-GSU134.500	8484.0
515157	BROWN 4 138.00	8142.5	588266	ASGI1611 138.00	4036.6

515159	COLBRTP4 138.00	6196.6	588267	ASGI1611XFMR25.000	5195.6
515162	FNDTION4 138.00	11411.5	588268	ASGI1611-GSU25.000	3356.7
515164	ROCKYPT4 138.00	10206.6	588269	ASGI1611-GEN13.200	5278.9
515172	SPRNDAL4 138.00	11215.3	588277	ASGI1612 138.00	5901.8
515176	BUTRFLD4 138.00	5608.2	588278	ASGI1612XFMR13.200	34385.3
515192	LULA 4 138.00	9148.1	588279	ASGI1612-GEN13.200	34385.3
515193	COLBRT-4 138.00	4744.3	588286	ASGI1613 138.00	4568.2
515318	SOTHADA4 138.00	11099.6	588287	ASGI1613XFMR25.000	4765.5
515362	HARDEN 4 138.00	8044.3			
ASGI-2016-013					
505596	EXPLOR 4 138.00	5235.2	520862	COLGATE4 138.00	5904.1
505598	ALLEN 4 138.00	5340.1	520934	HARTSHN4 138.00	8132.1
505600	TUPELO 4 138.00	10703.0	520986	MANNING4 138.00	4143.6
505602	S BROWN4 138.00	8183.5	521030	PITTSBG4 138.00	4298.2
505604	DENISON4 138.00	3051.7	521044	RUSSETT4 138.00	11000.3
510880	COALGTP4 138.00	6009.6	521047	SAVANNA4 138.00	4931.3
510881	ALLENGT4 138.00	10343.3	521071	TUPLOTP4 138.00	10382.3
510887	ATOKA--4 138.00	5760.7	521075	STONEWAL LH138.00	8546.1
510897	LONEOAK4 138.00	8334.9	521108	KRSYJCTN4 138.00	7823.1
510906	SMCALTP4 138.00	8099.8	521109	KRSYJCTS4 138.00	7600.5
510908	MCALEST4 138.00	9396.2	521188	ATKWEST4 138.00	5135.3
510916	ALLEN--4 138.00	5332.6	585330	ASGI2015-006138.00	4601.4
510935	EXPCOLT4 138.00	7448.6	585331	A15-006-XF-125.500	5946.3
510944	ENOWILT4 138.00	8167.4	588266	ASGI1611 138.00	4036.6
515157	BROWN 4 138.00	8142.5	588277	ASGI1612 138.00	5901.8
515159	COLBRTP4 138.00	6196.6	588278	ASGI1612XFMR13.200	34385.3
515192	LULA 4 138.00	9148.1	588286	ASGI1613 138.00	4568.2
520406	TUPELO4 138.00	9724.0	588287	ASGI1613XFMR25.000	4765.5

520418	LIMESTONEJ4 138.00	3444.2	588288	ASGI1613-GSU25.000	2500.6
520818	ASHLAND4 138.00	4568.2	588289	ASGI1613-GEN13.200	3977.9
520844	CARBON 4 138.00	6446.3			
GEN-2016-102					
510877	FIXCT4 138.00	6777.5	515174	VANOSS 4 138.00	12956.6
510948	EARLSBORO 4138.00	7180.9	515178	PARKLN 4 138.00	16111.0
511449	CORNVIL4 138.00	16035.4	515192	LULA 4 138.00	9148.1
511508	BLANCHD4 138.00	5593.9	515196	MILLCRK4 138.00	8864.4
514808	JOHNCO 4 138.00	14907.1	515286	STRLGTP4 138.00	13164.1
514814	PRICESF4 138.00	8851.1	515318	SOTHADA4 138.00	11099.6
515040	SEMINL1G 20.900	184830.5	515362	HARDEN 4 138.00	8044.3
515044	SEMINOL4 138.00	37895.3	515475	PURCELL4 138.00	9526.5
515055	MAUD 4 138.00	19107.4	515500	FRISCCO4 138.00	7903.9
515075	FRSTHIL4 138.00	13241.1	515531	VANOSTP4 138.00	13078.8
515097	WLNUTCK4 138.00	8973.7	515559	SULPHR 4 138.00	14175.6
515100	PAOLI- 4 138.00	10002.4	515570	MAYSVLT4 138.00	5627.9
515114	CHIGLEY4 138.00	7986.5	521019	OAKLAWN4 138.00	12386.2
515117	ARBUCKL4 138.00	15550.9	521122	HOWE 4 138.00	10801.3
515118	JOLLYVL4 138.00	9093.4	587820	GEN-2016-102138.00	9833.7
515121	MILLCKT4 138.00	10762.1	587821	G16-102XFMR134.500	15406.1
515122	SXMLCKT4 138.00	10904.0	587822	G16-102-GSU134.500	14988.1
515123	OAKLAW-4 138.00	12587.7	587823	G16-102-GEN10.6900	251696.9
515124	MAYSVIL4 138.00	5985.5	587824	G16-102-GEN20.6900	631993.1
515133	BLUERIV4 138.00	10739.6	588180	GEN-2016-126138.00	11671.1
515161	AIRPARK4 138.00	7299.5	588181	G16-126XFMR134.500	17552.2
515165	TOTAL 4 138.00	10868.5	588182	G16-126-GSU134.500	14898.1
515169	AIRPRKT4 138.00	8488.4	588183	G16-126-GEN10.6500	685826.3
515173	BERWYN 4 138.00	8114.9	588184	G16-126-TAP 138.00	11901.5

GEN-2016-126					
510948	EARLSBORO 4138.00	7180.9	515171	CHIKSAW4 138.00	12032.2
511508	BLANCHD4 138.00	5593.9	515173	BERWYN 4 138.00	8114.9
514808	JOHNCO 4 138.00	14907.1	515174	VANOSS 4 138.00	12956.6
514814	PRICESF4 138.00	8851.1	515178	PARKLN 4 138.00	16111.0
515040	SEMINL1G 20.900	184830.5	515196	MILLCRK4 138.00	8864.4
515044	SEMINOL4 138.00	37895.3	515318	SOTHADA4 138.00	11099.6
515055	MAUD 4 138.00	19107.4	515362	HARDEN 4 138.00	8044.3
515075	FRSTHIL4 138.00	13241.1	515500	FRISCCO4 138.00	7903.9
515097	WLNUTCK4 138.00	8973.7	515531	VANOSTP4 138.00	13078.8
515100	PAOLI- 4 138.00	10002.4	515559	SULPHR 4 138.00	14175.6
515114	CHIGLEY4 138.00	7986.5	515643	HONEYCK4 138.00	8983.2
515117	ARBUCKL4 138.00	15550.9	521019	OAKLAWN4 138.00	12386.2
515118	JOLLYVL4 138.00	9093.4	521122	HOWE 4 138.00	10801.3
515120	RUSSET-4 138.00	11069.4	587820	GEN-2016-102138.00	9833.7
515121	MILLCKT4 138.00	10762.1	587821	G16-102XFMR134.500	15406.1
515122	SXMLCKT4 138.00	10904.0	587822	G16-102-GSU134.500	14988.1
515123	OAKLAW-4 138.00	12587.7	587823	G16-102-GEN10.6900	251696.9
515124	MAYSVIL4 138.00	5985.5	587824	G16-102-GEN20.6900	631993.1
515133	BLUERIV4 138.00	10739.6	588180	GEN-2016-126138.00	11671.1
515150	CANEYCK4 138.00	8394.0	588181	G16-126XFMR134.500	17552.2
515161	AIRPARK4 138.00	7299.5	588182	G16-126-GSU134.500	14898.1
515165	TOTAL 4 138.00	10868.5	588183	G16-126-GEN10.6500	685826.3
515169	AIRPRKT4 138.00	8488.4	588184	G16-126-TAP 138.00	11901.5
GEN-2016-129					
337376	7SAREPTA% 345.00	8316.2	515041	SEMINL2G 17.100	183786.1
500250	DOLHILL7 345.00	11772.7	515042	SEMINL3G 20.900	179666.3

506945	CHAMSPR7 345.00	10051.6	515045	SEMINOL7 345.00	25405.9
507455	TURK 7 345.00	8779.1	515136	SUNNYSD7 345.00	10685.7
507760	SW SHV 7 345.00	15037.4	515223	MUSKOG4G 18.000	220247.3
508072	NWTXARK7 345.00	12690.8	515224	MUSKOGE7 345.00	26842.0
508298	LYDIA 7 345.00	12159.8	515225	MUSKOG5G 18.000	216737.1
508359	WELSH 7 345.00	19524.0	515226	MUSKOG6G 24.000	180869.6
508563	PIRKEY 7 345.00	15907.2	515235	PECANCK7 345.00	20164.3
508572	LEBROCK7 345.00	14833.4	515302	FTSMITH7 345.00	9333.4
508809	LONGWD 7 345.00	14542.6	515422	C-RIVER7 345.00	9230.8
508832	DIANA 7 345.00	17769.3	515497	MATHWSN7 345.00	30655.4
508841	WILKES 7 345.00	14415.3	515610	FSHRTAP7 345.00	16265.1
509404	WELSH1-1 18.000	167343.3	521157	HUGO 7 345.00	10966.6
509406	WELSH3-1 18.000	169720.7	560088	G16-063-TAP 345.00	7465.5
509409	WILKE3-1 22.000	105284.3	584780	GEN-2015-036345.00	7619.3
509745	CLARKSV7 345.00	18623.7	584781	G15-036-XF-134.500	50554.0
509782	R.S.S.-7 345.00	28832.2	584782	G15-036-GSU134.500	42173.6
509807	ONETA--7 345.00	25556.2	584784	G15-036-XF-234.500	50518.2
510907	PITTSB-7 345.00	13138.0	584785	G15-036-GSU234.500	39257.4
510911	VALIANT7 345.00	13018.3	587430	GEN-2016-063345.00	7378.5
510925	KIOWA 7 345.00	12911.7	587431	G16-063XFMR134.500	17727.6
511468	L.E.S.-7 345.00	12691.1	587432	G16-063-GSU134.500	17151.5
511568	TERRYRD7 345.00	9756.7	587434	G16-063XFMR234.500	17758.4
511571	RUSHSPR7 345.00	6346.1	587435	G16-063-GSU234.500	17246.7
511944	KIOWA G1 18.000	55450.8	588200	GEN-2016-129345.00	5210.4
511945	KIOWA G2 18.000	55450.8	588201	G16-129XFMR134.500	15642.7
511946	KIOWA S1 18.000	29986.9	588202	G16-129-GSU134.500	15345.9
511947	KIOWA S2 18.000	29986.9	588203	G16-129-GEN10.6900	650394.2
511948	KIOWA G3 18.000	55450.8	590005	MOSES 345.00	10138.6

511949	KIOWA G4 18.000	55450.8	590006	FARM SW 345.00	4902.5
514801	MINCO 7 345.00	16907.3	590007	PARIS SS 345.00	3997.2
514809	JOHNCO 7 345.00	9693.5	590008	MOSES-T 345.00	10138.6
514880	NORTWST7 345.00	31230.0	590009	SULSP SS 345.00	5190.2
514881	SPRNGCK7 345.00	22371.9	590010	MOSES1 G 18.000	152137.6
514901	CIMARON7 345.00	31782.5	590011	MOSES2 G 18.000	152144.6
514908	ARCADIA7 345.00	25057.8	590012	MOSES3 G 24.000	162168.0
514909	REDBUD 7 345.00	24204.3	599892	EASTDC 7 345.00	6059.5
514934	DRAPER 7 345.00	20244.6			

J15: GROUP 15 DYNAMIC STABILITY ANALYSIS REPORT

Definitive Interconnection System Impact Study

Southwest Power Pool

DISIS-2016-002 (Group 15)
Project No. 105822

08/10/2018

Definitive Interconnection System Impact Study

prepared for

Southwest Power Pool
DISIS-2016-002 (Group 15)
Little Rock, AR

Project No. 105822

08/10/2018

prepared by

Burns & McDonnell Engineering Company, Inc.
Houston, Texas

TABLE OF CONTENTS

Page No.

LIST OF TABLES

Page No.

LIST OF FIGURES

Page No.

APPENDICES

(AVAILABLE UPON REQUEST TO SPP)

EXECUTIVE SUMMARY

Southwest Power Pool (SPP) retained Burns & McDonnell to perform a Definitive Interconnection System Impact Study of the DISIS-2016-002 (Group 15) projects. This study included stability analysis and short circuit analysis to find impacts on the transmission system caused by the interconnections of Group 15 requests which includes five requests.

The DISIS-2016-002 Group 15 requests consist all wind projects, and GEN-2016-164 request is for a capacity increase based on an existing wind project. The Group 15 request summary is shown in Table ES-1.

Table ES-1: GEN-2016-017 Interconnection Project

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2016-036	44.6	GE 2.3MW & 2.5MW WTG (587713 & 587714)	Granite Falls 115kV Sub
GEN-2016-087	98.9	GE 2.3MW WTG (587723)	Bismarck-Glenham 230kV
GEN-2016-092	250.7	GE 2.3MW WTG (587753)	Tap Leland Olds-Ft Thompson 345kV
GEN-2016-103	250.7	GE 2.3MW WTG (587833)	Tap Leland Olds- Ft Thompson 345kV
GEN-2016-164	7.92 (uprate to GEN-2009-018IS)	GE 1.62MW WTG (659289)	Groton 115kV substation

The dynamic stability analysis was performed using PSS/E v. 33. For the DISIS-2016-002 (Group 15), all five requests are each modeled at its maximum requested capacity. The stability analysis evaluated the system for three load scenarios (2017 winter peak, 2018 summer peak and 2026 summer peak) simulating 100 faults that included three-phase and single-line-to-ground faults including faults on prior outage cases and stuck breakers. For stability analysis, it is observed that the addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit and curtailment of current study generation during Prior Outage of transmission circuits are required in order to maintain system reliability. The relevant faults are 92-103FLT05, 92-103FLT05-PO2, 92-103FLT07-PO2, 92-103FLT09-PO2, 92-103FLT10-PO2 and 92-103FLT04-PO3, and all these faults are TPL-001-4 Category P6 Transmission Circuit Events except for 92-103FLT05 a P1 Event.

The short circuit analysis was performed using PSS/E v.33. The short circuit analysis evaluated the system for the 2018 and 2026 Summer Peak cases. Three-phase fault currents were calculated for the 69 kV and above buses within 5 buses of generator's point of interconnection.

1.0 INTRODUCTION

Burns & McDonnell was retained by Southwest Power Pool (SPP) to perform a Definitive Interconnection System Impact Study of the DISIS-2016-002 (Group 15). This study focused on stability analysis to find impacts on the transmission system caused by the interconnections of Group 15 requests which includes five requests GEN-2016-036, GEN-2016-087, GEN-2016-092, GEN-2016-103 and GEN-2016-164.

The DISIS-2016-002 Group 15 requests consist all wind projects, and GEN-2016-164 request is for a capacity increase based on an existing wind project. The Group 15 request summary is shown in Table 1-1.

Table 1-1: GEN-2016-017 Interconnection Project

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2016-036	44.6	GE 2.3MW & 2.5MW WTG (587713 & 587714)Wind	Granite Falls 115kV Sub
GEN-2016-087	98.9	GE 2.3MW WTG (587723)Wind	Bismarck-Glenham 230kV
GEN-2016-092	250.7	GE 2.3MW WTG (587753)Wind	Tap Leland Olds-Ft Thompson 345kV
GEN-2016-103	250.7	GE 2.3MW WTG (587833)	Tap Leland Olds- Ft Thompson 345kV
GEN-2016-164	7.92 (uprate to GEN-2009-018IS)	GE 1.62MW WTG (659289)	Groton 115kV substation

1.1 Study Scope

This study is presented in the following five main parts:

1. Introduction
2. Study Assumptions
3. Stability Analysis
4. Short Circuit Analysis
5. Conclusions

1.2 Limitations

In the preparation of this report, the information provided to Burns & McDonnell by others was used by Burns & McDonnell to make certain assumptions with respect to conditions which may exist in the future. While Burns & McDonnell believes the assumptions made are reasonable for the purposes of this report, Burns & McDonnell makes no representation that the conditions assumed will, in fact, occur. In addition, while Burns & McDonnell has no reason to believe that the information provided by others, and on which this report is based, is inaccurate in any material respect, Burns & McDonnell has not independently verified such information and cannot guarantee its accuracy or completeness. To the extent that actual future conditions differ from those assumed herein or from the information provided to Burns & McDonnell, the actual results will vary from those presented.

2.0 STUDY ASSUMPTIONS

The stability analysis was performed using the PTI PSS/E software version 33.

2.1 Disturbance Performance Requirement

The following SPP Disturbance Performance Requirements were applied to the Bulk Electric System for the stability analysis. These requirements establish the minimum requirements for machine rotor angle damping and transient voltage recovery.

2.1.1 Rotor Angle Damping Requirement

The machine rotor angles shall exhibit well damped angular oscillations and acceptable power swings following a disturbance on the Bulk Electric System for all NERC events. Well damped angular oscillation is defined as:

1. The Successive Positive Peak Ratio (SPPR) must be less than or equal to 0.95 where SPPR is calculated as:

$$\text{SPPR} = \frac{\text{Peak Rotor Angle of 2nd Positive Swing Peak}}{\text{Peak Rotor Angle of 1st Positive Swing Peak}} \leq 0.95$$

   Or, Damping Factor % = (1 – SPPR) x 100% ≥ 5%

The machine rotor angle damping ratio may be determined by appropriate modal analysis (i.e. Prony Analysis) where the following equivalent requirement must be met:

Damping Ratio ≥ 0.0081633

2. Successive Positive Peak Ratio Five (SPPR5) must be less than or equal to 0.774 where SPPR5 is calculated as follows:

$$\text{SPPR5} = \frac{\text{Peak Rotor Angle of 5th Positive Swing Peak}}{\text{Peak Rotor Angle of 1st Positive Swing Peak}} \leq 0.774$$

   Or, Damping Factor % = (1 – SPPR5) x 100% ≥ 22.6%

The machine rotor angle damping ratio may be determined by appropriate modal analysis (i.e. Prony Analysis) where the following equivalent requirement must be met:

Damping Ratio ≥ 0.0081633.

Burns & McDonnell only calculated these damping values where oscillations were not well damped by the end of the simulation through visual inspection.

2.1.2 Transient Voltage Recovery Requirement:

Any time after a disturbance is cleared; bus voltages on the Bulk Electric System shall not swing outside of the bandwidth of 0.70 per unit to 1.20 per unit. All post-transient voltages must fall between the 0.90 per unit and 1.10 per unit range at the end of simulations. The pre-fault voltages shall be checked to ensure they fall within the 0.90 per unit and 1.10 per unit.

2.2 Study System

The study system consisted of facilities at or above 100 kV within five (5) buses away from the POI. Machines within this study area were monitored for the study.

2.3 Study Models

The stability analysis was performed using models developed from the 2016 Southwest Power Pool (SPP) Model Development Working Group (MDWG) PSS/E models. The base cases provided by SPP model the 2017 Winter Peak, 2018 Summer Peak and 2026 Summer Peak study conditions. The cases were developed with all the interconnection requests added to the base case with dispatch adjustments made per SPP's supplied dispatch requirements.

A single-line diagram for GEN-2016-036, GEN-2016-087, GEN-2016-036, GEN-2016-092/GEN-2016-103 and GEN-2016-164 is provided in Figure 2-1, Figure 2-2, Figure 2-3 and Figure 2-4, respectively.

Figure 2-1: GEN-2016-036 Single-line Diagram

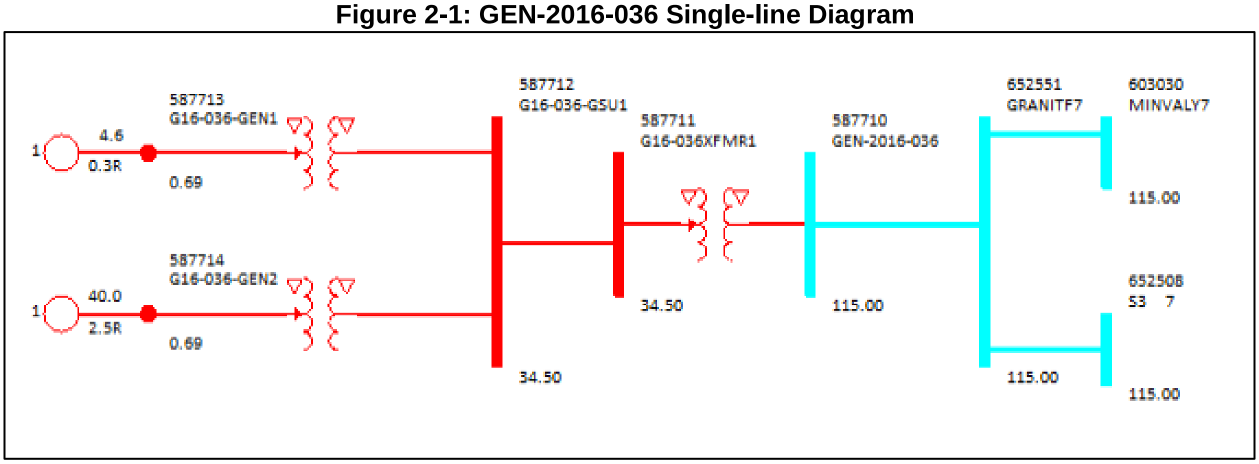


Figure 2-2: GEN-2016-087 Single-line Diagram

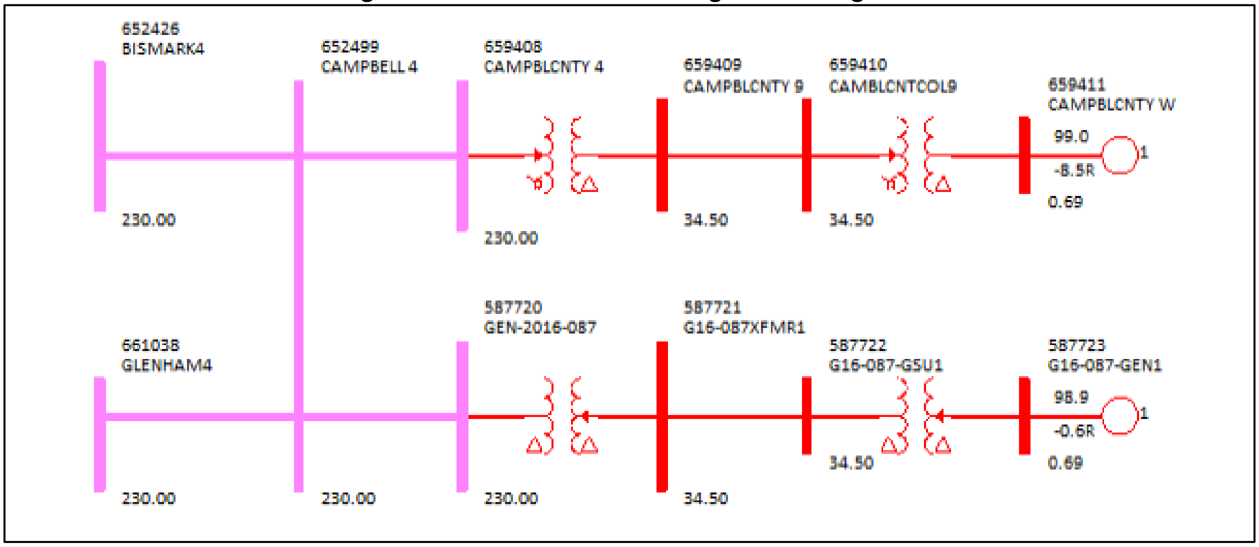


Figure 2-3: GEN-2016-092/GEN-2016-103 Single-line Diagram

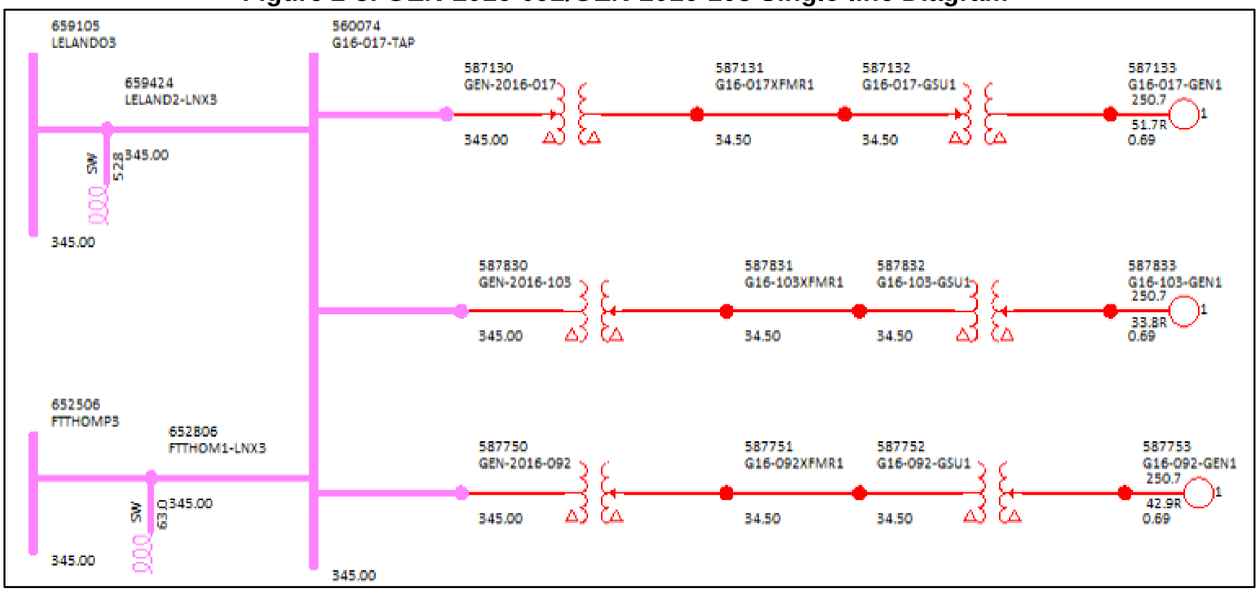
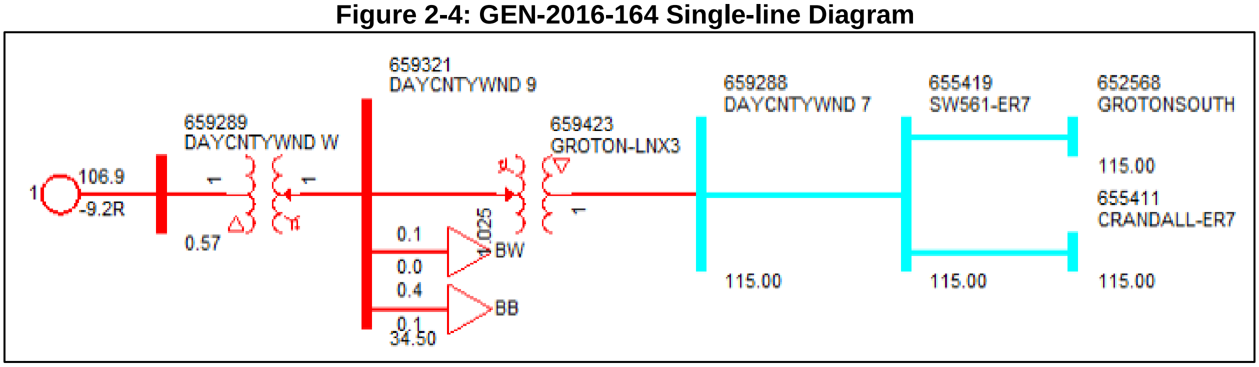


Figure 2-4: GEN-2016-164 Single-line Diagram



2.4 Prior Queued Projects

All study cases contained the Prior Queued Projects listed in Table 2-2 below.

Table 2-1: Prior Queued Projects

Request	Size (MW)	Generator Model	Point of Interconnection
G176	99	Wind	Yankee 115kV (603191)
G255	100.23	WT3 Generic Wind	Yankee 115kV (603191)
G586	30	Wind	Yankee 115kV (603191)
G736	200.48	GE 1.79MW	Big Stone South 230kV (620322)
H081	200	Vestas V110 2.0MW	Tap Brookings - Lyons County 345kV (601077)
J414	120	Vestas V110 2.0MW	Freeborn 161kV (631180)
J415	200	GE 2.3MW & 2.5MW WTG	Emery – Blackhawk 345kV (84151)
J432	98	Gamesa 2.0MW	Brookings 345kV (601031)
J436	150	Vestas V110 VCSS 2.0MW	Big Stone South-Ellendale 345kV (50416)
J437	150	Vestas V110 VCSS 2.0MW	Big Stone South-Ellendale 345kV (50416)
J439	500	Vestas V110 2.0MW	Obrien – Kossuth 345 kV line (84390)
J442	200	GE 2.0MW	Big Stone South 230 kV (620322)
J455	300	Vestas V110 2.0MW	Kossuth-Obrien 345 kV(55368)
J459	200	Vestas V110 2.0MW	Big Stone - Brookings 345kV (84590)
J460	200	Vestas V110 2.0MW	Tap Brookings - Lyons County 345kV (61041)
J485	46.85	GENSAL	West Side Substation (625447)
J488	151.8	GE WTG	Tap Big Stone - Ellendale 345kV (50416)
J489	151.8	GE WTG	Tap Big Stone - Ellendale 345kV (50416)
J493	150	Vestas V136 3.45MW	Big Stone - Brookings 345 kV Substation (71031)
J510	326.9	GENROU	Tap Brookings - Big Stone 345kV (71031)
J512	250.0	Vestas V110 2.0MW & V136 3.6MW	Nobles-Fenton 115kV (85121)
J523	50.0	Solar	Adams 161 kV (631122)
J525	50	Solar	Lake Wilson 69kV (618920)
J526	300	GE 2.5MW WTG	Tap Brookings - Big Stone 345kV (72031)
J529	250	Vestas V110 2.0MW	Obrien-Kossuth 345 kV (75368)
J569	100.0	Siemens 2.5MW WTG	Rock County 161kV (602039)
J575	100.0	GE 2.5MW WTG	Brookings County 345 kV (601031)
J577	102.8	GE 2.5MW WTG	Brookings County 345 kV (601031)
J587	200.0	Vestas V110 2.0MW	Brookings-H081 345kV (61041)
J590	90.0	Vestas V110 2.0MW	Obrien-Kossuth 345 kV (75368)
J594	150.0	Vestas V110 2.0MW	Jackson North 161kV (631210)
J596	100.0	Vestas V110 2.0MW	Morris-Moro 115kV ()
J597	300.0	Vestas V110 2.0MW	Brookings County 345kV (601031)
J614	66.0	Vestas V110 2.0MW	Rice 161kV (613330)
J637	98.0	Gamesa 2.0MW	Big Stone - Brookings 345 kV (86371)
J638	204.0	Gamesa 2.0MW	Big Stone - Brookings 345 kV (86371)
GEN-2002-009IS	40.5	WT3 Generic Wind	Fort Thompson 69kV (652276)
GEN-2003-016IS	120	GENROU	Groton 115kV (652512)
GEN-2006-008IS	97.4	GENROU	Groton 115kV (652512)
GEN-2007-004IS/GEN-2007-016IS	321	GENROU	White 345kV (652537)
GEN-2007-013IS/GEN-2007-	184	WT3 Generic Wind	Wessington Springs 230kV (652607)

Request	Size (MW)	Generator Model	Point of Interconnection
014IS/GEN-2010-003IS			
GEN-2007-023IS	49.5	WT3 Generic Wind	Formit-Summit 115kV (652522)
GEN-2009-001IS	200	GE 1.6MW	Groton-Watertown 345kV (652175)
GEN-2009-018IS	99	WT3 Generic Wind	Groton 115kV (652512)
GEN-2010-001IS	99	GENROU	Bismarck-Glenham 230kV (652499)
GEN-2012-014IS	100.34	WT3 Generic Wind	Groton 115kV (652512)
GEN-2013-001IS	89.7	Siemens 2.3MW	Summit-Watertown 115kV (652001)
GEN-2013-009IS	20.35	WT3 Generic Wind	Redfield NW 115kV (660015)
GEN-2014-001IS	103.7	GE 1.7MW	Newell-Maurine 115kV (652005)
ASGI-2016-005	20	GE 2.5MW	Tap White Lake - Stickeny 69kV (652252)
ASGI-2016-006	20	GE 2.5MW	Mitchall (660008)
ASGI-2016-007	20	GE 2.5MW	Kimball 69kV (652252)
GEN-2016-017	250.7	G.E. 2.3MW	Tap Fort Thompson (652806) – Leland olds (659105) 345kV, (G16-017-TAP, 560074)

3.0 STABILITY ANALYSIS

Burns & McDonnell performed stability analysis to identify impacts on the system stability resulting from the interconnection of DISIS-2016-002 (Group 15) requests.

3.1 Methodology

The Stability Analysis was performed using DISIS-2016-002 (Group 15) study cases. The power flow models and associated dynamics database were initialized (no-fault test) to confirm that there were no errors in the initial conditions of the system and the dynamic data. The dynamics model data for the DISIS-2016-002 (Group 15) requests is provided in Appendix A. The stability analysis was performed using PSS/E version 33.

During the fault simulations, the active power (PELEC), reactive power (QELEC), terminal voltage (ETERM), angle (ANGL) and speed (SPD) were monitored for the GEN-2016-036, GEN-2016-087, GEN-2016-092, GEN-2016-103 and GEN-2016-164 generation interconnection requests and prior queued projects listed in Table 1-1 and Table 2-2. The study area for the stability analysis is defined as five (5) buses away from the POI of each request. The machine rotor angle for synchronous machines and speed for asynchronous machines within this study area including those within 10 areas, 600 (XEL), 608 (MP), 613 (SMMPA), 615 (GRE), 620 (OTP), 640 (NPPD), 645 (OPPD), 650 (LES), 652 (WAPA) and 661 (MDU) were monitored. In addition, the voltages of all 100 kV and above buses within the study area were monitored.

3.2 Fault Definitions

Burns & McDonnell developed fault description for one hundred (100) normal clearing, stuck breaker, and prior outage contingency events. All contingency events studied are listed in Table 3-1, Table 3-2, Table 3-3 and Table 3-4 for local fault on GEN-2016-036, GEN-2016-087, GEN-2016-036, GEN-2016-092/GEN-2016-103 and GEN-2016-164, respectively. These contingencies were applied for the 2017 Winter Peak, 2018 Summer Peak and 2026 Summer Peak study models.

Table 3-1: Fault Definitions for GEN-2016-036

Fault Name	Contingency (Fault) Description
036FLT02_R-3PH	**3 Phase Fault on Granite Falls (652551) 115 kV Bus to Canby (620211) 115 kV Line, CKT 1**
	a. Apply Fault at the Granite Falls (652551) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652551-620211, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT03_R-3PH	**3 Phase Fault on Granite Falls (652551) 115 kV Bus to MinValley (603030) 115 kV Line, CKT 1**
	a. Apply Fault at the Granite Falls (652551) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652551-603030, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault

Fault Name	Contingency (Fault) Description
036FLT04_R-3PH	**3 Phase Fault on Granite Falls (652551) 115 kV Bus to S3 (652508) 115 kV Line, CKT 1**
	a. Apply Fault at the Granite Falls (652551) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652551-652508, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT07_R-3PH	**3 Phase Fault on Granite Falls (652550) 230 kV Bus to MinValley Tap (602008) 230 kV Line, CKT 1**
	a. Apply Fault at the Granite Falls (652550) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652550-602008, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT08_R-3PH	**3 Phase Fault on Granite Falls (652550) 230 kV Bus to MinValley Tap (602009) 230 kV Line, CKT 1**
	a. Apply Fault at the Granite Falls (652550) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652550-602009, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT09_R-3PH	**3 Phase Fault on Granite Falls (652550) 230 kV Bus to Appeldorn (652582) 230 kV Line, CKT 1**
	a. Apply Fault at the Granite Falls (652550) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652550-652582, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT10_R-3PH	**3 Phase Fault on Granite Falls (652550) 230 kV Bus to Morris (652554) 230 kV Line, CKT 1**
	a. Apply Fault at the Granite Falls (652550) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652550-652554, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT11_R-3PH	**3 Phase Fault on Granite Falls (652550) 230 kV Bus to Blair (652503) 230 kV Line, CKT 1**
	a. Apply Fault at the Granite Falls (652550) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652550-652503, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT12_R-3PH	**3 Phase Fault on Granite Falls (652550) 230 kV Bus to GRE-Willmarth (619975) 230 kV Line, CKT 1**
	a. Apply Fault at the Granite Falls (652550) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652550-619975, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT02-PO1	**Prior Outage: Granite Falls (652551) 115 kV Bus to MinValley (603030) 115 kV Line, CKT 1 (PO1)**
	3 Phase Fault on Granite Falls (652551) 115 kV Bus to Canby (620211) 115 kV Line, CKT 1
	a. Apply Fault at the Granite Falls (652551) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652551-620211, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT04-PO1	**Prior Outage: Granite Falls (652551) 115 kV Bus to MinValley (603030) 115 kV Line, CKT 1 (PO1)**
	3 Phase Fault on Granite Falls (652551) 115 kV Bus to S3 (652508) 115 kV Line, CKT 1
	a. Apply Fault at the Granite Falls (652551) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652551-652508, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT05-PO1	**Prior Outage: Granite Falls (652551) 115 kV Bus to MinValley (603030) 115 kV Line, CKT 1 (PO1)**
	3 Phase Fault on Granite Falls (652551) 115 kV Bus to Granite Falls (652550) 115/230 kV Transformer, CKT 2
	a. Apply Fault at the Granite Falls (652551) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115/230 kV Transformer (652551-652550, CKT 2)
036FLT06-PO1	**Prior Outage: Granite Falls (652551) 115 kV Bus to MinValley (603030) 115 kV Line, CKT 1 (PO1)**
	3 Phase Fault on Granite Falls (652551) 115 kV Bus to Granite Falls (652298) 115/69 kV Transformer, CKT 1
	a. Apply Fault at the Granite Falls (652551) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115/69 kV Transformer (652551-652298, CKT 1)
036FLT02-PO2	**Prior Outage: Granite Falls (652551) 115 kV Bus to Granite Falls (652550) 115/230 kV Transformer , CKT 1 (PO2)**
	3 Phase Fault on Granite Falls (652551) 115 kV Bus to Canby (620211) 115 kV Line, CKT 1
	a. Apply Fault at the Granite Falls (652551) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652551-620211, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault

Fault Name	Contingency (Fault) Description
036FLT03-PO2	**Prior Outage: Granite Falls (652551) 115 kV Bus to Granite Falls (652550) 115/230 kV Transformer , CKT 1 (PO2)**
	3 Phase Fault on Granite Falls (652551) 115 kV Bus to MinValley (603030)115 kV Line, CKT 1
	a. Apply Fault at the Granite Falls (652551) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652551-603030, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT04-PO2	**Prior Outage: Granite Falls (652551) 115 kV Bus to Granite Falls (652550) 115/230 kV Transformer , CKT 1 (PO2)**
	3 Phase Fault on Granite Falls (652551) 115 kV Bus to S3 (652508) 115 kV Line, CKT 1
	a. Apply Fault at the Granite Falls (652551) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652551-652508, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT05-PO2	**Prior Outage: Granite Falls (652551) 115 kV Bus to Granite Falls (652550) 115/230 kV Transformer, CKT 1 (PO2)**
	3 Phase Fault on Granite Falls (652551) 115 kV Bus to Granite Falls (652550) 115/230 kV Transformer, CKT 2
	a. Apply Fault at the Granite Falls (652551) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115/230 kV Transformer (652551-652550, CKT 2)
036FLT06-PO2	**Prior Outage: Granite Falls (652551) 115 kV Bus to Granite Falls (652550) 115/230 kV Transformer, CKT 1 (PO2)**
	3 Phase Fault on Granite Falls (652551) 115 kV Bus to Granite Falls (652298) 115/69 kV Transformer, CKT 1
	a. Apply Fault at the Granite Falls (652551) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115/69 kV Transformer (652551-652298, CKT 1)
036FLT07-PO3	**Prior Outage: Granite Falls (652550) 230 kV Bus to Blair (652503) 230 kV Line, CKT 1 (PO3)**
	3 Phase Fault on Granite Falls (652550) 230 kV Bus to MinValley Tap (602008) 230 kV Line, CKT 1
	a. Apply Fault at the Granite Falls (652550) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652550-602008, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT08-PO3	**Prior Outage: Granite Falls (652550) 230 kV Bus to Blair (652503) 230 kV Line, CKT 1 (PO3)**
	3 Phase Fault on Granite Falls (652550) 230 kV Bus to MinValley Tap (602009) 230 kV Line, CKT 1
	a. Apply Fault at the Granite Falls (652550) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652550-602009, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT09-PO3	**Prior Outage: Granite Falls (652550) 230 kV Bus to Blair (652503) 230 kV Line, CKT 1 (PO3)**
	3 Phase Fault on Granite Falls (652550) 230 kV Bus to Appeldorn (652582) 230 kV Line, CKT 1
	a. Apply Fault at the Granite Falls (652550) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652550-652582, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT10-PO3	**Prior Outage: Granite Falls (652550) 230 kV Bus to Blair (652503) 230 kV Line, CKT 1 (PO3)**
	3 Phase Fault on Granite Falls (652550) 230 kV Bus to Morris (652554) 230 kV Line, CKT 1
	a. Apply Fault at the Granite Falls (652550) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652550-652554, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT12-PO3	**Prior Outage: Granite Falls (652550) 230 kV Bus to Blair (652503) 230 kV Line, CKT 1 (PO3)**
	3 Phase Fault on Granite Falls (652550) 230 kV Bus to GRE-Willmar (619975) 230 kV Line, CKT 1
	a. Apply Fault at the Granite Falls (652550) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652550-619975, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
036FLT03-SB	**Single Phase Fault with Stuck Breaker on Granite Falls (652551) 115 kV Bus**
	a. Apply Fault at the Granite Falls (652551) 115 kV Bus
	b. Clear Fault after 16 Cycles and Trip the Following Elements:
	* Granite Falls to MinValley 115 kV Line (652551 - 603030)
	* Granite Falls to Granite Falls 115/230 kV Transformer (652551 - 652550)
036FLT10-SB	**Single Phase Fault with Stuck Breaker on Granite Falls (652550) 230 kV Bus**
	a. Apply Fault at the Granite Falls (652550) 230 kV Bus
	b. Clear Fault after 16 Cycles and Trip the Following Elements:
	* Granite Falls to Morris 230 kV Line (652550 - 652554)
	* Granite Falls 230/115 kV Transformer (652550 - 652551)

Fault Name	Contingency (Fault) Description
	* Granite Falls to Minnesota Valley 230 kV Line (652550 - 602009)
	* Granite Falls to AppelDorn 230 kV Line (652550 - 652582)
036FLT11-SB	**Single Phase Fault with Stuck Breaker on Granite Falls (652550) 230 kV Bus**
	a. Apply Fault at the Granite Falls (652550) 230 kV Bus
	b. Clear Fault after 16 Cycles and Trip the Following Elements:
	* Granite Falls to Blair 230 kV Line (652550 - 652503)
	* Granite Falls 230/115 kV Transformer (652550 - 652551)
	* Granite Falls to Minnesota Valley 230 kV Line (652550 - 602008)
	* Granite Falls to Willmar 230 kV Line (652550 - 619975)

Table 3-2: Fault Definitions for GEN-2016-087

Fault Name	Contingency (Fault) Description
087FLT03_R-3PH	**3 Phase Fault on Campbell (652499) 230 kV Bus to Bismark (652426) 230 kV Line, CKT 1**
	a. Apply Fault at the Campbell (652499) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652499-652426, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
087FLT04_R-3PH	**3 Phase Fault on Campbell (652499) 230 kV Bus to Glenham (661038) 230 kV Line, CKT 1**
	a. Apply Fault at the Campbell (652499) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652499-661038, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
087FLT05_R-3PH	**3 Phase Fault on Bismark (652426) 230 kV Bus to Ward (652296) 230 kV Line, CKT 1**
	a. Apply Fault at the Bismark (652426) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652426-652296, CKT 1)
	c. Wait Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
087FLT06_R-3PH	**3 Phase Fault on Bismark (652426) 230 kV Bus to Washburn (652456) 230 kV Line, CKT 1**
	a. Apply Fault at the Bismark (652426) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652426-652456, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
087FLT07_R-3PH	**3 Phase Fault on Bismark (652426) 230 kV Bus to Weber (659128) 230 kV Line, CKT 1**
	a. Apply Fault at the Bismark (652426) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652426-659128, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
087FLT08_R-3PH	**3 Phase Fault on Bismark (652426) 230 kV Bus to Jamestown (652444) 230 kV Line, CKT 1**
	a. Apply Fault at the Bismark (652426) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652426-652444, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
087FLT09_R-3PH	**3 Phase Fault on Bismark (652426) 230 kV Bus to Hilken (652466) 230 kV Line, CKT 1**
	a. Apply Fault at the Bismark (652426) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652426-652466, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
087FLT12_R-3PH	**3 Phase Fault on Glenham (661038) 230 kV Bus to Whitlock (652527) 230 kV Line, CKT 1**
	a. Apply Fault at the Glenham (661038) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (661038-652527, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
087FLT06-PO1	**Prior Outage: Campbell (652499) 230 kV Bus to Glenham (661038) 230 kV Line, CKT 1 (PO1)**
	3 Phase Fault on Bismark (652426) 230 kV Bus to Washburn (652456) 230 kV Line, CKT 1
	a. Apply Fault at the Bismark (652426) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652426-652456, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
087FLT08-PO1	**Prior Outage: Campbell (652499) 230 kV Bus to Glenham (661038) 230 kV Line, CKT 1 (PO1)**
	3 Phase Fault on Bismark (652426) 230 kV Bus to Jamestown (652444) 230 kV Line, CKT 1
	a. Apply Fault at the Bismark (652426) 230 kV Bus

Fault Name	Contingency (Fault) Description
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652426-652444, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
087FLT09-PO1	**Prior Outage: Campbell (652499) 230 kV Bus to Glenham (661038) 230 kV Line, CKT 1 (PO1)**
	3 Phase Fault on Bismark (652426) 230 kV Bus to Hilken (652466) 230 kV Line, CKT 1
	a. Apply Fault at the Bismark (652426) 230 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 230 kV Line (652426-652466, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
087FLT07-SB	**Single Phase Fault with Stuck Breaker on Bismark (652426) 230 kV Bus**
	a. Apply Fault at the Bismark (652426) 230 kV Bus
	b. Clear Fault after 16 Cycles and Trip the Following Elements:
	* Bismark to Weber 230 kV Line (652426 - 659128)
	* Bismark to Cambell County 230 kV Line (652426 - 652499)
	* Bismark 230/115 kV Transformer (652426 - 652427)
	* Bismark to Hilken 230 kV Line (652426 - 652466)
087FLT08-SB	**Single Phase Fault with Stuck Breaker on Bismark (652426) 230 kV Bus**
	a. Apply Fault at the Bismark (652426) 230 kV Bus
	b. Clear Fault after 16 Cycles and Trip the Following Elements:
	* Bismark to Washburn 230 kV Line (652426 - 652456)
	* Bismark to Ward 230 kV Line (652426 - 652296)
	* Bismark 230/115 kV Transformer (652426 - 652427)
	* Bismark to Jamestown 230 kV Line (652426 - 652444)
087FLT12-SB	**Single Phase Fault with Stuck Breaker on Glenham (661038) 230 kV Bus**
	a. Apply Fault at the Glenham (661038) 230 kV Bus
	b. Clear Fault after 16 Cycles and Trip the Following Elements:
	* Glenham to Whitlock 230 kV Line (661038-652527)
	* Glenham 230/115 kV Transformer (661038-661035, CKT 1)

Table 3-3: Fault Definitions for GEN-2016-092/GEN-2016-103

Fault Name	Contingency (Fault) Description
92-103FLT04_R-3PH	**3 Phase Fault on G16-017-Tap (560074) 345 kV Bus to Leland Olds (659105) 345 kV Line, CKT 1**
	a. Apply Fault at the G16-017-Tap (560074) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (560074-659105, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
92-103FLT05_R-3PH	**3 Phase Fault on G16-017-Tap (560074) 345 kV Bus to Fort Thompson (652506) 345 kV Line, CKT 1**
	a. Apply Fault at the G16-017-Tap (560074) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (560074-652506, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
92-103FLT07_R-3PH	**3 Phase Fault on Leland Olds (659105) 345 kV Bus to Antelope Valley (659101) 345 kV Line, CKT 2**
	a. Apply Fault at the Leland Olds (659105) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (659105-659101, CKT 2)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
92-103FLT10_R-3PH	**3 Phase Fault on Leland Olds (659105) 345 kV Bus to Groton (659160) 345 kV Line, CKT 1**
	a. Apply Fault at the Leland Olds (659105) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (659105-659160, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
92-103FLT11_R-3PH	**3 Phase Fault on Fort Thompson (652506) 345 kV Bus to Grand Prairie (652532) 345 kV Line, CKT 1**
	a. Apply Fault at the Fort Thompson (652506) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (652506-652532, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
92-103FLT13_R-3PH	**3 Phase Fault on Grand Prairie (652532) 345 kV Bus to Holt Co. (640510) 345 kV Line, CKT 1**

Fault Name	Contingency (Fault) Description
	a. Apply Fault at the Grand Prairie (652532) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (652532-640510, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
92-103FLT15_R-3PH	**3 Phase Fault on Antelope Valley (659101) 345 kV Bus to Broadland (659120) 345 kV Line, CKT 1**
	a. Apply Fault at the Antelope Valley (659101) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (659101-659120, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
92-103FLT11-PO1	**Prior Outage: G16-017-Tap (560074) 345 kV Bus to Leland Olds (659105) 345 kV Line, CKT 1 (PO1)**
	3 Phase Fault on Fort Thompson (652506) 345 kV Bus to Grand Prairie (652532) 345 kV Line, CKT 1
	a. Apply Fault at the Fort Thompson (652506) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (652506-652532, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
92-103FLT05-PO2*	**Prior Outage: G16-017-Tap (560074) 345 kV to Fort Thompson (652506) 345 kV Line, CKT 1 (PO2)**
	3 Phase Fault on G16-017-Tap (560074) 345 kV Bus to Fort Thompson (652506) 345 kV Line, CKT 2
	a. Apply Fault at the G16-017-Tap (560074) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (560074-652506, CKT 2)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
92-103FLT07-PO2*	**Prior Outage: G16-017-Tap (560074) 345 kV to Fort Thompson (652506) 345 kV Line, CKT 1 (PO2)**
	3 Phase Fault on Leland Olds (659105) 345 kV to Antelope Valley (659101) 345 kV Line, CKT 1
	a. Apply Fault at the Leland Olds (659105) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (659105-659101, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
92-103FLT09-PO2*	**Prior Outage: G16-017-Tap (560074) 345 kV Bus to Fort Thompson (652506) 345 kV Line, CKT 1 (PO2)**
	3 Phase Fault on Leland Olds (659105) 345 kV Bus to Leland Olds (659106) 345/230 kV Transformer, CKT 1
	a. Apply Fault at the Leland Olds (659105) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345/230 kV Transformer (659105-659106, CKT 1)
92-103FLT10-PO2*	**Prior Outage: G16-017-Tap (560074) 345 kV Bus to Fort Thompson (652506) 345 kV Line, CKT 1 (PO2)**
	3 Phase Fault on Leland Olds (659105) 345 kV Bus to Groton (659160) 345 kV Line, CKT 1
	a. Apply Fault at the Leland Olds (659105) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (659105-659160, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
92-103FLT04-PO3	**Prior Outage: G16-165-Tap (588344) to Holt County (640510) 345 kV Line, CKT 1 (PO3)**
	3 Phase Fault on G16-017-Tap (560074) 345 kV Bus to Leland Olds (659105) 345 kV Line, CKT 1
	a. Apply Fault at the G16-017-Tap (560074) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (560074-659105, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
92-103FLT07-SB	**Single Phase Fault with Stuck Breaker on Leland Olds (659105) 345 kV Bus**
	a. Apply Fault at the Leland Olds (659105) 345 kV Bus
	b. Clear Fault after 16 Cycles and Trip the Following Elements:
	* Leland Olds to Antelope Valley 345 kV Line (659105 - 659101)
	* Leland Olds to Leland Olds 345/230 kV Transformer (659105 - 659106 - 659202)
92-103FLT10-SB	**Single Phase Fault with Stuck Breaker on Leland Olds (659105) 345 kV Bus**
	a. Apply Fault at the Leland Olds (659105) 345 kV Bus
	b. Clear Fault after 16 Cycles and Trip the Following Elements:
	* Leland Olds 345/230 kV Transformer (659105 - 659106 - 659201)
	* Leland Olds to Groton 345 kV Line (659105 - 659160)
92-103FLT11-SB	**Single Phase Fault with Stuck Breaker on Fort Thompson (652506) 345 kV Bus**
	a. Apply Fault at the Fort Thompson (652506) 345 kV Bus
	b. Clear Fault after 16 Cycles and Trip the Following Elements:
	* Fort Thompson to Grand Prairie 345 kV Line (652506 - 652532)
	* Fort Thompson to Fort Thompson 345/230 kV Transformer (652506 - 652507)

*: With addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit.

Table 3-4: Fault Definitions for GEN-2016-164

Fault Name	Contingency (Fault) Description
164FLT01_R-3PH	**3 Phase Fault on Groton (652512) 115 kV Bus to Groton South (652568) 115 kV Line, CKT 1**
	a. Apply Fault at the Groton (652512) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652512-652568, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT02_R-3PH	**3 Phase Fault on Groton (652512) 115 kV Bus to Bristol (652533) 115 kV Line, CKT 1**
	a. Apply Fault at the Groton (652512) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652512-652533, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT04_R-3PH	**3 Phase Fault on Groton (652512) 115 kV Bus to Aberdeen (660001) 115 kV Line, CKT 1**
	a. Apply Fault at the Groton (652512) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652512-660001, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT07_R-3PH	**3 Phase Fault on Groton (652512) / Groton South (652568) 115 kV Bus to Ordway (652534) 115 kV Line, CKT 1**
	a. Apply Fault at the Groton (652512) / Groton South (652568) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652568-652534, CKT 2)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT09_R-3PH	**3 Phase Fault on Groton (652512) / Groton South (652568) 115 kV Bus to Redfield (652535) 115 kV Line, CKT 1**
	a. Apply Fault at the Groton (652512) / Groton South (652568) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652568-652535, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT12_R-3PH	**3 Phase Fault on Groton (569160) 345 kV Bus to G09_001IST (652175) 345 kV Line, CKT 1**
	a. Apply Fault at the Groton (569160) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (569160-652175, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT13_R-3PH	**3 Phase Fault on Groton (569160) 345 kV Bus to Leland Olds (659105) 345 kV Line, CKT 1**
	a. Apply Fault at the Groton (569160) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (569160-659105, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT14_R-3PH	**3 Phase Fault on G09_001IST (652175) 345 kV Bus to Watertown (652529) 345 kV Line, CKT 1**
	a. Apply Fault at the G09_001IST (652175) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (652175-652529, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT15_3PH	**3 Phase Fault on Groton (652512) / Groton South (652568) 115 kV Bus to Groton (659160) 115/345 kV Transformer, CKT 1**
	a. Apply Fault at the Groton (652512) / Groton South (652568) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted Transformer (652512/652568-659160, CKT 1)
164FLT07-PO1	**Prior Outage: Groton (652512) 115 kV Bus to Groton South (652568) 115 kV Line, CKT 1 (PO1)**
	3 Phase Fault on Groton South (652568) 115 kV Bus to Ordway (652534) 115 kV Line, CKT 1
	a. Apply Fault at the Groton (652512) / Groton South (652568) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652568-652534, CKT 2)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT09-PO1	**Prior Outage: Groton (652512) 115 kV Bus to Groton South (652568) 115 kV Line, CKT 1 (PO1)**
	3 Phase Fault on Groton South (652568) 115 kV Bus to Redfield (652535) 115 kV Line, CKT 1
	a. Apply Fault at the Groton South (652568) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652568-652535, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault

Fault Name	Contingency (Fault) Description
164FLT12-PO1	**Prior Outage: Groton (652512) 115 kV Bus to Groton South (652568) 115 kV Line, CKT 1 (PO1)**
	3 Phase Fault on Groton (569160) 345 kV Bus to G09_001IST (652175) 345 kV Line, CKT 1
	a. Apply Fault at the Groton (569160) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (569160-652175, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT13-PO1	**Prior Outage: Groton (652512) 115 kV Bus to Groton South (652568) 115 kV Line, CKT 1 (PO1)**
	3 Phase Fault on Groton (569160) 345 kV Bus to Leland Olds (659105) 345 kV Line, CKT 1
	a. Apply Fault at the Groton (569160) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (569160-659105, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT14-PO1	**Prior Outage: Groton (652512) 115 kV Bus to Groton South (652568) 115 kV Line, CKT 1 (PO1)**
	3 Phase Fault on G09_001IST (652175) 345 kV Bus to Watertown (652529) 345 kV Line, CKT 1
	a. Apply Fault at the G09_001IST (652175) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (652175-652529, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT15-PO1	**Prior Outage: Groton (652512) 115 kV Bus to Groton South (652568) 115 kV Line, CKT 1 (PO1)**
	3 Phase Fault on Groton South (652568) 115 kV Bus to Groton (659160) 115/345 kV Transformer, CKT 1
	a. Apply Fault at the Groton South (652568) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted Transformer (652568-659160, CKT 1)
164FLT01-PO2	**Prior Outage: Groton (652512) / Groton South (652568) 115 kV Bus to Groton (659160) 115/345 kV Transformer, CKT 1 (PO2)**
	3 Phase Fault on Groton South (652568) 115 kV Bus to Groton (652512) 115 kV Line, CKT 1
	a. Apply Fault at the Groton South (652568) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652568-652512, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT07-PO2	**Prior Outage: Groton (652512) / Groton South (652568) 115 kV Bus to Groton (659160) 115/345 kV Transformer, CKT 1 (PO2)**
	3 Phase Fault on Groton (652512) / Groton South (652568) 115 kV Bus to Ordway (652534) 115 kV Line, CKT 2
	a. Apply Fault at the Groton South (652568) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652568-652534, CKT 2)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT09-PO2	**Prior Outage: Groton (652512) / Groton South (652568) 115 kV Bus to Groton (659160) 115/345 kV Transformer, CKT 1 (PO2)**
	3 Phase Fault on Groton (652512) / Groton South (652568) 115 kV Bus to Redfield (652535) 115 kV Line, CKT 1
	a. Apply Fault at the Groton South (652568) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652568-652535, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT13-PO2	**Prior Outage: Groton (652512) / Groton South (652568) 115 kV Bus to Groton (659160) 115/345 kV Transformer, CKT 1 (PO2)**
	3 Phase Fault on Groton (569160) 345 kV Bus to Leland Olds (659105) 345 kV Line, CKT 1
	a. Apply Fault at the Groton (569160) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (569160-659105, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT14-PO2	**Prior Outage: Groton (652512) / Groton South (652568) 115 kV Bus to Groton (659160) 115/345 kV Transformer, CKT 1 (PO2)**
	3 Phase Fault on G09_001IST (652175) 345 kV Bus to Watertown (652529) 345 kV Line, CKT 1
	a. Apply Fault at the G09_001IST (652175) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (652175-652529, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT01-PO3	**Prior Outage: G09_001IST (652175) 345 kV Bus to Watertown (652529) 345 kV Line, CKT 1 (PO3)**
	3 Phase Fault on Groton (652512) 115 kV Bus to Groton South (652568) 115 kV Line, CKT 1
	a. Apply Fault at the Groton (652512) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652512-652568, CKT 1)

Fault Name	Contingency (Fault) Description
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT02-PO3	**Prior Outage: G09_001IST (652175) 345 kV Bus to Watertown (652529) 345 kV Line, CKT 1 (PO3)**
	3 Phase Fault on Groton (652512) 115 kV Bus to Bristol (652533) 115 kV Line, CKT 1
	a. Apply Fault at the Groton (652512) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652512-652533, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT04-PO3	**Prior Outage: G09_001IST (652175) 345 kV Bus to Watertown (652529) 345 kV Line, CKT 1 (PO3)**
	3 Phase Fault on Groton (652512) 115 kV Bus to Aberdeen (660001) 115 kV Line, CKT 1
	a. Apply Fault at the Groton (652512) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652512-660001, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT07-PO3	**Prior Outage: G09_001IST (652175) 345 kV Bus to Watertown (652529) 345 kV Line, CKT 1 (PO3)**
	3 Phase Fault on Groton (652512) / Groton South (652568) 115 kV Bus to Ordway (652534) 115 kV Line, CKT 1
	a. Apply Fault at the Groton (652512) / Groton South (652568) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652568-652534, CKT 2)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT09-PO3	**Prior Outage: G09_001IST (652175) 345 kV Bus to Watertown (652529) 345 kV Line, CKT 1 (PO3)**
	3 Phase Fault on Groton (652512) / Groton South (652568) 115 kV Bus to Redfield (652535) 115 kV Line, CKT 1
	a. Apply Fault at the Groton (652512) / Groton South (652568) 115 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 115 kV Line (652568-652535, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT13-PO3	**Prior Outage: G09_001IST (652175) 345 kV Bus to Watertown (652529) 345 kV Line, CKT 1 (PO3)**
	3 Phase Fault on Groton (569160) 345 kV Bus to Leland Olds (659105) 345 kV Line, CKT 1
	a. Apply Fault at the Groton (569160) 345 kV Bus
	b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (569160-659105, CKT 1)
	c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
	d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
164FLT01-SB	**Single Phase Fault with Stuck Breaker on Groton (652512) 115 kV Bus**
	a. Apply Fault at the Groton (652512) 115 kV Bus
	b. Clear Fault after 16 Cycles and Trip the Following Elements:
	* Groton to Aberdeen 115 kV Line (652512 - 660001)
	* Groton to Bristol 115 kV Line (652512 - 652533)
	* Groton 115 kV Switched Shunts (652512)
	* Groton to Groton 115/69 kV Transformers (652512 - 652250 & 652512 - 652253)
164FLT12-SB	**Single Phase Fault with Stuck Breaker on Groton (659160) 345 kV Bus**
	a. Apply Fault at the Groton (659160) 345 kV Bus
	b. Clear Fault after 16 Cycles and Trip the Following Elements:
	* Groton to Leland Olds 345 kV Line (659160 - 659105)
	* Groton to G09_001IST 345 kV Line (659160 - 652175)
	* Groton 345/115 kV Transformer (659160 - 652568)
	* Groton 345 kV bus (659160)

Single-line-to-ground (SLG) fault impedance values were determined by applying a fault on the base case large enough to produce a 0.6 p.u. voltage value on the faulted bus. This SLG value was used for the SLG faults in stuck breaker fault.

3.3 Results

It is observed that addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit and curtailment of current study generation during Prior Outage of transmission circuits are required in order to maintain system reliability The relevant faults are 92-103FLT05, 92-103FLT05-PO2, 92-103FLT07-PO2, 92-103FLT09-PO2, 92-103FLT10-PO2 and 92-103FLT04-PO3, and all these faults are TPL-001-4 Category P6 Transmission Circuit Events except for 92-103FLT05 a P1 Event.

Table 3-5 summarizes result for the machine rotor angle damping requirement and transient voltage recovery criteria for all the faults studied. The dynamic stability plots are provided in Appendix B.

Table 3-5: Dynamic Stability Results

Fault	2017WP	2018SP	2026SP
036FLT02_R-3PH	Stable	Stable	Stable
036FLT03_R-3PH	Stable	Stable	Stable
036FLT04_R-3PH	Stable	Stable	Stable
036FLT07_R-3PH	Stable	Stable	Stable
036FLT08_R-3PH	Stable	Stable	Stable
036FLT09_R-3PH	Stable	Stable	Stable
036FLT10_R-3PH	Stable	Stable	Stable
036FLT11_R-3PH	Stable	Stable	Stable
036FLT12_R-3PH	Stable	Stable	Stable
036FLT02-PO1	Stable	Stable	Stable
036FLT04-PO1	Stable	Stable	Stable
036FLT05-PO1	Stable	Stable	Stable
036FLT06-PO1	Stable	Stable	Stable
036FLT02-PO2	Stable	Stable	Stable
036FLT03-PO2	Stable	Stable	Stable
036FLT04-PO2	Stable	Stable	Stable
036FLT05-PO2	Stable	Stable	Stable
036FLT06-PO2	Stable	Stable	Stable
036FLT07-PO3	Stable	Stable	Stable
036FLT08-PO3	Stable	Stable	Stable
036FLT09-PO3	Stable	Stable	Stable
036FLT10-PO3	Stable	Stable	Stable
036FLT12-PO3	Stable	Stable	Stable
036FLT03-SB	Stable	Stable	Stable
036FLT10-SB	Stable	Stable	Stable
036FLT11-SB	Stable	Stable	Stable
087FLT03_R-3PH	Stable	Stable	Stable
087FLT04_R-3PH	Stable	Stable	Stable
087FLT05_R-3PH	Stable	Stable	Stable
087FLT06_R-3PH	Stable	Stable	Stable
087FLT07_R-3PH	Stable	Stable	Stable
087FLT08_R-3PH	Stable	Stable	Stable
087FLT09_R-3PH	Stable	Stable	Stable
087FLT12_R-3PH	Stable	Stable	Stable
087FLT06-PO1	Stable	Stable	Stable
087FLT08-PO1	Stable	Stable	Stable
087FLT09-PO1	Stable	Stable	Stable
087FLT07-SB	Stable	Stable	Stable
087FLT08-SB	Stable	Stable	Stable
087FLT12-SB	Stable	Stable	Stable
92-103FLT04_R-3PH	Stable	Stable	Stable
92-103FLT05_R-3PH	Stable with addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit	Stable with addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit	Stable with addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit
92-103FLT07_R-3PH	Stable	Stable	Stable
92-103FLT10_R-3PH	Stable	Stable	Stable

Fault	2017WP	2018SP	2026SP
92-103FLT11_R-3PH	Stable	Stable	Stable
92-103FLT13_R-3PH	Stable	Stable	Stable
92-103FLT15_R-3PH	Stable	Stable	Stable
92-103FLT11-PO1	Stable	Stable	Stable
92-103FLT07-PO2*****	Stable with addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit	Stable with addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit	Stable with addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit
92-103FLT09-PO2*****	Stable with addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit	Stable with addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit	Stable with addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit
92-103FLT10-PO2*****	Stable with addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit	Stable with addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit	Stable with addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit
92-103FLT04-PO3	Stable with 200MW of curtailment	Stable with 200MW of curtailment	Stable with 200MW of curtailment
92-103FLT05-PO2*	Stable with 200MW of curtailment	Stable with 200MW of curtailment	Stable with 200MW of curtailment
92-103FLT07-SB	Stable	Stable	Stable
92-103FLT10-SB	Stable	Stable	Stable
92-103FLT11-SB	Stable	Stable	Stable
164FLT01_R-3PH	N/A	Stable	Stable
164FLT02_R-3PH	Stable	Stable	Stable
164FLT04_R-3PH	Stable	Stable	Stable
164FLT07_R-3PH	Stable	Stable	Stable
164FLT09_R-3PH	Stable	Stable	Stable
164FLT12_R-3PH	Stable	Stable	Stable
164FLT13_R-3PH	Stable	Stable	Stable
164FLT14_R-3PH	Stable	Stable	Stable
164FLT15_3PH	Stable	Stable	Stable
164FLT07-PO1	N/A	Stable	Stable
164FLT09-PO1	N/A	Stable	Stable
164FLT12-PO1	N/A	Stable	Stable
164FLT13-PO1	N/A	Stable	Stable
164FLT14-PO1	N/A	Stable	Stable
164FLT15-PO1	N/A	Stable	Stable
164FLT01-PO2	N/A	Stable	Stable
164FLT07-PO2	Stable	Stable	Stable
164FLT09-PO2	Stable	Stable	Stable
164FLT13-PO2	Stable	Stable	Stable
164FLT14-PO2	Stable	Stable	Stable
164FLT01-PO3	Stable	Stable	Stable
164FLT02-PO3	Stable	Stable	Stable
164FLT04-PO3	Stable	Stable	Stable
164FLT07-PO3	Stable	Stable	Stable
164FLT09-PO3	Stable	Stable	Stable
164FLT13-PO3	Stable	Stable	Stable
164FLT01-SB	N/A	Stable	Stable
164FLT12-SB	Stable	Stable	Stable

N/A: not applicable because of the network configuration;

*: with addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit.

4.0 SHORT CIRCUIT ANALYSIS

Burns & McDonnell performed short circuit analysis to identify impacts on the system resulting from the interconnection of DISIS-2016-002 (Group 15) requests. The analysis was performed using version 33 of the PTI PSS/E software. The following sections outline the methodology and results of the analysis.

4.1 Methodology

The short circuit analysis was performed using the 2018 and 2026 Summer Peak models. Three-phase fault currents were calculated for the 69 kV and above buses within 5 buses of generator's point of interconnection.

4.2 Short Circuit Analysis Results

Table 4-1 through Table 4-4 summarize the three-phase fault currents observed for facilities two buses away from each queue project for the 2018 and 2026 Summer Peak cases. Details of the fault current for facilities within 5 buses from the generator's point of interconnection is provided in Appendix C.

Table 4-1: 2018 & 2026 Summer Peak GEN-2016-036 Three-Phase Fault Currents

Bus Dist. From POI	BUS NUMBER	BUS NAME	Voltage (kV)	AREA	ZONE	3 Phase Fault Current (kA)	
						2018SP	2026SP
0	652551	GRANITF7	115	652	1604	17.386	17.493
1	603030	MINVALY7	115	600	606	16.387	16.458
1	620211	CANBY 7	115	620	648	3.890	4.109
1	652508	S3 7	115	652	1604	9.168	9.184
1	652550	GRANITF4	230	652	1604	12.995	13.082
1	652297	GRANITF9	13	652	1604	28.734	28.770
1	652292	GRANITF2	13	652	1604	25.909	25.939
1	652298	GRANITF8	69	652	1604	4.554	4.558
1	652288	GRANITE	13	652	1604	5.140	5.141
2	603177	MAYNARD7	115	600	603	7.223	7.234
2	603257	MINVALY	115	600	606	16.275	16.345
2	605045	MINNVAL8	69	600	606	9.420	9.433
2	613310	REDFLST7	115	600	631	6.429	6.435
2	602008	MINVALT4	230	600	606	12.861	12.944
2	605729	MN VLY6	13	600	606	25.935	25.956
2	605723	MN VLY5	13	600	606	19.020	19.031
2	620111	CANBY 9	41	620	648	2.555	2.585
2	620173	DAWS TP7	115	620	648	3.074	3.150
2	620212	BURR 7	115	620	648	3.558	3.832
2	652552	MARS ER7	115	652	1604	8.334	8.347
2	658072	ERIE RD7	115	600	1627	12.504	12.533
2	602009	MNVLTAP4	230	600	606	12.822	12.905
2	619975	GRE-WILL	230	615	643	5.189	5.223
2	652503	BLAIR 4	230	652	1604	9.876	9.927
2	652554	MORRIS 4	230	652	1605	4.811	4.803
2	652582	APPLEDOR	230	652	1604	7.103	7.130
2	617911	GRE-PNNC	69	615	643	3.315	3.316

Table 4-2: 2018 & 2026 Summer Peak GEN-2016-087 Three-Phase Fault Currents

Bus Dist. From POI	BUS NUMBER	BUS NAME	Voltage (kV)	AREA	ZONE	3 Phase Fault Current (kA)	
						2018SP	2026SP
0	652499	CAMPBELL	230	652	1605	4.636	4.645
1	652426	BISMARK4	230	652	1605	13.455	13.912
1	659408	CAMPBLCN	230	652	1628	4.212	4.219
1	661038	GLENHAM4	230	652	1636	4.864	4.871
2	652296	WARD 4	230	652	1628	11.833	12.269
2	652444	JAMESTN4	230	652	1605	8.267	8.351
2	652456	WASHBRN4	230	652	1605	10.024	10.074
2	652466	HILKEN 4	230	652	1604	8.489	8.575
2	659128	WEBER 4	230	652	1628	4.810	4.850
2	652427	BISMARK7	115	652	1605	14.200	14.865
2	652467	BISMARK2	12	652	1605	27.518	27.812
2	652392	BISMARK9	12	652	1605	27.518	27.812
2	659409	CAMPBLCN	34	652	1628	16.179	16.193
2	85991	J599	230	652	1636	3.934	3.937
2	652527	WHITLOK4	230	652	1604	4.861	4.863
2	661035	GLENHAM7	115	661	1636	4.705	4.708
2	661600	GLENHAM9	41	661	1636	6.131	6.132
2	655652	BIS EXPR	115	652	1628	14.200	14.865

Table 4-3: 2018 & 2026 Summer Peak GEN-2016-092/GEN-2016-103 Three-Phase Fault Currents

Bus Dist. From POI	BUS NUMBER	BUS NAME	Voltage (kV)	AREA	ZONE	3 Phase Fault Current (kA)	
						2018SP	2026SP
0	560074	G16-017-	345	652	1604	6.530	6.532
1	587130	GEN-2016	345	652	1604	6.474	6.476
1	652806	FTTHOM1-	345	652	1604	9.492	9.499
1	659424	LELAND2-	345	652	1628	16.770	16.810
1	652506	FTTHOMP3	345	652	1604	9.492	9.499
1	659105	LELANDO3	345	652	1628	16.770	16.810
1	652807	FTTHOM2-	345	652	1604	9.492	9.499
1	652507	FTTHOMP4	230	652	1604	20.541	20.564
1	659422	LELAND1-	345	652	1628	16.770	16.810
1	659106	LELANDO4	230	652	1628	22.973	23.043
2	587131	G16-017X	34	652	1604	24.372	24.374
2	652273	FTTHMP19	13	652	1604	26.018	26.021
2	652274	FTTHMP29	13	652	1604	26.019	26.021
2	588210	GEN-2016	345	652	1628	11.370	11.388
2	659101	ANTELOP3	345	652	1628	16.904	16.944
2	659111	LELAN32G	20	652	1629	128.583	128.642
2	659201	LELNDOLD	13	652	1628	33.989	34.000
2	659202	LELNDOLD	13	652	1628	26.411	26.415
2	652833	GRPRAR2-	345	652	1604	6.830	6.840
2	587764	G16-094-	230	652	1604	13.117	13.124
2	652276	FTTHOMP8	69	652	1604	4.427	4.427
2	652509	FTRANDL4	230	652	1604	11.031	11.054
2	652514	HURON 4	230	652	1604	10.828	10.848
2	652516	LAKPLAT4	230	652	1604	5.620	5.623
2	652519	OAHE 4	230	652	1604	14.216	14.222

Bus Dist. From POI	BUS NUMBER	BUS NAME	Voltage (kV)	AREA	ZONE	3 Phase Fault Current (kA)	
						2018SP	2026SP
2	652540	BIGBND14	230	652	1604	12.078	12.085
2	652541	BIGBND24	230	652	1604	12.001	12.008
2	652606	LETCHER4	230	652	1604	4.730	4.738
2	652607	WESSINGT	230	652	1604	6.813	6.818
2	659218	COTEAU	345	652	1628	16.904	16.944
2	659420	ANTELOP-	345	652	1628	16.904	16.944
2	659423	GROTON-L	345	652	1628	6.202	6.222
2	587030	GEN-2016	230	652	659	7.370	7.377
2	615901	GRE-STAN	230	615	643	16.684	17.008
2	652441	GARRISN4	230	652	1605	11.403	11.446
2	652456	WASHBRN4	230	652	1605	10.024	10.074
2	659108	LOGAN 4	230	652	1628	5.311	5.131
2	659110	LELAN41G	22	652	1629	85.322	85.356
2	659109	BASIN 7	115	652	1628	5.189	5.191
2	659200	BASIN 9	13	652	1628	13.865	13.866
2	652532	GR PRAIR	345	652	1604	6.830	6.840
2	659160	GROTON 3	345	652	1628	6.202	6.222
2	652832	GRPRAR1-	345	652	1604	6.830	6.840

Table 4-4: 2018 & 2026 Summer Peak GEN-2016-164 Three-Phase Fault Currents

Bus Dist. From POI	BUS NUMBER	BUS NAME	Voltage (kV)	AREA	ZONE	3 Phase Fault Current (kA)	
						2018SP	2026SP
0	652512	GROTON 7	115	652	1604	18.262	18.293
1	652250	GROTON18	69	652	1604	4.126	4.127
1	652253	GROTON2	69	652	1604	1.856	1.856
1	652533	BRISTOL7	115	652	1604	4.754	4.764
1	659028	G12_014I	115	652	1604	5.671	5.674
1	660001	ABDNSBT7	115	652	1634	7.608	7.610
1	652534	ORDWAY 7	115	652	1604	9.592	9.599
1	652535	REDFELD7	115	652	1604	4.111	4.112
1	655419	SW561-ER	115	652	1632	6.705	6.708
1	659275	GROTONB7	115	652	1628	17.749	17.777
1	659160	GROTON 3	345	652	1628	6.202	6.222
1	659161	GROTON 9	13	652	1628	24.235	24.242
1	659423	GROTON-L	345	652	1628	6.202	6.222
2	655256	FERNEY-E	69	652	1632	2.782	2.782
2	655267	GROTON-E	69	652	1632	2.267	2.267
2	655395	NWPS509-	69	652	1632	4.117	4.118
2	652289	BRISTOL8	69	652	1604	2.758	2.760
2	652522	SUMMIT-7	115	652	1604	5.261	5.316
2	659029	G12_014I	34	652	1604	9.635	9.636
2	660000	ABDNJCT7	115	652	1634	5.582	5.584
2	660002	REDFLD 7	115	652	1634	4.195	4.196
2	580101	GI-0723I	115	652	1604	5.261	5.316
2	652290	ORDWAY 8	69	652	1604	5.495	5.497
2	652432	EDGELEY7	115	652	1605	4.030	4.032
2	652291	REDFELD8	69	652	1604	2.804	2.804
2	652515	HURON 7	115	652	1604	15.029	15.046
2	655411	CRANDALL	115	652	1632	6.419	6.421
2	659288	DAYCNTYW	115	652	1628	5.238	5.239

Bus Dist. From POI	BUS NUMBER	BUS NAME	Voltage (kV)	AREA	ZONE	3 Phase Fault Current (kA)	
						2018SP	2026SP
2	659272	GROTON	13	652	1629	65.189	65.203
2	659274	GROTON	13	652	1629	65.189	65.203
2	652175	G09_001I	345	652	659	6.369	6.402
2	659422	LELAND1-	345	652	1628	16.770	16.810
2	659105	LELANDO3	345	652	1628	16.770	16.810
2	659424	LELAND2-	345	652	1628	16.770	16.810
2	659106	LELANDO4	230	652	1628	22.973	23.043

5.0 CONCLUSIONS

The purpose of this study was to evaluate the impacts of the DISIS-2016-002 (Group 15) generation interconnection projects on the SPP transmission system. Short circuit analysis and stability analysis were performed for the evaluation.

For stability analysis, it is observed that addition of GEN-2016-017-Tap to Ft. Thompson 345kV 2nd circuit and curtailment of current study generation during Prior Outage of transmission circuits are required in order to maintain system reliability. The relevant faults are 92-103FLT05, 92-103FLT05-PO2, 92-103FLT07-PO2, 92-103FLT09-PO2, 92-103FLT10-PO2 and 92-103FLT04-PO3, and all these faults are TPL-001-4 Category P6 Transmission Circuit Events except for 92-103FLT05 a P1 Event.

The short circuit analysis evaluated the system for the 2018 and 2026 Summer Peak cases. Three-phase fault currents were calculated for the 69 kV and above buses within 5 buses of generator's point of interconnection.

It should be noted that the results of this study are based on available data and assumptions made at the time of this study. If any of the data and/or assumptions change, the results provided in this report may not apply.

CREATE AMAZING.

Burns & McDonnell World Headquarters
9400 Ward Parkway
Kansas City, MO 64114
O 816-333-9400
F 816-333-3690
www.burnsmcd.com

J16: GROUP 16 DYNAMIC STABILITY ANALYSIS REPORT

Southwest Power Pool Inc. (SPP)

Definitive Impact Study

DISIS-2016-002 (Group 16)

Draft Report Submitted to
Southwest Power Pool Inc.
August 2018

POWER-tek Global Inc.
Mississauga, Ontario, L4Z 1H8 Canada
647 300 3160
info@powertek-usa.com, www.powertek-usa.com

TABLE OF CONTENTS

1. Executive Summary

The DISIS-2016-002 (Group 16) Impact Study is a generation interconnection study performed by POWER-tek Global Inc. for Southwest Power Pool (SPP). This report presents the results of impact study comprising of short circuit and stability analyses for the proposed interconnection projects under DISIS-2016-002 (Group 16) ("The Projects") as described in Table 1.1 below:

Table 1.1: Interconnection Request

Request	Size (MW)	Generator Model	Point of Interconnection (POI)
GEN-2016-108	200	GE 2.5MW WTG (587863)	Tap Antelope Valley Substation (AVS)-Charlie Creek 345kV (587864)
GEN-2016-130	202	GE 2.0MW WTG (588213)	Leland Olds 345kV (659105)
GEN-2016-151	202	GE 2.0MW WTG (588283)	Tande 345kV Sub (659336)
GEN-2016-152	102	GE 2.0MW WTG (588293)	Tande 345kV Sub (659336)
GEN-2016-155	103.68 (1.28MW uprate of GEN-2007-015IS)	GE 1.62MW WTG (659366)	Hilken 230kV switching station (652466)

Short circuit analysis up to 5 Buses away from each point of interconnection (POI) and transient stability simulations were performed for the Projects in service at its full output. SPP provided three base cases for Winter-2017, Summer-2018, and Summer-2026, each comprising of a power flow, sequence data and corresponding dynamics database. The previous queued request projects were already modeled in the base cases.

Stability analysis results indicate system instability for several contingencies on the SPP system. The following transmission reinforcements were tested:

1. Addition of a 2nd 345/230kV transformer at Tande station
2. Addition of a new Emmons County 345kV substation along Antelope Valley Station to Broadland 345kV (500kV) and Fort Thompson to Leland Olds 345kV circuits
3. Addition of a new McIntosh County 345kV substation along Groton to Leland Olds 345kV circuit
4. Addition of a new approximately 45 mile Emmons County to McIntosh County 345kV circuit
5. Upgrade Broadland 345kV (500kV) to Huron 230kV transformer

With the above transmission reinforcements there are no impacts on the stability performance of the SPP system during cluster scenarios for the contingencies tested on the provided base cases. For all contingencies evaluated, the study machines stayed on-line and stable for all simulated faults. The project stability simulations specified test disturbances did not show instability problems in the SPP system. Any oscillations were damped out.

2. Introduction

2.1. Project Overview and Assumptions

The DISIS-2016-002 (Group 16) Impact Study is a generation interconnection study performed by POWER-tek Global Inc. for SPP. This report presents the results of impact study comprising of short circuit analysis and stability analyses for the proposed interconnection projects under DISIS-2016-002 (Group 16) ("The Projects") as described in Table 2.1.1 below:

Table 2.1.1: Interconnection requests

Request	Size (MW)	Generator Model	Point of Interconnection (POI)
GEN-2016-108	200	GE 2.5MW WTG (587863)	Tap Antelope Valley Substation (AVS)-Charlie Creek 345kV (587864)
GEN-2016-130	202	GE 2.0MW WTG (588213)	Leland Olds 345kV (659105)
GEN-2016-151	202	GE 2.0MW WTG (588283)	Tande 345kV Sub (659336)
GEN-2016-152	102	GE 2.0MW WTG (588293)	Tande 345kV Sub (659336)
GEN-2016-155	103.68 (1.28MW uprate of GEN-2007-015IS)	GE 1.62MW WTG (659366)	Hilken 230kV switching station (652466)

Figure 2.1.1, 2.1.2, 2.1.3, and 2.1.4, shows the single line diagram for the interconnection of the Projects to present and planned system of SPP. This arrangement was modeled and studied in power flow cases for these projects.

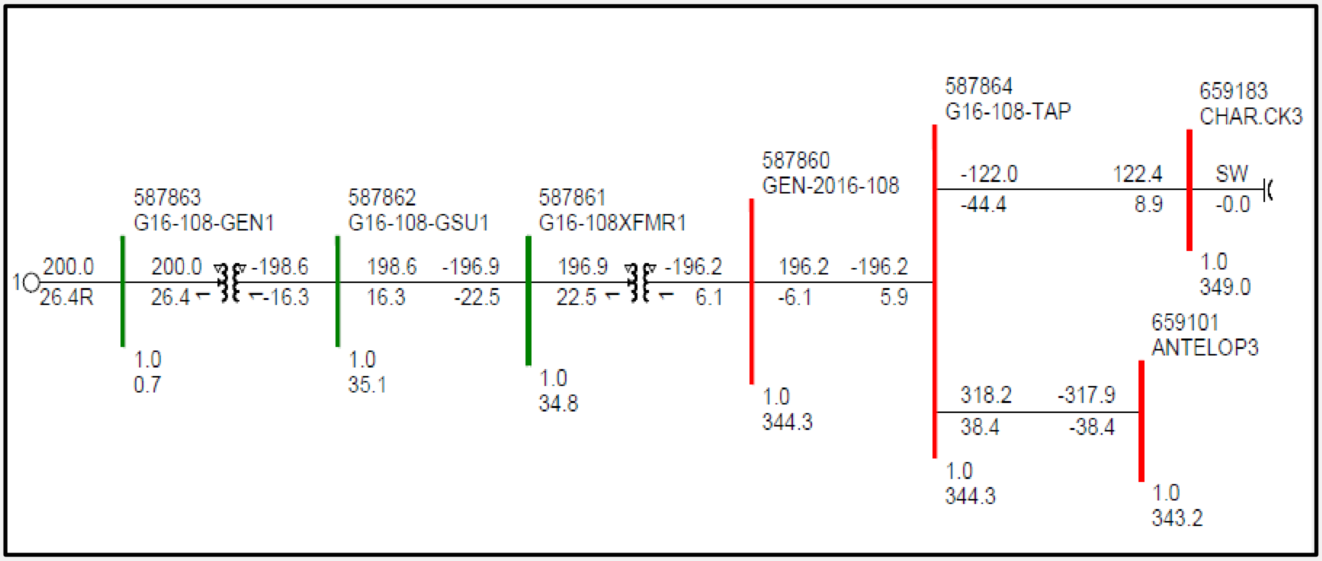


Figure 2.1.1: Power flow single line diagram for GEN-2016-108 and surrounding system components

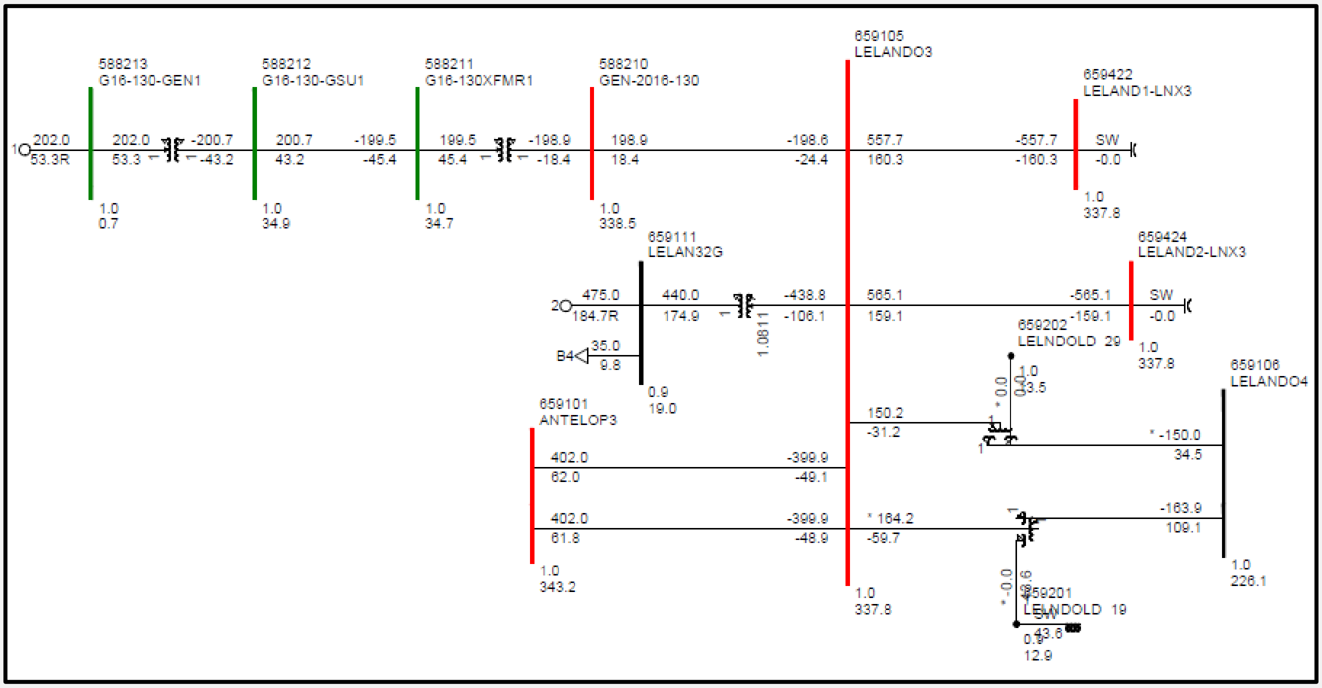


Figure 2.1.2: Power flow single line diagram for GEN-2016-130 and surrounding system components

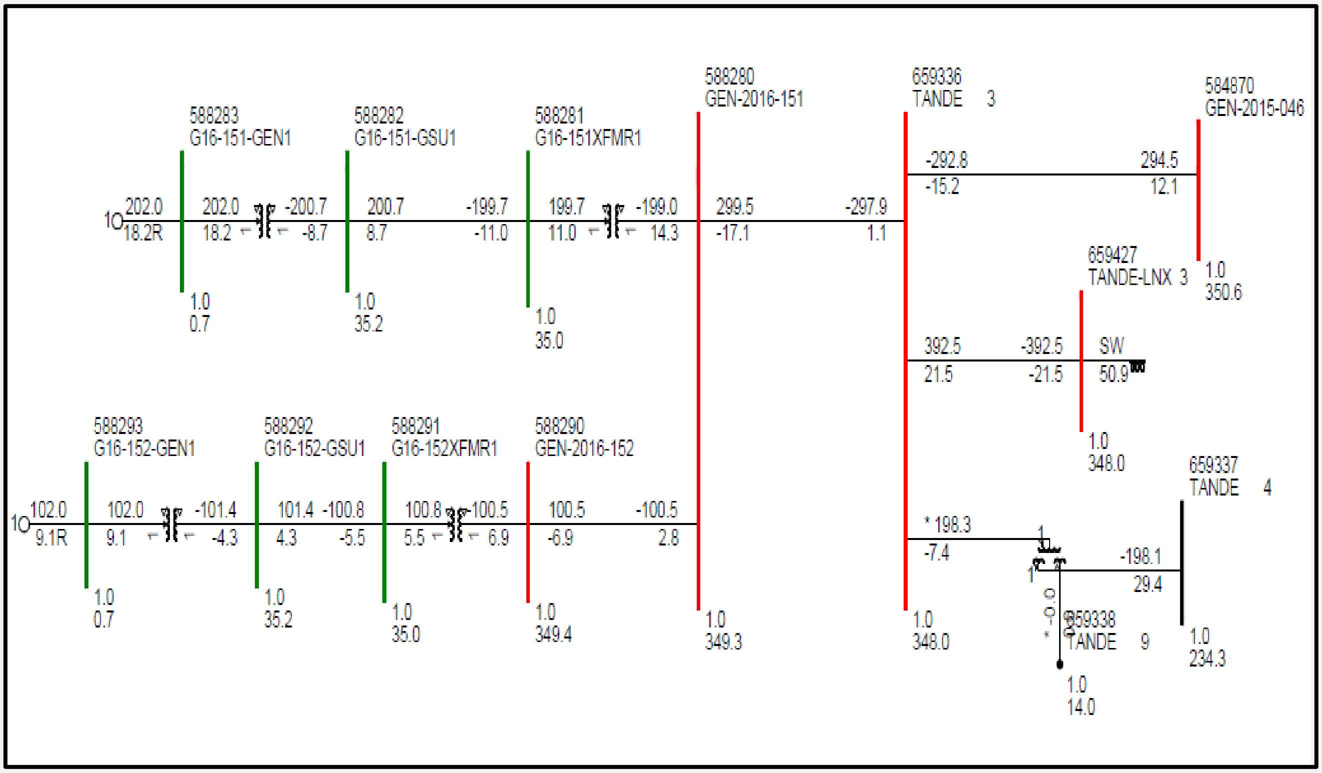


Figure 2.1.3: Power flow single line diagram for GEN-2016-151 and GEN-2016-152 and surrounding system components

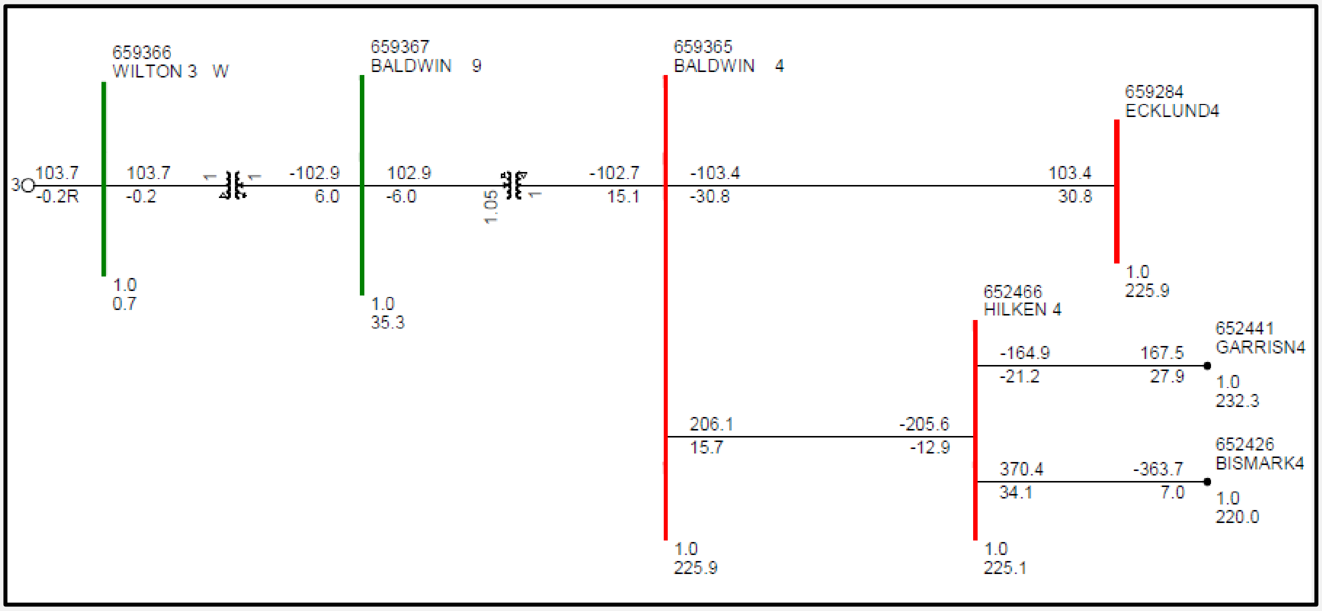


Figure 2.1.4: Power flow single line diagram for GEN-2016-155 and surrounding system components

Appendix-D contains the machines, interconnection, and machines user model parameters.

Table 2.1.2 below shows the list of prior queued projects modeled in the base case.

Table 2.1.2: List of previous queued request projects

Request	Size (MW)	Wind Turbine Model	Point of Interconnection
Coyote	453	GENROU	Coyote 345kV (661016)
G380	149.1	Suzlon S88 2.1MW	Rugby 115kV (620379)
G408	11.88	WT1 Generic Wind	Tap McHenry - Souris 115kV (605634)
G502	50.6	W4GUR Wind	Milton Young 230kV (657756)
G645/G788	102.6	GENROU	Ladish 115kV (620270)
G723	7	GENSAL	Heskett 115kV (661043)
G752	150	WT3 Generic Wind	Tap Bison - Hettinger 230kV (661047)
G830	99	GENCLS	GRE McHenry 115kV (615348)
J003	19.5	WT3 Generic Wind	Baker 115kV (661005)
J249	180	WT3 Generic Wind	MDU Tatanka 230kV (661096)
J262/J263	200	Vestas V100 2.0MW	Jamestown 345 (620269)
J290	150	Vestas V100 2.0MW	Tap Glenboro South - Rugby 230kV (602057)
J316	150	GE 1.7045MW	MDU 230 kV Tatanka-Ellendale line (11117)
J511	200	Vestas V110 2MW	Stanton 230kV (615901)
J593	224	Vestas V110 2MW	Tioga 4 230kV (661084)
MPC01300	455	GENROU	Square Butte 230kV (657756)
MPC02100	100	GE 2.0MW WTG	Center-Mandan 230kV (657741)
Young1	274	GENROU	Center 230kV (657751)
GEN-2005-008IS/GEN-2016-052	52.8	GE 1.6MW	Hilken 230kV [Ecklund 230kV] (652466)
GEN-2006-015IS/GEN-2016-053	52.8	GE 1.6MW	Hilken 230kV [Ecklund 230kV] (652466)
GEN-2007-015IS	102.4	GE 1.6MW WTG (659366)	Hilken 230kV [Ecklund 230kV] (652466)

Request	Size (MW)	Wind Turbine Model	Point of Interconnection
GEN-2009-026IS	106.5	GENROU	Dickenson-Heskett 230kV (652468)
GEN-2010-007IS	172.5	GENROU	Antelope Valley 345kV (659101)
GEN-2011-005IS/GEN-2012-005IS/GEN-2012-007IS	141	GENROU	Williston 115kV (652421)
GEN-2012-002IS	47	GENROU	Watford City 115/230kV (652408)
GEN-2012-004IS/GEN-2012-008IS	94	GENROU	Williston-Ch. Creek 230kV (652216)
GEN-2012-006IS	141	GENROU	Williston-Ch. Creek 230kV (659391)
GEN-2012-012IS	75	GE 2.678MW	Wolf Point-Circle 115kV (910007)
GEN-2014-003IS	91	GE 1.784MW	Culbertson 115kV (659262)
GEN-2014-004IS	384.2	GE 1.7MW	Charlie Creek 345kV (659183)
GEN-2014-006IS	113.3	GENSAL	Williston 115kV (659430)
GEN-2014-010IS	150	Vestas V110 VCSS 2.0MW	Neset 115kV (659139)
GEN-2014-014IS	149.73	GE 1.715/1.79MW	Belfield-Rhame 230kV (659448)
GEN-2015-046	300	Vestes V110 2.0MW	Tande 345kV (659336)
GEN-2015-096	149.03	GE 2.0MW	Tap Belfied - Rhame 230kV (659448)
GEN-2015-098	98.9	GE 2.3MW	Mingusville 230kV (652616)
GEN-2016-004	201.6	Vestas V110 VCSS 2.0MW, Vestas V136 3.6MW	Leland Olds 230kV (659106)

ATC (Available Transfer Capability) studies were not performed as part of this study. These studies will be required at the time transmission service is actually requested. Additional transmission upgrades may be required based on that analysis.

Study assumptions in general have been based on the specific information and data provided by SPP. The accuracy of the conclusions contained within this study is dependent on the assumptions made with respect to other generation additions and transmission improvements planned by other entities. Changes in the assumptions of the timing of other generation additions or transmission improvements may affect this study's conclusions.

2.2. Objectives

The objectives of the study are to determine the impact on system stability of interconnecting the proposed power plants to SPP's transmission system.

2.3. Models and Simulations Tools Used

Version 33.7 of the Siemens, PSS/E™ power system simulation program was used in this study.

SPP provided its latest stability database cases for Winter-2017, Summer-2018, and Summer-2026 peak seasons. The Project's PSS/E model had been developed prior to this study and was included in the power flow case and the dynamics database. Machines, interconnection and dynamic model data for the Project plants is provided in Appendix D.

Power flow single line diagram of the projects in summer 2018 peak condition is shown in Figure 2.1.1, 2.1.2, 2.1.3, and 2.1.4 respectively. These figures show that each wind farm model includes representation of the radial transmission line and the substation transformer. The remainder of each wind farm is represented by lumped equivalents including a generator, a step-up transformer, and collector system impedance.

No special modeling is required of line relays in these cases, except for the special modeling related to the wind-turbine tripping.

All generators in Areas 330, 356, 600, 615, 620, 635, 640, 645, 652, and 661 were monitored.

3. Short Circuit Analysis

The short circuit analysis out five buses away was performed for 2018 and 2026 summer peak cases for each interconnection request under project cluster scenario of DISIS-2016-002 (Group 16). No outage was assumed in the system model.

3.1. Short Circuit Result for 2018 Summer Peak Case

The short circuit results for summer-2018 scenario at the POI are tabulated below.

3.1.1. Short Circuit Result for Tap Antelope Valley Substation (AVS)-Charlie Creek 345kV (587864)

The results of the short circuit analysis for POI i.e., Tap Antelope Valley Substation (AVS)-Charlie Creek 345kV (587864) and five bus levels away are tabulated below in Table 3.1.1.

Table 3.1.1: Short circuit results for Tap Antelope Valley Substation (AVS)-Charlie Creek 345kV (587864)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
587864	G16-108-TAP 345.0	0 LEVELS AWAY	12370.4
587860	GEN-2016-108345.0	1 LEVELS AWAY	12153.2
659101	ANTELOP3 345.0	1 LEVELS AWAY	16879.4
659183	CHAR.CK3 345.0	1 LEVELS AWAY	10701.3
587861	G16-108XFMR134.50	2 LEVELS AWAY	23020
652424	BELFELD3 345.0	2 LEVELS AWAY	6491.7
659103	ANTEL31G 23.00	2 LEVEL AWAY	147084.1
659105	LELANDO3 345.0	2 LEVELS AWAY	16723.4
659107	ANTEL32G 23.00	2 LEVELS AWAY	147084.1
659124	G14_004IS_1 34.50	2 LEVELS AWAY	45563.9
659182	CHAR.CK7 115.0	2 LEVELS AWAY	14065.3
659211	CHARCREEK 1913.80	2 Level Away	23842.5
659212	DGC 3345.0	2 LEVELS AWAY	16066.7
659218	COTEAU 3345.0	2 LEVELS AWAY	16879.4
659302	CHAR.CK4 230.0	2 LEVELS AWAY	11347.2
659318	CHARCREEK 2913.80	2 LEVELS AWAY	23040.3
659319	CHARCREEK 3913.80	2 LEVELS AWAY	30568

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659384	ROUNDUP 3345.0	2 LEVELS AWAY	8791
659390	PATENTGATE 3345.0	2 LEVELS AWAY	6720.5
659404	ANTELPHILLS3345.0	2 LEVELS AWAY	11355.4
659420	ANTELOP-LNX3345.0	2 LEVELS AWAY	16879.4
587862	G16-108-GSU134.50	3 LEVELS AWAY	21771.3
588210	GEN-2016-130345.0	3 LEVELS AWAY	11349.3
652216	WATFORD4 230.0	3 LEVELS AWAY	6071.1
652220	BELFELD29 13.80	3 LEVELS AWAY	24524.7
652221	BELFELD9 13.80	3 LEVELS AWAY	22592.2
652419	KILDEER7 115.0	3 LEVELS AWAY	7795.6
652425	BELFELD4 230.0	3 LEVELS AWAY	8938
655833	GRSYBTTP-MK7115.0	3 LEVELS AWAY	13084.6
659106	LELANDO4 230.0	3 LEVELS AWAY	22934.6
659111	LELAN32G 20.00	3 LEVELS AWAY	128515.4
659125	G14_004IS_2 0.690	3 LEVELS AWAY	1883520.2
659184	R.RIDER7 115.0	3 LEVELS AWAY	4229.2
659185	FOUREYES 7115.0	3 LEVELS AWAY	3596.6
659201	LELNDOLD 1913.80	3 LEVELS AWAY	33985
659202	LELNDOLD 2913.80	3 LEVELS AWAY	26406.8
659214	DGC NB5301B913.80	3 LEVELS AWAY	26386.9
659215	DGC NB5302A913.80	3 LEVELS AWAY	17409.3
659219	COT 13.8T1 913.80	3 LEVELS AWAY	21668.5
659220	DGC NB5301A913.80	3 LEVELS AWAY	26081
659221	DGC NB5302B913.80	3 LEVELS AWAY	41143.6
659222	COTEAU1 869.00	3 LEVELS AWAY	9271.1
659231	COT 13.8T2 913.80	3 LEVELS AWAY	21520.5
659232	DGC________913.80	3 LEVELS AWAY	18493
659233	DGC 4230.0	3 LEVELS AWAY	7064.5
659333	JUDSON 3345.0	3 LEVELS AWAY	6245.7

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659385	ROUNDUP 7115.0	3 LEVELS AWAY	12580.6
659386	ROUNDUP 913.80	3 LEVELS AWAY	23280.6
659387	KUMMERRIDGE3345.0	3 LEVELS AWAY	3530.4
659391	PATENTGATE 7115.0	3 LEVELS AWAY	15257.4
659392	PATENTGATE1913.80	3 LEVELS AWAY	23540.7
659393	PATENTGATE2913.80	3 LEVELS AWAY	23540.7
659405	ANTELPHILLS934.50	3 LEVELS AWAY	22789.8
659421	BRDLAND-LNX3345.0	3 LEVELS AWAY	3987
659422	LELAND1-LNX3345.0	3 LEVELS AWAY	16723.4
659424	LELAND2-LNX3345.0	3 LEVELS AWAY	16723.4
560074	G16-017-TAP 345.0	4 LEVELS AWAY	6509.7
587030	GEN-2016-004230.0	4 LEVELS AWAY	7366.7
587863	G16-108-GEN10.690	4 LEVELS AWAY	909186.4
588211	G16-130XFMR134.50	4 LEVELS AWAY	25124.6
615901	GRE-STANTON4230.0	4 LEVELS AWAY	16682.1
652408	WATFORD7 115.0	4 LEVELS AWAY	7003.7
652413	MEDORA 4 230.0	4 LEVELS AWAY	4975.7
652417	DICKNSN4 230.0	4 LEVELS AWAY	6558.7
652422	HALIDAY7 115.0	4 LEVELS AWAY	4685.3
652441	GARRISN4 230.0	4 LEVELS AWAY	11400.3
652456	WASHBRN4 230.0	4 LEVELS AWAY	10018.2
652471	WATFORD9 13.20	4 LEVELS AWAY	16534.7
652472	WATFORD29 13.20	4 LEVELS AWAY	10916.2
655834	GRASSYBT-MK7115.0	4 LEVELS AWAY	6611.9
655835	LITTLKNF-MK7115.0	4 LEVELS AWAY	6982.5
655844	TIMBERCK-MK7115.0	4 LEVELS AWAY	8535.7
655850	IDEAL -MK7115.0	4 LEVELS AWAY	10282.3
655851	NRTHWEST-MK7115.0	4 LEVELS AWAY	10858.4
655853	BEARCREK-MK7115.0	4 LEVELS AWAY	9502.9

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
655856	G8 -MK7115.0	4 LEVELS AWAY	6596.7
655891	KILLDEER-MK7115.0	4 LEVELS AWAY	7726.2
655893	DUNNCENTRMK7115.0	4 LEVELS AWAY	4967.7
659108	LOGAN 4 230.0	4 LEVELS AWAY	5309.9
659109	BASIN 7 115.0	4 LEVELS AWAY	5187.9
659110	LELAN41G 22.00	4 LEVELS AWAY	85302.2
659120	BRDLAND3 345.0	4 LEVELS AWAY	3987
659129	NBCS5 KLDR1G13.80	4 LEVELS AWAY	6118.3
659181	BICNTNL7 115.0	4 LEVELS AWAY	3269.7
659200	BASIN 9 13.80	4 LEVELS AWAY	13863.7
659226	DGC 3001B 913.80	4 LEVELS AWAY	25140.8
659227	DGC 3004B 913.80	4 LEVELS AWAY	25735.1
659228	DGC 1452 913.80	4 LEVELS AWAY	20518.4
659229	DGC 1721 913.80	4 LEVELS AWAY	21954.9
659234	DGC NB5301E913.80	4 LEVELS AWAY	20759.1
659235	DGC NB5301D913.80	4 LEVELS AWAY	14129.1
659236	DGC UREA 869.00	4 LEVELS AWAY	6976.6
659309	S HEART 4230.0	4 LEVELS AWAY	8938
659334	JUDSON 4230.0	4 LEVELS AWAY	8044.3
659335	JUDSON 913.80	4 LEVELS AWAY	34436.5
659349	LSSSWTCHST 7115.0	4 LEVELS AWAY	11501.4
659368	TIMBERCREEK4230.0	4 LEVELS AWAY	6125
659388	KUMMERRIDGE7115.0	4 LEVELS AWAY	8304.1
659389	KUMMERRIDG1913.80	4 LEVELS AWAY	20516.9
659394	KUMMERRIDG2913.80	4 LEVELS AWAY	20516.9
659406	ANTELPHLCOL934.50	4 LEVELS AWAY	21188.9
659423	GROTON-LNX3 345.0	4 LEVELS AWAY	5484.1
659427	TANDE-LNX 3345.0	4 LEVELS AWAY	5396.3
659448	DAGLUM 4230.0	4 LEVELS AWAY	6133.3

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
85111	J511 230.0	5 LEVELS AWAY	6618.8
587031	G16-004XFMR134.50	5 LEVELS AWAY	22913.9
587130	GEN-2016-017345.0	5 LEVELS AWAY	6453.8
587750	GEN-2016-092345.0	5 LEVELS AWAY	6453.9
587830	GEN-2016-103345.0	5 LEVELS AWAY	6454.9
588212	G16-130-GSU134.50	5 LEVELS AWAY	24489.6
615600	GRE-COAL CR4230.0	5 LEVELS AWAY	16874.6
615900	GRE-COAL TP4230.0	5 LEVELS AWAY	14548.3
652325	WASHBRN9 41.80	5 LEVELS AWAY	3159.9
652400	WILISTN4 230.0	5 LEVELS AWAY	8376.1
652418	DKSN-ND7 115.0	5 LEVELS AWAY	5867.7
652420	NSALEM 7 115.0	5 LEVELS AWAY	1808.5
652426	BISMARK4 230.0	5 LEVELS AWAY	13451.4
652442	GARRISN7 115.0	5 LEVELS AWAY	12798.7
652444	JAMESTN4 230.0	5 LEVELS AWAY	8261.7
652457	GARISN1G 13.80	5 LEVELS AWAY	60365.8
652458	GARISN2G 13.80	5 LEVELS AWAY	60333.6
652459	GARISN3G 13.80	5 LEVELS AWAY	60301.5
652466	HILKEN 4 230.0	5 LEVELS AWAY	8490
652468	HEBRON 4 230.0	5 LEVELS AWAY	5092.7
652616	MINGUSVILLE4230.0	5 LEVELS AWAY	3826.4
652806	FTTHOM1-LNX3345.0	5 LEVELS AWAY	9426.7
655836	OAKDALE -MK7115.0	5 LEVELS AWAY	7834.4
655838	INDIANHL-MK7115.0	5 LEVELS AWAY	5858.8
655840	CHRRYCRK-MK7115.0	5 LEVELS AWAY	7003.7
655842	HAYBUTTE-MK7115.0	5 LEVELS AWAY	8215.4
655845	GARDENCK2MK7115.0	5 LEVELS AWAY	4831.8
655846	F9 -MK7115.0	5 LEVELS AWAY	4075.5
655848	KEENETAP-MK7115.0	5 LEVELS AWAY	6291.1

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
655863	HILAND -MK7115.0	5 LEVELS AWAY	5190.8
655881	DAP -MK7115.0	5 LEVELS AWAY	7625.6
655882	GALAXYTP-MK7115.0	5 LEVELS AWAY	7075.2
655886	KEENE -MK7115.0	5 LEVELS AWAY	6419
655889	LCGASPLT-MK7115.0	5 LEVELS AWAY	7973.2
655892	ALEXANDR-MK7115.0	5 LEVELS AWAY	7632.2
655894	HALLIDAY-MK7115.0	5 LEVELS AWAY	3536
655897	COYOTCHARMK7115.0	5 LEVELS AWAY	5393.7
657756	SQBUTTE4 230.0	5 LEVELS AWAY	20507.3
659143	BLAISDELL 4230.0	5 LEVELS AWAY	5090.7
659155	LOGAN 7 115.0	5 LEVELS AWAY	8851.4
659160	GROTON 3 345.0	5 LEVELS AWAY	5484.1
659191	SQUAWGP7 115.0	5 LEVELS AWAY	3257.3
659197	DICKNSON 913.80	5 LEVELS AWAY	15035.1
659204	BROADLAND 913.80	5 LEVELS AWAY	22950.6
659205	BRDLAND4 230.0	5 LEVELS AWAY	9724.4
659208	LOGAN 913.80	5 LEVELS AWAY	19630
659266	RHAME 4 230.0	5 LEVELS AWAY	3989.6
659306	S HEART 7115.0	5 LEVELS AWAY	2191.3
659336	TANDE 3345.0	5 LEVELS AWAY	5396.3
659348	LNSMCK1+3GN7115.0	5 LEVELS AWAY	11501.4
659407	ANTELPHILLSW0.690	5 LEVELS AWAY	844902.8
659450	BRADYWND 4230.0	5 LEVELS AWAY	3417.6
661008	BEULAH 7 115.0	5 LEVELS AWAY	9614

3.1.2. Short Circuit Result for Leland Olds 345kV (659105)

The results of the short circuit analysis for POI i.e., Leland Olds 345kV (659105) and five bus levels away are tabulated below in Table 3.1.2.

Table 3.1.2: Short circuit results for Leland Olds 345kV (659105)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659105	LELANDO3 345.0	0 LEVELS AWAY	16723.4
588210	GEN-2016-130345.0	1 LEVELS AWAY	11349.3
659101	ANTELOP3 345.0	1 LEVELS AWAY	16879.4
659106	LELANDO4 230.0	1 LEVELS AWAY	22934.6
659111	LELAN32G 20.00	1 LEVELS AWAY	128515.4
659201	LELNDOLD 1913.80	1 LEVELS AWAY	33985
659202	LELNDOLD 2913.80	1 LEVELS AWAY	26406.8
659422	LELAND1-LNX3345.0	1 LEVELS AWAY	16723.4
659424	LELAND2-LNX3345.0	1 LEVELS AWAY	16723.4
560074	G16-017-TAP 345.0	2 LEVELS AWAY	6509.7
587030	GEN-2016-004230.0	2 LEVELS AWAY	7366.7
587864	G16-108-TAP 345.0	2 LEVELS AWAY	12370.4
588211	G16-130XFMR134.50	2 LEVELS AWAY	25124.6
615901	GRE-STANTON4230.0	2 LEVELS AWAY	16682.1
652441	GARRISN4 230.0	2 LEVELS AWAY	11400.3
652456	WASHBRN4 230.0	2 LEVELS AWAY	10018.2
659103	ANTEL31G 23.00	2 LEVELS AWAY	147084.1
659107	ANTEL32G 23.00	2 LEVELS AWAY	147084.1
659108	LOGAN 4 230.0	2 LEVEL AWAY	5309.9
659109	BASIN 7 115.0	2 LEVELS AWAY	5187.9
659110	LELAN41G 22.00	2 LEVELS AWAY	85302.2
659200	BASIN 9 13.80	2 LEVELS AWAY	13863.7
659212	DGC 3345.0	2 LEVELS AWAY	16066.7
659218	COTEAU 3345.0	2 LEVELS AWAY	16879.4
659384	ROUNDUP 3345.0	2 LEVELS AWAY	8791

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659404	ANTELPHILLS3345.0	2 LEVELS AWAY	11355.4
659420	ANTELOP-LNX3345.0	2 LEVELS AWAY	16879.4
659423	GROTON-LNX3 345.0	2 LEVELS AWAY	5484.1
85111	J511 230.0	3 LEVELS AWAY	6618.8
587031	G16-004XFMR134.50	3 LEVELS AWAY	22913.9
587130	GEN-2016-017345.0	3 LEVELS AWAY	6453.8
587750	GEN-2016-092345.0	3 LEVELS AWAY	6453.9
587830	GEN-2016-103345.0	3 LEVELS AWAY	6454.9
587860	GEN-2016-108345.0	3 LEVELS AWAY	12153.2
588212	G16-130-GSU134.50	3 LEVELS AWAY	24489.6
615600	GRE-COAL CR4230.0	3 LEVELS AWAY	16874.6
615900	GRE-COAL TP4230.0	3 LEVELS AWAY	14548.3
652325	WASHBRN9 41.80	3 LEVELS AWAY	3159.9
652420	NSALEM 7 115.0	3 LEVELS AWAY	1808.5
652426	BISMARK4 230.0	3 LEVELS AWAY	13451.4
652442	GARRISN7 115.0	3 LEVELS AWAY	12798.7
652444	JAMESTN4 230.0	3 LEVELS AWAY	8261.7
652457	GARISN1G 13.80	3 LEVELS AWAY	60365.8
652458	GARISN2G 13.80	3 LEVELS AWAY	60333.6
652459	GARISN3G 13.80	3 LEVELS AWAY	60301.5
652466	HILKEN 4 230.0	3 LEVELS AWAY	8490
652806	FTTHOM1-LNX3345.0	3 LEVELS AWAY	9426.7
657756	SQBUTTE4 230.0	3 LEVELS AWAY	20507.3
659143	BLAISDELL 4230.0	3 LEVELS AWAY	5090.7
659155	LOGAN 7 115.0	3 LEVELS AWAY	8851.4
659160	GROTON 3 345.0	3 LEVELS AWAY	5484.1
659183	CHAR.CK3 345.0	3 LEVELS AWAY	10701.3
659208	LOGAN 913.80	3 LEVELS AWAY	19630
659214	DGC NB5301B913.80	3 LEVELS AWAY	26386.9

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
659215	DGC NB5302A913.80	3 LEVELS AWAY	17409.3
659219	COT 13.8T1 913.80	3 LEVELS AWAY	21668.5
659220	DGC NB5301A913.80	3 LEVELS AWAY	26081
659221	DGC NB5302B913.80	3 LEVELS AWAY	41143.6
659222	COTEAU1 869.00	3 LEVELS AWAY	9271.1
659231	COT 13.8T2 913.80	3 LEVELS AWAY	21520.5
659232	DGC________913.80	3 LEVELS AWAY	18493
659233	DGC 4230.0	3 LEVELS AWAY	7064.5
659385	ROUNDUP 7115.0	3 LEVELS AWAY	12580.6
659386	ROUNDUP 913.80	3 LEVELS AWAY	23280.6
659405	ANTELPHILLS934.50	3 LEVELS AWAY	22789.8
659421	BRDLAND-LNX3345.0	3 LEVELS AWAY	3987
85112	J511 COL 34.50	4 LEVELS AWAY	21433.2
587032	G16-004-GSU134.50	4 LEVELS AWAY	20118.9
587035	G16-004-GSU234.50	4 LEVELS AWAY	21470.8
587131	G16-017XFMR134.50	4 LEVELS AWAY	24351.2
587751	G16-092XFMR134.50	4 LEVELS AWAY	24378.7
587831	G16-103XFMR134.50	4 LEVELS AWAY	24323.4
587861	G16-108XFMR134.50	4 LEVELS AWAY	23020
588213	G16-130-GEN10.690	4 LEVELS AWAY	1008125.8
603023	MALLARD7 115.0	4 LEVELS AWAY	8937.7
608602	SQBEAST4 230.0	4 LEVELS AWAY	20507.3
615001	GRE-COAL 41G22.00	4 LEVELS AWAY	132420.6
615002	GRE-COAL 42G22.00	4 LEVELS AWAY	131822
615347	GRE-MCHENRY4230.0	4 LEVELS AWAY	5693.8
615601	GRE-COAL FM869.00	4 LEVELS AWAY	8511.6
615602	GRE-COALFM1T12.47	4 LEVELS AWAY	16538.2
615603	GRE-COALFM2T12.47	4 LEVELS AWAY	16461.1
620381	UNDERWD4 230.0	4 LEVELS AWAY	13528.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652175	G09_001IST 345.0	4 LEVELS AWAY	5938.6
652207	JAMEST29 13.20	4 LEVELS AWAY	20684.7
652208	JAMEST19 13.20	4 LEVELS AWAY	20743.5
652296	WARD 4 230.0	4 LEVELS AWAY	11830.4
652392	BISMARK9 12.47	4 LEVELS AWAY	27517.5
652416	DEVAUL 7 115.0	4 LEVELS AWAY	1317.9
652424	BELFELD3 345.0	4 LEVELS AWAY	6491.7
652427	BISMARK7 115.0	4 LEVELS AWAY	14198
652435	FARGO 4 230.0	4 LEVELS AWAY	10073.7
652445	JAMESTN7 115.0	4 LEVELS AWAY	9958
652449	MAX 7 115.0	4 LEVELS AWAY	5769.8
652460	GARISN4G 13.80	4 LEVELS AWAY	37940.8
652461	GARISN5G 13.80	4 LEVELS AWAY	37934.3
652467	BISMARK29 12.47	4 LEVELS AWAY	27517.7
652499	CAMPBELL 4 230.0	4 LEVELS AWAY	4634.7
652506	FTTHOMP3 345.0	4 LEVELS AWAY	9426.7
652568	GROTONSOUTH 115.0	4 LEVELS AWAY	13757.5
652590	SNAKECR7 115.0	4 LEVELS AWAY	5198.9
655643	VOLTAIR -CP7115.0	4 LEVELS AWAY	8215.9
655657	SWMINOT -CP7115.0	4 LEVELS AWAY	6168.3
655853	BEARCREK-MK7115.0	4 LEVELS AWAY	9502.9
655893	DUNNCENTRMK7115.0	4 LEVELS AWAY	4967.7
657751	CENTER 4 230.0	4 LEVELS AWAY	18773.8
657759	PICKERT4 230.0	4 LEVELS AWAY	4176.6
657791	CENTER 3 345.0	4 LEVELS AWAY	11314.9
657848	YNG2 4 230.0	4 LEVELS AWAY	17130.9
657947	CENTR1TE 13.80	4 LEVELS AWAY	45137.8
657948	CENTR2TE 13.80	4 LEVELS AWAY	45140.9
659120	BRDLAND3 345.0	4 LEVELS AWAY	3987

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659124	G14_004IS_1 34.50	4 LEVELS AWAY	45563.9
659128	WEBER 4 230.0	4 LEVELS AWAY	4809.5
659144	BLAISDELL 7115.0	4 LEVELS AWAY	6678.1
659161	GROTON 9 13.80	4 LEVELS AWAY	23232
659164	BLAISDELL 913.80	4 LEVELS AWAY	24749.8
659182	CHAR.CK7 115.0	4 LEVELS AWAY	14065.3
659211	CHARCREEK 1913.80	4 LEVELS AWAY	23842.5
659226	DGC 3001B 913.80	4 LEVELS AWAY	25140.8
659227	DGC 3004B 913.80	4 LEVELS AWAY	25735.1
659228	DGC 1452 913.80	4 LEVELS AWAY	20518.4
659229	DGC 1721 913.80	4 LEVELS AWAY	21954.9
659234	DGC NB5301E913.80	4 LEVELS AWAY	20759.1
659235	DGC NB5301D913.80	4 LEVELS AWAY	14129.1
659236	DGC UREA 869.00	4 LEVELS AWAY	6976.6
659302	CHAR.CK4 230.0	4 LEVELS AWAY	11347.2
659318	CHARCREEK 2913.80	4 LEVELS AWAY	23040.3
659319	CHARCREEK 3913.80	4 LEVELS AWAY	30568
659365	BALDWIN 4230.0	4 LEVELS AWAY	7465.1
659390	PATENTGATE 3345.0	4 LEVELS AWAY	6720.5
659406	ANTELPHLCOL934.50	4 LEVELS AWAY	21188.9
659543	PICKCITY RR7115.0	4 LEVELS AWAY	8997.8
661084	TIOGA4 4 230.0	4 LEVELS AWAY	8820.2
85113	J511 COL 2 34.50	5 LEVELS AWAY	18871
85114	J511 COL 3 34.50	5 LEVELS AWAY	20195.1
85931	J593 230.0	5 LEVELS AWAY	5406.7
587033	G16-004-GEN10.690	5 LEVELS AWAY	224601.4
587036	G16-004-GEN20.650	5 LEVELS AWAY	842432.1
587132	G16-017-GSU134.50	5 LEVELS AWAY	23326.1
587720	GEN-2016-087230.0	5 LEVELS AWAY	4634.7

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
587752	G16-092-GSU134.50	5 LEVELS AWAY	22869.9
587832	G16-103-GSU134.50	5 LEVELS AWAY	22117.2
587862	G16-108-GSU134.50	5 LEVELS AWAY	21771.3
602006	SHEYNNE4 230.0	5 LEVELS AWAY	10965.9
603280	MAGIC CITY 7115.0	5 LEVELS AWAY	6829.7
608597	SQBP1DC4 230.0	5 LEVELS AWAY	20507.3
608599	SQBP2DC4 230.0	5 LEVELS AWAY	20507.3
608600	BISONMP4 230.0	5 LEVELS AWAY	5767.3
608818	OLIVER19 34.50	5 LEVELS AWAY	9496.7
608830	OLIVER29 34.50	5 LEVELS AWAY	7068
615348	GRE-MCHENRY7115.0	5 LEVELS AWAY	8275.8
615349	GRE-MCHENRYT12.47	5 LEVELS AWAY	12859.9
615903	GRE-BALTA 4230.0	5 LEVELS AWAY	6503.3
620167	PICKERT9 41.60	5 LEVELS AWAY	2590.6
620290	HARVEY 4 230.0	5 LEVELS AWAY	4845.5
620369	JAMESTN3 345.0	5 LEVELS AWAY	5283.9
652174	G09_001IS_1 34.50	5 LEVELS AWAY	23088.7
652216	WATFORD4 230.0	5 LEVELS AWAY	6071.1
652220	BELFELD29 13.80	5 LEVELS AWAY	24524.7
652221	BELFELD9 13.80	5 LEVELS AWAY	22592.2
652222	MAX 9 41.60	5 LEVELS AWAY	4752.4
652257	DEVAUL 8 69.00	5 LEVELS AWAY	1207.7
652273	FTTHMP19 13.80	5 LEVELS AWAY	25983.8
652274	FTTHMP29 13.80	5 LEVELS AWAY	25984.7
652320	JAMESTN9 41.80	5 LEVELS AWAY	3303.8
652419	KILDEER7 115.0	5 LEVELS AWAY	7795.6
652425	BELFELD4 230.0	5 LEVELS AWAY	8938
652428	CARNGTN7 115.0	5 LEVELS AWAY	2595.9
652432	EDGELEY7 115.0	5 LEVELS AWAY	4006.3

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652434	FARGOSVC 13.20	5 LEVELS AWAY	33370.9
652436	FARGO 7 115.0	5 LEVELS AWAY	10484.5
652437	GRNDFKS4 230.0	5 LEVELS AWAY	6604
652440	NELSON 7 115.0	5 LEVELS AWAY	7124.3
652452	RUGBY 7 115.0	5 LEVELS AWAY	8032.1
652454	VALLEYC7 115.0	5 LEVELS AWAY	4348.8
652464	DENBIGH TAP7115.0	5 LEVELS AWAY	4420.6
652507	FTTHOMP4 230.0	5 LEVELS AWAY	20211.1
652512	GROTON 7 115.0	5 LEVELS AWAY	13757.3
652529	WATERTN3 345.0	5 LEVELS AWAY	10271.3
652534	ORDWAY 7 115.0	5 LEVELS AWAY	8314.6
652535	REDFELD7 115.0	5 LEVELS AWAY	4034.7
652553	MOORHED4 230.0	5 LEVELS AWAY	6930.6
652807	FTTHOM2-LNX3345.0	5 LEVELS AWAY	9426.7
655419	SW561-ER7 115.0	5 LEVELS AWAY	6210.4
655641	BTHOLD -CP7115.0	5 LEVELS AWAY	5144.8
655642	WARDTERT-CP912.47	5 LEVELS AWAY	18223.8
655647	BIS WARD-CP7115.0	5 LEVELS AWAY	7153.1
655652	BIS EXPR-CP7115.0	5 LEVELS AWAY	14198
655655	RUTHVILL-CP7115.0	5 LEVELS AWAY	4878.5
655661	DGLASCRK-CP7115.0	5 LEVELS AWAY	3619.2
655833	GRSYBTTP-MK7115.0	5 LEVELS AWAY	13084.6
655836	OAKDALE -MK7115.0	5 LEVELS AWAY	7834.4
655916	PALERMO -MW7115.0	5 LEVELS AWAY	4961.6
655944	PLAZA -MW7115.0	5 LEVELS AWAY	4726.8
657741	ROUGHRIDER 4230.0	5 LEVELS AWAY	14789.4
657748	CENTER2G 20.00	5 LEVELS AWAY	136736.6
657749	CENTER1G 22.00	5 LEVELS AWAY	77671.7
657923	PICKERT8 69.00	5 LEVELS AWAY	3109.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
657951	CNTSHNT3 345.0	5 LEVELS AWAY	11314.9
659125	G14_004IS_2 0.690	5 LEVELS AWAY	1883520.2
659138	NESET 4 230.0	5 LEVELS AWAY	8820.2
659184	R.RIDER7 115.0	5 LEVELS AWAY	4229.2
659185	FOUREYES 7115.0	5 LEVELS AWAY	3596.6
659204	BROADLAND 913.80	5 LEVELS AWAY	22950.6
659205	BRDLAND4 230.0	5 LEVELS AWAY	9724.4
659275	GROTONB7 115.0	5 LEVELS AWAY	13192.2
659284	ECKLUND4 230.0	5 LEVELS AWAY	7465.1
659300	STANTONTAP 7115.0	5 LEVELS AWAY	7375.4
659333	JUDSON 3345.0	5 LEVELS AWAY	6245.7
659362	WHEELOCK 4230.0	5 LEVELS AWAY	6425.7
659367	BALDWIN 934.50	5 LEVELS AWAY	16560.7
659387	KUMMERRIDGE3345.0	5 LEVELS AWAY	3530.4
659391	PATENTGATE 7115.0	5 LEVELS AWAY	15257.4
659392	PATENTGATE1913.80	5 LEVELS AWAY	23540.7
659393	PATENTGATE2913.80	5 LEVELS AWAY	23540.7
659407	ANTELPHILLSW0.690	5 LEVELS AWAY	844902.8
659408	CAMPBLCNTY 4230.0	5 LEVELS AWAY	4210.7
661016	COYOTE 3 345.0	5 LEVELS AWAY	7919.7
661029	ESTBMRK7 115.0	5 LEVELS AWAY	14180.9
661038	GLENHAM4 230.0	5 LEVELS AWAY	4862.9
661053	MANDAN 4 230.0	5 LEVELS AWAY	13967.7
661085	TIOGA4 7 115.0	5 LEVELS AWAY	8877.2
661900	TIOGA4 9 13.80	5 LEVELS AWAY	16687.6
672603	BDV 4 230.0	5 LEVELS AWAY	4201

3.1.3. Short Circuit Result for Tande 345kV Sub (659336)

The results of the short circuit analysis for POI i.e., Tande 345kV Sub (659336) and five bus levels away are tabulated below in Table 3.1.3.

Table 3.1.3: Short circuit results for Tande 345kV Sub (659336)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659336	TANDE 3345.0	0 LEVELS AWAY	6060.5
584870	GEN-2015-046345.0	1 LEVELS AWAY	4885.7
588280	GEN-2016-151345.0	1 LEVELS AWAY	3977
659337	TANDE 4230.0	1 LEVELS AWAY	9425.8
659338	TANDE 913.80	1 LEVELS AWAY	35432.6
659379	TANDE 913.80	1 LEVELS AWAY	35432.6
659427	TANDE-LNX 3345.0	1 LEVELS AWAY	6060.5
584871	G15-046-XF-134.50	2 LEVELS AWAY	38157.6
588281	G16-151XFMR134.50	2 LEVELS AWAY	19578.6
588290	GEN-2016-152345.0	2 LEVELS AWAY	3779.3
659138	NESET 4 230.0	2 LEVELS AWAY	9777.8
659333	JUDSON 3345.0	2 LEVELS AWAY	6440.9
584872	G15-046-GSU134.50	3 LEVELS AWAY	38361.1
588282	G16-151-GSU134.50	3 LEVELS AWAY	19353.6
588291	G16-152XFMR134.50	3 LEVELS AWAY	12145.5
659139	NESET 7 115.0	3 LEVELS AWAY	9147.6
659146	NESET 9 13.80	3 LEVELS AWAY	17261.3
659334	JUDSON 4230.0	3 LEVELS AWAY	8236.3
659335	JUDSON 913.80	3 LEVELS AWAY	35517.8
659390	PATENTGATE 3345.0	3 LEVELS AWAY	6871.3
661084	TIOGA4 4 230.0	3 LEVELS AWAY	9777.8
85931	J593 230.0	4 LEVELS AWAY	5777.5
584873	G15-046-GEN10.690	4 LEVELS AWAY	2101474.2
588283	G16-151-GEN10.690	4 LEVELS AWAY	858497.2
588292	G16-152-GSU134.50	4 LEVELS AWAY	11934.9

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652400	WILISTN4 230.0	4 LEVELS AWAY	8577.1
655909	HESS GAS-MW7115.0	4 LEVELS AWAY	8196.1
655930	WHTEARTH-MW7115.0	4 LEVELS AWAY	8746.4
655947	PWRSLKTP-MW7115.0	4 LEVELS AWAY	6210.7
655952	NTIOGA-MW 7115.0	4 LEVELS AWAY	8196.1
659143	BLAISDELL 4230.0	4 LEVELS AWAY	5240.4
659183	CHAR.CK3 345.0	4 LEVELS AWAY	10719.2
659362	WHEELOCK 4230.0	4 LEVELS AWAY	6698.3
659387	KUMMERRIDGE3345.0	4 LEVELS AWAY	3628.6
659391	PATENTGATE 7115.0	4 LEVELS AWAY	15692.5
659392	PATENTGATE1913.80	4 LEVELS AWAY	24338.5
659393	PATENTGATE2913.80	4 LEVELS AWAY	24338.5
661085	TIOGA4 7 115.0	4 LEVELS AWAY	9204.4
661900	TIOGA4 9 13.80	4 LEVELS AWAY	17304.7
672603	BDV 4 230.0	4 LEVELS AWAY	4661.2
85932	J593 COL1 34.50	5 LEVELS AWAY	29020.8
587864	G16-108-TAP 345.0	5 LEVELS AWAY	12312.6
588293	G16-152-GEN10.690	5 LEVELS AWAY	503937.1
652391	WILLISTON27 115.0	5 LEVELS AWAY	15598.1
652421	WILISTN7 115.0	5 LEVELS AWAY	15598.1
652424	BELFELD3 345.0	5 LEVELS AWAY	6508.3
652621	WILISTN9 13.20	5 LEVELS AWAY	22245.4
652622	WILISTN29 13.20	5 LEVELS AWAY	22245.4
655844	TIMBERCK-MK7115.0	5 LEVELS AWAY	8786.7
655850	IDEAL -MK7115.0	5 LEVELS AWAY	10591.1
655851	NRTHWEST-MK7115.0	5 LEVELS AWAY	11180.8
655856	G8 -MK7115.0	5 LEVELS AWAY	6802.6
655902	PVALLEY -MW7115.0	5 LEVELS AWAY	5464.3
655946	POWERSLK-MW7115.0	5 LEVELS AWAY	4263.2

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
655948	LIBERTY -MW7115.0	5 LEVELS AWAY	5757.1
655953	WSTBNKTP-MW7115.0	5 LEVELS AWAY	8196.1
659108	LOGAN 4 230.0	5 LEVELS AWAY	5354.6
659124	G14_004IS_1 34.50	5 LEVELS AWAY	46781.6
659144	BLAISDELL 7115.0	5 LEVELS AWAY	6901.4
659164	BLAISDELL 913.80	5 LEVELS AWAY	25389.5
659182	CHAR.CK7 115.0	5 LEVELS AWAY	14391.8
659211	CHARCREEK 1913.80	5 LEVELS AWAY	24695.6
659302	CHAR.CK4 230.0	5 LEVELS AWAY	11481.6
659318	CHARCREEK 2913.80	5 LEVELS AWAY	23792.8
659319	CHARCREEK 3913.80	5 LEVELS AWAY	31533.8
659349	LSSSWTCHST 7115.0	5 LEVELS AWAY	11852.1
659363	WHEELOCK 7115.0	5 LEVELS AWAY	6749.9
659364	WHEELOCK 913.80	5 LEVELS AWAY	27395.2
659368	TIMBERCREEK4230.0	5 LEVELS AWAY	6273.5
659384	ROUNDUP 3345.0	5 LEVELS AWAY	8845.9
659388	KUMMERRIDGE7115.0	5 LEVELS AWAY	8557.2
659389	KUMMERRIDG1913.80	5 LEVELS AWAY	21312
659394	KUMMERRIDG2913.80	5 LEVELS AWAY	21312
661080	STANLEY7 115.0	5 LEVELS AWAY	3528.4
661086	TIOGA7 7 115.0	5 LEVELS AWAY	7773.2
672602	BDX 4 230.0	5 LEVELS AWAY	4336.3

3.1.4. Short Circuit Result for Hilken 230kV switching station (652466)

The results of the short circuit analysis for POI i.e., Hilken 230kV switching station (652466) and five bus levels away are tabulated below in Table 3.1.4.

Table 3.1.4: Short circuit results for Hilken 230kV switching station (652466)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652466	HILKEN 4 230.0	0 LEVELS AWAY	8490
652426	BISMARK4 230.0	1 LEVELS AWAY	13451.4
652441	GARRISN4 230.0	1 LEVELS AWAY	11400.3
659365	BALDWIN 4230.0	1 LEVELS AWAY	7465.1
652296	WARD 4 230.0	2 LEVELS AWAY	11830.4
652392	BISMARK9 12.47	2 LEVELS AWAY	27517.5
652427	BISMARK7 115.0	2 LEVELS AWAY	14198
652442	GARRISN7 115.0	2 LEVELS AWAY	12798.7
652444	JAMESTN4 230.0	2 LEVELS AWAY	8261.7
652456	WASHBRN4 230.0	2 LEVELS AWAY	10018.2
652457	GARISN1G 13.80	2 LEVELS AWAY	60365.8
652458	GARISN2G 13.80	2 LEVELS AWAY	60333.6
652459	GARISN3G 13.80	2 LEVELS AWAY	60301.5
652467	BISMARK29 12.47	2 LEVELS AWAY	27517.7
652499	CAMPBELL 4 230.0	2 LEVELS AWAY	4634.7
659106	LELANDO4 230.0	2 LEVELS AWAY	22934.6
659128	WEBER 4 230.0	2 LEVELS AWAY	4809.5
659284	ECKLUND4 230.0	2 LEVELS AWAY	7465.1
659367	BALDWIN 934.50	2 LEVELS AWAY	16560.7
587030	GEN-2016-004230.0	3 LEVELS AWAY	7366.7
587720	GEN-2016-087230.0	3 LEVELS AWAY	4634.7
615901	GRE-STANTON4230.0	3 LEVELS AWAY	16682.1
652207	JAMEST29 13.20	3 LEVELS AWAY	20684.7
652208	JAMEST19 13.20	3 LEVELS AWAY	20743.5
652325	WASHBRN9 41.80	3 LEVELS AWAY	3159.9
652435	FARGO 4 230.0	3 LEVELS AWAY	10073.7
652445	JAMESTN7 115.0	3 LEVELS AWAY	9958

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652449	MAX 7 115.0	3 LEVELS AWAY	5769.8
652460	GARISN4G 13.80	3 LEVELS AWAY	37940.8
652461	GARISN5G 13.80	3 LEVELS AWAY	37934.3
652590	SNAKECR7 115.0	3 LEVELS AWAY	5198.9
655642	WARDTERT-CP912.47	3 LEVELS AWAY	18223.8
655643	VOLTAIR -CP7115.0	3 LEVELS AWAY	8215.9
655647	BIS WARD-CP7115.0	3 LEVELS AWAY	7153.1
655652	BIS EXPR-CP7115.0	3 LEVELS AWAY	14198
657759	PICKERT4 230.0	3 LEVELS AWAY	4176.6
659105	LELANDO3 345.0	3 LEVELS AWAY	16723.4
659108	LOGAN 4 230.0	3 LEVELS AWAY	5309.9
659109	BASIN 7 115.0	3 LEVELS AWAY	5187.9
659110	LELAN41G 22.00	3 LEVELS AWAY	85302.2
659200	BASIN 9 13.80	3 LEVELS AWAY	13863.7
659201	LELNDOLD 1913.80	3 LEVELS AWAY	33985
659202	LELNDOLD 2913.80	3 LEVELS AWAY	26406.8
659322	ECKLUNDWND1934.50	3 LEVELS AWAY	22042.6
659323	ECKLUNDWND2934.50	3 LEVELS AWAY	22041.4
659366	WILTON 3 W0.690	3 LEVELS AWAY	600739.9
659408	CAMPBLCNTY 4230.0	3 LEVELS AWAY	4210.7
659543	PICKCITY RR7115.0	3 LEVELS AWAY	8997.8
661029	ESTBMRK7 115.0	3 LEVELS AWAY	14180.9
661038	GLENHAM4 230.0	3 LEVELS AWAY	4862.9
661053	MANDAN 4 230.0	3 LEVELS AWAY	13967.7
85111	J511 230.0	4 LEVELS AWAY	6618.8
85991	J599 230.0	4 LEVELS AWAY	3933.4
560998	WILTON COL2 34.50	4 LEVELS AWAY	18881.8
579294	WILTON COL1 34.50	4 LEVELS AWAY	19022
587031	G16-004XFMR134.50	4 LEVELS AWAY	22913.9

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
587721	G16-087XFMR134.50	4 LEVELS AWAY	11475.9
588210	GEN-2016-130345.0	4 LEVELS AWAY	11349.3
602006	SHEYNNE4 230.0	4 LEVELS AWAY	10965.9
615348	GRE-MCHENRY7115.0	4 LEVELS AWAY	8275.8
615600	GRE-COAL CR4230.0	4 LEVELS AWAY	16874.6
615900	GRE-COAL TP4230.0	4 LEVELS AWAY	14548.3
620167	PICKERT9 41.60	4 LEVELS AWAY	2590.6
652222	MAX 9 41.60	4 LEVELS AWAY	4752.4
652320	JAMESTN9 41.80	4 LEVELS AWAY	3303.8
652420	NSALEM 7 115.0	4 LEVELS AWAY	1808.5
652428	CARNGTN7 115.0	4 LEVELS AWAY	2595.9
652432	EDGELEY7 115.0	4 LEVELS AWAY	4006.3
652434	FARGOSVC 13.20	4 LEVELS AWAY	33370.9
652436	FARGO 7 115.0	4 LEVELS AWAY	10484.5
652437	GRNDFKS4 230.0	4 LEVELS AWAY	6604
652440	NELSON 7 115.0	4 LEVELS AWAY	7124.3
652454	VALLEYC7 115.0	4 LEVELS AWAY	4348.8
652464	DENBIGH TAP7115.0	4 LEVELS AWAY	4420.6
652468	HEBRON 4 230.0	4 LEVELS AWAY	5092.7
652527	WHITLOK4 230.0	4 LEVELS AWAY	4857.4
652553	MOORHED4 230.0	4 LEVELS AWAY	6930.6
655644	NBISMRCK-CP7115.0	4 LEVELS AWAY	9229.2
655648	CIRCLE K-CP7115.0	4 LEVELS AWAY	5458.3
655661	DGLASCRK-CP7115.0	4 LEVELS AWAY	3619.2
657741	ROUGHRIDER 4230.0	4 LEVELS AWAY	14789.4
657756	SQBUTTE4 230.0	4 LEVELS AWAY	20507.3
657923	PICKERT8 69.00	4 LEVELS AWAY	3109.6
659101	ANTELOP3 345.0	4 LEVELS AWAY	16879.4
659111	LELAN32G 20.00	4 LEVELS AWAY	128515.4

Bus #	Bus Name	Level Away	Fault Current (Amperes) 3 PH
659143	BLAISDELL 4230.0	4 LEVELS AWAY	5090.7
659155	LOGAN 7 115.0	4 LEVELS AWAY	8851.4
659208	LOGAN 913.80	4 LEVELS AWAY	19630
659300	STANTONTAP 7115.0	4 LEVELS AWAY	7375.4
659409	CAMPBLCNTY 934.50	4 LEVELS AWAY	16177.2
659422	LELAND1-LNX3345.0	4 LEVELS AWAY	16723.4
659424	LELAND2-LNX3345.0	4 LEVELS AWAY	16723.4
661009	BISEXP 7 115.0	4 LEVELS AWAY	12020.6
661035	GLENHAM7 115.0	4 LEVELS AWAY	4704.4
661042	HESKETT4 230.0	4 LEVELS AWAY	13288.9
661054	MANDAN 7 115.0	4 LEVELS AWAY	17668.7
661060	LINTON 7 115.0	4 LEVELS AWAY	1323.2
661119	26TH&D 7 115.0	4 LEVELS AWAY	12884.1
661600	GLENHAM9 41.60	4 LEVELS AWAY	6130.2
661908	MANDAN 9 13.80	4 LEVELS AWAY	33693.4
10651	G830_SUB 115.0	5 LEVELS AWAY	5158.1
83021	J302 POI 230.0	5 LEVELS AWAY	5619.1
85112	J511 COL 34.50	5 LEVELS AWAY	21433.2
85992	J599 COL1 34.50	5 LEVELS AWAY	22566.5
560074	G16-017-TAP 345.0	5 LEVELS AWAY	6509.7
587032	G16-004-GSU134.50	5 LEVELS AWAY	20118.9
587035	G16-004-GSU234.50	5 LEVELS AWAY	21470.8
587050	GEN-2016-007115.0	5 LEVELS AWAY	3928.4
587722	G16-087-GSU134.50	5 LEVELS AWAY	10820.9
587864	G16-108-TAP 345.0	5 LEVELS AWAY	12370.4
588211	G16-130XFMR134.50	5 LEVELS AWAY	25124.6
603018	SHEYNNE7 115.0	5 LEVELS AWAY	12620
603023	MALLARD7 115.0	5 LEVELS AWAY	8937.7
605634	VELVA TAP 115.0	5 LEVELS AWAY	6706.3

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
605724	SHEYENNE5 9 13.80	5 LEVELS AWAY	12606.1
605730	SHEYENNE6 9 13.80	5 LEVELS AWAY	12469.7
608602	SQBEAST4 230.0	5 LEVELS AWAY	20507.3
615001	GRE-COAL 41G22.00	5 LEVELS AWAY	132420.6
615002	GRE-COAL 42G22.00	5 LEVELS AWAY	131822
615347	GRE-MCHENRY4230.0	5 LEVELS AWAY	5693.8
615349	GRE-MCHENRYT12.47	5 LEVELS AWAY	12859.9
615601	GRE-COAL FM869.00	5 LEVELS AWAY	8511.6
615602	GRE-COALFM1T12.47	5 LEVELS AWAY	16538.2
615603	GRE-COALFM2T12.47	5 LEVELS AWAY	16461.1
620336	AUDUBON4 230.0	5 LEVELS AWAY	5220
620381	UNDERWD4 230.0	5 LEVELS AWAY	13528.6
652201	GRNDFKS9 12.47	5 LEVELS AWAY	48685.8
652203	FARGO 8 69.00	5 LEVELS AWAY	12384
652204	VALLEYC8 69.00	5 LEVELS AWAY	2524.3
652321	CARNGTN9 41.80	5 LEVELS AWAY	2736.5
652322	EDGELEY9 41.80	5 LEVELS AWAY	3507.2
652323	FARGO 9 41.80	5 LEVELS AWAY	1308
652328	EDGELEY 19 13.20	5 LEVELS AWAY	3302.1
652416	DEVAUL 7 115.0	5 LEVELS AWAY	1317.9
652417	DICKNSN4 230.0	5 LEVELS AWAY	6558.7
652423	BARLOW 7 115.0	5 LEVELS AWAY	2585.8
652433	EDGELEY8 69.00	5 LEVELS AWAY	2686.8
652443	GRNDFKS7 115.0	5 LEVELS AWAY	10356.6
652453	TOWNER 7 115.0	5 LEVELS AWAY	4587.3
652534	ORDWAY 7 115.0	5 LEVELS AWAY	8314.6
652554	MORRIS 4 230.0	5 LEVELS AWAY	4809.5
652587	MOORHED7 115.0	5 LEVELS AWAY	6196.9
652613	VALLEYC9 13.20	5 LEVELS AWAY	3670.9

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652638	ENDERLIN 7 115.0	5 LEVELS AWAY	3281.6
652821	SULLYBT-LNX3230.0	5 LEVELS AWAY	6546
655646	GVPINES -CP7115.0	5 LEVELS AWAY	4727.2
655657	SWMINOT -CP7115.0	5 LEVELS AWAY	6168.3
655662	ROSEGLEN-CP7115.0	5 LEVELS AWAY	3477.8
657707	CALEDON7 115.0	5 LEVELS AWAY	3324.2
657742	OLIVERWND3 4230.0	5 LEVELS AWAY	10467.4
657751	CENTER 4 230.0	5 LEVELS AWAY	18773.8
657754	MAPLE R4 230.0	5 LEVELS AWAY	12152.1
657755	PRAIRIE4 230.0	5 LEVELS AWAY	7345.1
657791	CENTER 3 345.0	5 LEVELS AWAY	11314.9
657848	YNG2 4 230.0	5 LEVELS AWAY	17130.9
657947	CENTR1TE 13.80	5 LEVELS AWAY	45137.8
657948	CENTR2TE 13.80	5 LEVELS AWAY	45140.9
658080	MPSBROOK 115.0	5 LEVELS AWAY	6447.6
659103	ANTEL31G 23.00	5 LEVELS AWAY	147084.1
659107	ANTEL32G 23.00	5 LEVELS AWAY	147084.1
659144	BLAISDELL 7115.0	5 LEVELS AWAY	6678.1
659164	BLAISDELL 913.80	5 LEVELS AWAY	24749.8
659190	NDPRAIRWND 7115.0	5 LEVELS AWAY	7124.3
659212	DGC 3345.0	5 LEVELS AWAY	16066.7
659218	COTEAU 3345.0	5 LEVELS AWAY	16879.4
659273	WILTON 2 W0.690	5 LEVELS AWAY	732685.4
659280	POMONA 7 115.0	5 LEVELS AWAY	3262
659294	WILTON 1 W0.690	5 LEVELS AWAY	734751.2
659305	ROUGHRDRMGS7115.0	5 LEVELS AWAY	9411.1
659384	ROUNDUP 3345.0	5 LEVELS AWAY	8791
659400	NDSUNFLWR 4230.0	5 LEVELS AWAY	4579.3
659404	ANTELPHILLS3345.0	5 LEVELS AWAY	11355.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659410	CAMBLCNTCOL934.50	5 LEVELS AWAY	15287.3
659420	ANTELOP-LNX3345.0	5 LEVELS AWAY	16879.4
659423	GROTON-LNX3 345.0	5 LEVELS AWAY	5484.1
661008	BEULAH 7 115.0	5 LEVELS AWAY	9614
661030	STEIN 7 115.0	5 LEVELS AWAY	12206.7
661037	BOWDLE 7 115.0	5 LEVELS AWAY	1668.3
661039	MOBRIDG7 115.0	5 LEVELS AWAY	2854.2
661043	HESKETT7 115.0	5 LEVELS AWAY	17638.6
661051	STH9TH 7 115.0	5 LEVELS AWAY	10779.5
661067	MANDANW7 115.0	5 LEVELS AWAY	12668.6
661084	TIOGA4 4 230.0	5 LEVELS AWAY	8820.2
661906	HESKETT9 13.80	5 LEVELS AWAY	27981.7

3.2. Short Circuit Result for 2026 Summer Peak Case

The short circuit results for summer-2026 scenario at the POI are tabulated below.

3.2.1. Short Circuit Result for Tap Antelope Valley Substation (AVS)-Charlie Creek 345kV (587864)

The results of the short circuit analysis for POI i.e., Tap Antelope Valley Substation (AVS)-Charlie Creek 345kV (587864) and five bus levels away are tabulated below in Table 3.2.1.

Table 3.2.1: Short circuit results for Tap Antelope Valley Substation (AVS)-Charlie Creek 345kV (587864)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
587864	G16-108-TAP 345.0	0 LEVELS AWAY	12405.9
587860	GEN-2016-108345.0	1 LEVELS AWAY	12187.4
659101	ANTELOP3 345.0	1 LEVELS AWAY	16939
659183	CHAR.CK3 345.0	1 LEVELS AWAY	10775.7
587861	G16-108XFMR134.50	2 LEVELS AWAY	23028.8

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652424	BELFELD3 345.0	2 LEVELS AWAY	6515.3
659103	ANTEL31G 23.00	2 LEVELS AWAY	147226.4
659105	LELANDO3 345.0	2 LEVELS AWAY	16803.9
659107	ANTEL32G 23.00	2 LEVELS AWAY	147226.4
659124	G14_004IS_1 34.50	2 LEVELS AWAY	45667
659182	CHAR.CK7 115.0	2 LEVELS AWAY	14105.1
659211	CHARCREEK 1913.80	2 LEVELS AWAY	23856.4
659212	DGC 3345.0	2 LEVELS AWAY	16120.7
659218	COTEAU 3345.0	2 LEVELS AWAY	16939
659302	CHAR.CK4 230.0	2 LEVELS AWAY	11447.3
659318	CHARCREEK 2913.80	2 LEVELS AWAY	23068.8
659319	CHARCREEK 3913.80	2 LEVELS AWAY	30618
659384	ROUNDUP 3345.0	2 LEVELS AWAY	8828.8
659390	PATENTGATE 3345.0	2 LEVELS AWAY	6741.4
659404	ANTELPHILLS3345.0	2 LEVELS AWAY	11381.9
659420	ANTELOP-LNX3345.0	2 LEVELS AWAY	16939
587862	G16-108-GSU134.50	3 LEVELS AWAY	21778.9
588210	GEN-2016-130345.0	3 LEVELS AWAY	11385.6
652216	WATFORD4 230.0	3 LEVELS AWAY	6281.5
652220	BELFELD29 13.80	3 LEVELS AWAY	24538.1
652221	BELFELD9 13.80	3 LEVELS AWAY	22603.4
652419	KILDEER7 115.0	3 LEVELS AWAY	7806.9
652425	BELFELD4 230.0	3 LEVELS AWAY	8967.3
655833	GRSYBTTP-MK7115.0	3 LEVELS AWAY	13119
659106	LELANDO4 230.0	3 LEVELS AWAY	23038.4
659111	LELAN32G 20.00	3 LEVELS AWAY	128633.4
659125	G14_004IS_2 0.690	3 LEVELS AWAY	1886573.1
659184	R.RIDER7 115.0	3 LEVELS AWAY	4232
659185	FOUREYES 7115.0	3 LEVELS AWAY	3599.2

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659201	LELNDOLD 1913.80	3 LEVELS AWAY	33999
659202	LELNDOLD 2913.80	3 LEVELS AWAY	26414.7
659214	DGC NB5301B913.80	3 LEVELS AWAY	26392.7
659215	DGC NB5302A913.80	3 LEVELS AWAY	17411.8
659219	COT 13.8T1 913.80	3 LEVELS AWAY	21672.4
659220	DGC NB5301A913.80	3 LEVELS AWAY	26086.7
659221	DGC NB5302B913.80	3 LEVELS AWAY	41157.7
659222	COTEAU1 869.00	3 LEVELS AWAY	9274.7
659231	COT 13.8T2 913.80	3 LEVELS AWAY	21524.3
659232	DGC________913.80	3 LEVELS AWAY	18495.8
659233	DGC 4230.0	3 LEVELS AWAY	7071.4
659333	JUDSON 3345.0	3 LEVELS AWAY	6263.8
659385	ROUNDUP 7115.0	3 LEVELS AWAY	12607
659386	ROUNDUP 913.80	3 LEVELS AWAY	23291.4
659387	KUMMERRIDGE3345.0	3 LEVELS AWAY	3536.2
659391	PATENTGATE 7115.0	3 LEVELS AWAY	15287.6
659392	PATENTGATE1913.80	3 LEVELS AWAY	23549.7
659393	PATENTGATE2913.80	3 LEVELS AWAY	23549.7
659405	ANTELPHILLS934.50	3 LEVELS AWAY	22798
659421	BRDLAND-LNX3345.0	3 LEVELS AWAY	3994.7
659422	LELAND1-LNX3345.0	3 LEVELS AWAY	16803.9
659424	LELAND2-LNX3345.0	3 LEVELS AWAY	16803.9
560074	G16-017-TAP 345.0	4 LEVELS AWAY	6486.2
587030	GEN-2016-004230.0	4 LEVELS AWAY	7376.2
587863	G16-108-GEN10.690	4 LEVELS AWAY	909417.8
588211	G16-130XFMR134.50	4 LEVELS AWAY	25137.6
615901	GRE-STANTON4230.0	4 LEVELS AWAY	17008
652408	WATFORD7 115.0	4 LEVELS AWAY	7543
652413	MEDORA 4 230.0	4 LEVELS AWAY	4982.8

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652417	DICKNSN4 230.0	4 LEVELS AWAY	6583.6
652422	HALIDAY7 115.0	4 LEVELS AWAY	4691.3
652441	GARRISN4 230.0	4 LEVELS AWAY	11446.1
652456	WASHBRN4 230.0	4 LEVELS AWAY	10073.5
652471	WATFORD9 13.20	4 LEVELS AWAY	16889
652472	WATFORD29 13.20	4 LEVELS AWAY	11075.5
655834	GRASSYBT-MK7115.0	4 LEVELS AWAY	6620.6
655835	LITTLKNF-MK7115.0	4 LEVELS AWAY	6992.2
655844	TIMBERCK-MK7115.0	4 LEVELS AWAY	8545
655850	IDEAL -MK7115.0	4 LEVELS AWAY	10296
655851	NRTHWEST-MK7115.0	4 LEVELS AWAY	10873.6
655853	BEARCREK-MK7115.0	4 LEVELS AWAY	9518.2
655856	G8 -MK7115.0	4 LEVELS AWAY	6602.3
655891	KILLDEER-MK7115.0	4 LEVELS AWAY	7737.2
655893	DUNNCENTRMK7115.0	4 LEVELS AWAY	4971.8
659108	LOGAN 4 230.0	4 LEVELS AWAY	5130.6
659109	BASIN 7 115.0	4 LEVELS AWAY	5190.5
659110	LELAN41G 22.00	4 LEVELS AWAY	85354
659120	BRDLAND3 345.0	4 LEVELS AWAY	3994.7
659129	NBCS5 KLDR1G13.80	4 LEVELS AWAY	6118.6
659181	BICNTNL7 115.0	4 LEVELS AWAY	3271
659200	BASIN 9 13.80	4 LEVELS AWAY	13865.9
659226	DGC 3001B 913.80	4 LEVELS AWAY	25146.1
659227	DGC 3004B 913.80	4 LEVELS AWAY	25740.6
659228	DGC 1452 913.80	4 LEVELS AWAY	20522
659229	DGC 1721 913.80	4 LEVELS AWAY	21958.9
659234	DGC NB5301E913.80	4 LEVELS AWAY	20762.7
659235	DGC NB5301D913.80	4 LEVELS AWAY	14130.8
659236	DGC UREA 869.00	4 LEVELS AWAY	6978.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659309	S HEART 4230.0	4 LEVELS AWAY	8967.3
659334	JUDSON 4230.0	4 LEVELS AWAY	8097.2
659335	JUDSON 913.80	4 LEVELS AWAY	34479.6
659349	LSSSWTCHST 7115.0	4 LEVELS AWAY	11512.7
659368	TIMBERCREEK4230.0	4 LEVELS AWAY	6214.7
659388	KUMMERRIDGE7115.0	4 LEVELS AWAY	8314.7
659389	KUMMERRIDG1913.80	4 LEVELS AWAY	20524.7
659394	KUMMERRIDG2913.80	4 LEVELS AWAY	20524.7
659406	ANTELPHLCOL934.50	4 LEVELS AWAY	21195.7
659423	GROTON-LNX3 345.0	4 LEVELS AWAY	6204.8
659427	TANDE-LNX 3345.0	4 LEVELS AWAY	5399.9
659448	DAGLUM 4230.0	4 LEVELS AWAY	6143.8
85111	J511 230.0	5 LEVELS AWAY	6664
587031	G16-004XFMR134.50	5 LEVELS AWAY	22924.7
587130	GEN-2016-017345.0	5 LEVELS AWAY	6430.8
587750	GEN-2016-092345.0	5 LEVELS AWAY	6430.8
587830	GEN-2016-103345.0	5 LEVELS AWAY	6431.8
588212	G16-130-GSU134.50	5 LEVELS AWAY	24501.8
615600	GRE-COAL CR4230.0	5 LEVELS AWAY	17028.5
615900	GRE-COAL TP4230.0	5 LEVELS AWAY	14697.4
652325	WASHBRN9 41.80	5 LEVELS AWAY	3160.9
652400	WILISTN4 230.0	5 LEVELS AWAY	8435.8
652418	DKSN-ND7 115.0	5 LEVELS AWAY	5877.4
652420	NSALEM 7 115.0	5 LEVELS AWAY	1808.9
652426	BISMARK4 230.0	5 LEVELS AWAY	13911.9
652442	GARRISN7 115.0	5 LEVELS AWAY	12849.6
652444	JAMESTN4 230.0	5 LEVELS AWAY	8350.8
652457	GARISN1G 13.80	5 LEVELS AWAY	60402.1
652458	GARISN2G 13.80	5 LEVELS AWAY	60369.8

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652459	GARISN3G 13.80	5 LEVELS AWAY	60337.6
652466	HILKEN 4 230.0	5 LEVELS AWAY	8577.3
652468	HEBRON 4 230.0	5 LEVELS AWAY	5127.2
652616	MINGUSVILLE4230.0	5 LEVELS AWAY	3828.8
652806	FTTHOM1-LNX3345.0	5 LEVELS AWAY	9344.6
655836	OAKDALE -MK7115.0	5 LEVELS AWAY	7845.1
655838	INDIANHL-MK7115.0	5 LEVELS AWAY	5863.1
655840	CHRRYCRK-MK7115.0	5 LEVELS AWAY	7543
655842	HAYBUTTE-MK7115.0	5 LEVELS AWAY	8224
655845	GARDENCK2MK7115.0	5 LEVELS AWAY	5080.5
655846	F9 -MK7115.0	5 LEVELS AWAY	4077.6
655848	KEENETAP-MK7115.0	5 LEVELS AWAY	6297.2
655863	HILAND -MK7115.0	5 LEVELS AWAY	5194.2
655881	DAP -MK7115.0	5 LEVELS AWAY	7634.6
655882	GALAXYTP-MK7115.0	5 LEVELS AWAY	7082.9
655886	KEENE -MK7115.0	5 LEVELS AWAY	6425.3
655889	LCGASPLT-MK7115.0	5 LEVELS AWAY	7981.4
655892	ALEXANDR-MK7115.0	5 LEVELS AWAY	7639.7
655894	HALLIDAY-MK7115.0	5 LEVELS AWAY	3539.4
655897	COYOTCHARMK7115.0	5 LEVELS AWAY	5707
657756	SQBUTTE4 230.0	5 LEVELS AWAY	22533.4
659143	BLAISDELL 4230.0	5 LEVELS AWAY	5030
659155	LOGAN 7 115.0	5 LEVELS AWAY	8104.6
659160	GROTON 3 345.0	5 LEVELS AWAY	6204.8
659191	SQUAWGP7 115.0	5 LEVELS AWAY	3258.3
659197	DICKNSON 913.80	5 LEVELS AWAY	15042.8
659204	BROADLAND 913.80	5 LEVELS AWAY	22963.4
659205	BRDLAND4 230.0	5 LEVELS AWAY	9761.8
659208	LOGAN 913.80	5 LEVELS AWAY	19124.2

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659266	RHAME 4 230.0	5 LEVELS AWAY	3992
659306	S HEART 7115.0	5 LEVELS AWAY	2192.2
659336	TANDE 3345.0	5 LEVELS AWAY	5399.9
659348	LNSMCK1+3GN7115.0	5 LEVELS AWAY	11512.7
659407	ANTELPHILLSW0.690	5 LEVELS AWAY	845092.6
659450	BRADYWND 4230.0	5 LEVELS AWAY	3420
661008	BEULAH 7 115.0	5 LEVELS AWAY	9670.2

3.2.2. Short Circuit Result for Leland Olds 345kV (659105)

The results of the short circuit analysis for POI i.e., Leland Olds 345kV (659105) and five bus levels away are tabulated below in Table 3.2.2.

Table 3.2.2: Short circuit results for Leland Olds 345kV (659105)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659105	LELANDO3 345.0	0 LEVELS AWAY	16803.9
588210	GEN-2016-130345.0	1 LEVELS AWAY	11385.6
659101	ANTELOP3 345.0	1 LEVELS AWAY	16939
659106	LELANDO4 230.0	1 LEVELS AWAY	23038.4
659111	LELAN32G 20.00	1 LEVELS AWAY	128633.4
659201	LELNDOLD 1913.80	1 LEVELS AWAY	33999
659202	LELNDOLD 2913.80	1 LEVELS AWAY	26414.7
659422	LELAND1-LNX3345.0	1 LEVELS AWAY	16803.9
659424	LELAND2-LNX3345.0	1 LEVELS AWAY	16803.9
560074	G16-017-TAP 345.0	2 LEVELS AWAY	6486.2
587030	GEN-2016-004230.0	2 LEVELS AWAY	7376.2
587864	G16-108-TAP 345.0	2 LEVELS AWAY	12405.9
588211	G16-130XFMR134.50	2 LEVELS AWAY	25137.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
615901	GRE-STANTON4230.0	2 LEVELS AWAY	17008
652441	GARRISN4 230.0	2 LEVELS AWAY	11446.1
652456	WASHBRN4 230.0	2 LEVELS AWAY	10073.5
659103	ANTEL31G 23.00	2 LEVELS AWAY	147226.4
659107	ANTEL32G 23.00	2 LEVELS AWAY	147226.4
659108	LOGAN 4 230.0	2 LEVELS AWAY	5130.6
659109	BASIN 7 115.0	2 LEVELS AWAY	5190.5
659110	LELAN41G 22.00	2 LEVELS AWAY	85354
659200	BASIN 9 13.80	2 LEVELS AWAY	13865.9
659212	DGC 3345.0	2 LEVELS AWAY	16120.7
659218	COTEAU 3345.0	2 LEVELS AWAY	16939
659384	ROUNDUP 3345.0	2 LEVELS AWAY	8828.8
659404	ANTELPHILLS3345.0	2 LEVELS AWAY	11381.9
659420	ANTELOP-LNX3345.0	2 LEVELS AWAY	16939
659423	GROTON-LNX3 345.0	2 LEVELS AWAY	6204.8
85111	J511 230.0	3 LEVELS AWAY	6664
587031	G16-004XFMR134.50	3 LEVELS AWAY	22924.7
587130	GEN-2016-017345.0	3 LEVELS AWAY	6430.8
587750	GEN-2016-092345.0	3 LEVELS AWAY	6430.8
587830	GEN-2016-103345.0	3 LEVELS AWAY	6431.8
587860	GEN-2016-108345.0	3 LEVELS AWAY	12187.4
588212	G16-130-GSU134.50	3 LEVELS AWAY	24501.8
615600	GRE-COAL CR4230.0	3 LEVELS AWAY	17028.5
615900	GRE-COAL TP4230.0	3 LEVELS AWAY	14697.4
652325	WASHBRN9 41.80	3 LEVELS AWAY	3160.9
652420	NSALEM 7 115.0	3 LEVELS AWAY	1808.9
652426	BISMARK4 230.0	3 LEVELS AWAY	13911.9
652442	GARRISN7 115.0	3 LEVELS AWAY	12849.6
652444	JAMESTN4 230.0	3 LEVELS AWAY	8350.8

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652457	GARISN1G 13.80	3 LEVELS AWAY	60402.1
652458	GARISN2G 13.80	3 LEVELS AWAY	60369.8
652459	GARISN3G 13.80	3 LEVELS AWAY	60337.6
652466	HILKEN 4 230.0	3 LEVELS AWAY	8577.3
652806	FTTHOM1-LNX3345.0	3 LEVELS AWAY	9344.6
657756	SQBUTTE4 230.0	3 LEVELS AWAY	22533.4
659143	BLAISDELL 4230.0	3 LEVELS AWAY	5030
659155	LOGAN 7 115.0	3 LEVELS AWAY	8104.6
659160	GROTON 3 345.0	3 LEVELS AWAY	6204.8
659183	CHAR.CK3 345.0	3 LEVELS AWAY	10775.7
659208	LOGAN 913.80	3 LEVELS AWAY	19124.2
659214	DGC NB5301B913.80	3 LEVELS AWAY	26392.7
659215	DGC NB5302A913.80	3 LEVELS AWAY	17411.8
659219	COT 13.8T1 913.80	3 LEVELS AWAY	21672.4
659220	DGC NB5301A913.80	3 LEVELS AWAY	26086.7
659221	DGC NB5302B913.80	3 LEVELS AWAY	41157.7
659222	COTEAU1 869.00	3 LEVELS AWAY	9274.7
659231	COT 13.8T2 913.80	3 LEVELS AWAY	21524.3
659232	DGC_________913.80	3 LEVELS AWAY	18495.8
659233	DGC 4230.0	3 LEVELS AWAY	7071.4
659385	ROUNDUP 7115.0	3 LEVELS AWAY	12607
659386	ROUNDUP 913.80	3 LEVELS AWAY	23291.4
659405	ANTELPHILLS934.50	3 LEVELS AWAY	22798
659421	BRDLAND-LNX3345.0	3 LEVELS AWAY	3994.7
85112	J511 COL 34.50	4 LEVELS AWAY	21491.5
587032	G16-004-GSU134.50	4 LEVELS AWAY	20127
587035	G16-004-GSU234.50	4 LEVELS AWAY	21479.9
587131	G16-017XFMR134.50	4 LEVELS AWAY	24327.6
587751	G16-092XFMR134.50	4 LEVELS AWAY	24355

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
587831	G16-103XFMR134.50	4 LEVELS AWAY	24299.7
587861	G16-108XFMR134.50	4 LEVELS AWAY	23028.8
588213	G16-130-GEN10.690	4 LEVELS AWAY	1008486.8
603023	MALLARD7 115.0	4 LEVELS AWAY	7460.7
608602	SQBEAST4 230.0	4 LEVELS AWAY	22533.4
615001	GRE-COAL 41G22.00	4 LEVELS AWAY	132875.6
615002	GRE-COAL 42G22.00	4 LEVELS AWAY	132267.7
615347	GRE-MCHENRY4230.0	4 LEVELS AWAY	5746.9
615601	GRE-COAL FM869.00	4 LEVELS AWAY	8523.4
615602	GRE-COALFM1T12.47	4 LEVELS AWAY	16546.2
615603	GRE-COALFM2T12.47	4 LEVELS AWAY	16469
620381	UNDERWD4 230.0	4 LEVELS AWAY	13616.6
652175	G09_001IST 345.0	4 LEVELS AWAY	6390.5
652207	JAMEST29 13.20	4 LEVELS AWAY	20713.2
652208	JAMEST19 13.20	4 LEVELS AWAY	20772.2
652296	WARD 4 230.0	4 LEVELS AWAY	12268.9
652392	BISMARK9 12.47	4 LEVELS AWAY	27811.8
652416	DEVAUL 7 115.0	4 LEVELS AWAY	1318
652424	BELFELD3 345.0	4 LEVELS AWAY	6515.3
652427	BISMARK7 115.0	4 LEVELS AWAY	14864.6
652435	FARGO 4 230.0	4 LEVELS AWAY	10101.3
652445	JAMESTN7 115.0	4 LEVELS AWAY	10016.4
652449	MAX 7 115.0	4 LEVELS AWAY	5711.4
652460	GARISN4G 13.80	4 LEVELS AWAY	37973
652461	GARISN5G 13.80	4 LEVELS AWAY	37966.5
652467	BISMARK29 12.47	4 LEVELS AWAY	27812
652499	CAMPBELL 4 230.0	4 LEVELS AWAY	4642.7
652506	FTTHOMP3 345.0	4 LEVELS AWAY	9344.6
652568	GROTONSOUTH 115.0	4 LEVELS AWAY	18185

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652590	SNAKECR7 115.0	4 LEVELS AWAY	5204
655643	VOLTAIR -CP7115.0	4 LEVELS AWAY	7765.8
655657	SWMINOT -CP7115.0	4 LEVELS AWAY	5860.1
655853	BEARCREK-MK7115.0	4 LEVELS AWAY	9518.2
655893	DUNNCENTRMK7115.0	4 LEVELS AWAY	4971.8
657751	CENTER 4 230.0	4 LEVELS AWAY	20284.3
657759	PICKERT4 230.0	4 LEVELS AWAY	4271.7
657791	CENTER 3 345.0	4 LEVELS AWAY	11948.9
657848	YNG2 4 230.0	4 LEVELS AWAY	18355.5
657947	CENTR1TE 13.80	4 LEVELS AWAY	45739.5
657948	CENTR2TE 13.80	4 LEVELS AWAY	45740.5
659120	BRDLAND3 345.0	4 LEVELS AWAY	3994.7
659124	G14_004IS_1 34.50	4 LEVELS AWAY	45667
659128	WEBER 4 230.0	4 LEVELS AWAY	4850.3
659144	BLAISDELL 7115.0	4 LEVELS AWAY	6615.2
659161	GROTON 9 13.80	4 LEVELS AWAY	24222.7
659164	BLAISDELL 913.80	4 LEVELS AWAY	24663.7
659182	CHAR.CK7 115.0	4 LEVELS AWAY	14105.1
659211	CHARCREEK 1913.80	4 LEVELS AWAY	23856.4
659226	DGC 3001B 913.80	4 LEVELS AWAY	25146.1
659227	DGC 3004B 913.80	4 LEVELS AWAY	25740.6
659228	DGC 1452 913.80	4 LEVELS AWAY	20522
659229	DGC 1721 913.80	4 LEVELS AWAY	21958.9
659234	DGC NB5301E913.80	4 LEVELS AWAY	20762.7
659235	DGC NB5301D913.80	4 LEVELS AWAY	14130.8
659236	DGC UREA 869.00	4 LEVELS AWAY	6978.6
659302	CHAR.CK4 230.0	4 LEVELS AWAY	11447.3
659318	CHARCREEK 2913.80	4 LEVELS AWAY	23068.8
659319	CHARCREEK 3913.80	4 LEVELS AWAY	30618

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659365	BALDWIN 4230.0	4 LEVELS AWAY	7527.6
659390	PATENTGATE 3345.0	4 LEVELS AWAY	6741.4
659406	ANTELPHLCOL934.50	4 LEVELS AWAY	21195.7
659543	PICKCITY RR7115.0	4 LEVELS AWAY	9023.4
661084	TIOGA4 4 230.0	4 LEVELS AWAY	8798.8
85113	J511 COL 2 34.50	5 LEVELS AWAY	18915.4
85114	J511 COL 3 34.50	5 LEVELS AWAY	20245.2
85931	J593 230.0	5 LEVELS AWAY	5400.8
587033	G16-004-GEN10.690	5 LEVELS AWAY	224611.3
587036	G16-004-GEN20.650	5 LEVELS AWAY	842654
587132	G16-017-GSU134.50	5 LEVELS AWAY	23305
587720	GEN-2016-087230.0	5 LEVELS AWAY	4642.7
587752	G16-092-GSU134.50	5 LEVELS AWAY	22849.9
587832	G16-103-GSU134.50	5 LEVELS AWAY	22098.8
587862	G16-108-GSU134.50	5 LEVELS AWAY	21778.9
602006	SHEYNNE4 230.0	5 LEVELS AWAY	10989.3
603280	MAGIC CITY 7115.0	5 LEVELS AWAY	4789.1
608597	SQBP1DC4 230.0	5 LEVELS AWAY	22533.4
608599	SQBP2DC4 230.0	5 LEVELS AWAY	22533.4
608600	BISONMP4 230.0	5 LEVELS AWAY	8131.2
608818	OLIVER19 34.50	5 LEVELS AWAY	9521.7
608830	OLIVER29 34.50	5 LEVELS AWAY	7092.5
615348	GRE-MCHENRY7115.0	5 LEVELS AWAY	7811.5
615349	GRE-MCHENRYT12.47	5 LEVELS AWAY	12894.2
615903	GRE-BALTA 4230.0	5 LEVELS AWAY	6293.2
620167	PICKERT9 41.60	5 LEVELS AWAY	2597
620290	HARVEY 4 230.0	5 LEVELS AWAY	4772.5
620369	JAMESTN3 345.0	5 LEVELS AWAY	5345.7
652174	G09_001IS_1 34.50	5 LEVELS AWAY	23572.9

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652216	WATFORD4 230.0	5 LEVELS AWAY	6281.5
652220	BELFELD29 13.80	5 LEVELS AWAY	24538.1
652221	BELFELD9 13.80	5 LEVELS AWAY	22603.4
652222	MAX 9 41.60	5 LEVELS AWAY	4737.9
652257	DEVAUL 8 69.00	5 LEVELS AWAY	1207.7
652273	FTTHMP19 13.80	5 LEVELS AWAY	25937.9
652274	FTTHMP29 13.80	5 LEVELS AWAY	25938.8
652320	JAMESTN9 41.80	5 LEVELS AWAY	3306.1
652419	KILDEER7 115.0	5 LEVELS AWAY	7806.9
652425	BELFELD4 230.0	5 LEVELS AWAY	8967.3
652428	CARNGTN7 115.0	5 LEVELS AWAY	2602.1
652432	EDGELEY7 115.0	5 LEVELS AWAY	4031.6
652434	FARGOSVC 13.20	5 LEVELS AWAY	33389.1
652436	FARGO 7 115.0	5 LEVELS AWAY	10500.8
652437	GRNDFKS4 230.0	5 LEVELS AWAY	7135
652440	NELSON 7 115.0	5 LEVELS AWAY	6869.3
652452	RUGBY 7 115.0	5 LEVELS AWAY	7807.9
652454	VALLEYC7 115.0	5 LEVELS AWAY	4353.4
652464	DENBIGH TAP7115.0	5 LEVELS AWAY	4394.9
652507	FTTHOMP4 230.0	5 LEVELS AWAY	19787.3
652512	GROTON 7 115.0	5 LEVELS AWAY	18184.5
652529	WATERTN3 345.0	5 LEVELS AWAY	10693.8
652534	ORDWAY 7 115.0	5 LEVELS AWAY	9572.7
652535	REDFELD7 115.0	5 LEVELS AWAY	4105.6
652553	MOORHED4 230.0	5 LEVELS AWAY	6938.8
652807	FTTHOM2-LNX3345.0	5 LEVELS AWAY	9344.6
655419	SW561-ER7 115.0	5 LEVELS AWAY	6698.4
655641	BTHOLD -CP7115.0	5 LEVELS AWAY	5073
655642	WARDTERT-CP912.47	5 LEVELS AWAY	18278.1

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
655647	BIS WARD-CP7115.0	5 LEVELS AWAY	7230.7
655652	BIS EXPR-CP7115.0	5 LEVELS AWAY	14864.6
655655	RUTHVILL-CP7115.0	5 LEVELS AWAY	4493.4
655661	DGLASCRK-CP7115.0	5 LEVELS AWAY	3618.2
655833	GRSYBTTP-MK7115.0	5 LEVELS AWAY	13119
655836	OAKDALE -MK7115.0	5 LEVELS AWAY	7845.1
655916	PALERMO -MW7115.0	5 LEVELS AWAY	4930.7
655944	PLAZA -MW7115.0	5 LEVELS AWAY	4704.8
657741	ROUGHRIDER 4230.0	5 LEVELS AWAY	15610.7
657748	CENTER2G 20.00	5 LEVELS AWAY	139370.2
657749	CENTER1G 22.00	5 LEVELS AWAY	78532.7
657923	PICKERT8 69.00	5 LEVELS AWAY	3125.1
657951	CNTSHNT3 345.0	5 LEVELS AWAY	11948.9
659125	G14_004IS_2 0.690	5 LEVELS AWAY	1886573.1
659138	NESET 4 230.0	5 LEVELS AWAY	8798.8
659184	R.RIDER7 115.0	5 LEVELS AWAY	4232
659185	FOUREYES 7115.0	5 LEVELS AWAY	3599.2
659204	BROADLAND 913.80	5 LEVELS AWAY	22963.4
659205	BRDLAND4 230.0	5 LEVELS AWAY	9761.8
659275	GROTONB7 115.0	5 LEVELS AWAY	17677.5
659284	ECKLUND4 230.0	5 LEVELS AWAY	7527.6
659300	STANTONTAP 7115.0	5 LEVELS AWAY	7395.8
659333	JUDSON 3345.0	5 LEVELS AWAY	6263.8
659362	WHEELOCK 4230.0	5 LEVELS AWAY	6434.7
659367	BALDWIN 934.50	5 LEVELS AWAY	16597.9
659387	KUMMERRIDGE3345.0	5 LEVELS AWAY	3536.2
659391	PATENTGATE 7115.0	5 LEVELS AWAY	15287.6
659392	PATENTGATE1913.80	5 LEVELS AWAY	23549.7
659393	PATENTGATE2913.80	5 LEVELS AWAY	23549.7

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659407	ANTELPHILLSW0.690	5 LEVELS AWAY	845092.6
659408	CAMPBLCNTY 4230.0	5 LEVELS AWAY	4217.3
661016	COYOTE 3 345.0	5 LEVELS AWAY	8095.2
661029	ESTBMRK7 115.0	5 LEVELS AWAY	14849.2
661038	GLENHAM4 230.0	5 LEVELS AWAY	4867.8
661053	MANDAN 4 230.0	5 LEVELS AWAY	14850
661085	TIOGA4 7 115.0	5 LEVELS AWAY	8858.5
661900	TIOGA4 9 13.80	5 LEVELS AWAY	16678.8
672603	BDV 4 230.0	5 LEVELS AWAY	4204

3.2.3. Short Circuit Result for Tande 345kV Sub (659336)

The results of the short circuit analysis for POI i.e., Tande 345kV Sub (659336) and five bus levels away are tabulated below in Table 3.2.3.

Table 3.2.3: Short circuit results for Tande 345kV Sub (659336)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659336	TANDE 3345.0	0 LEVELS AWAY	6051.5
584870	GEN-2015-046345.0	1 LEVELS AWAY	4859.4
588280	GEN-2016-151345.0	1 LEVELS AWAY	3968
659337	TANDE 4230.0	1 LEVELS AWAY	9415.5
659338	TANDE 913.80	1 LEVELS AWAY	35215.1
659379	TANDE 913.80	1 LEVELS AWAY	35215.1
659427	TANDE-LNX 3345.0	1 LEVELS AWAY	6051.5
584871	G15-046-XF-134.50	2 LEVELS AWAY	37643.7
588281	G16-151XFMR134.50	2 LEVELS AWAY	19563.2
588290	GEN-2016-152345.0	2 LEVELS AWAY	3770.4
659138	NESET 4 230.0	2 LEVELS AWAY	9769.5

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659333	JUDSON 3345.0	2 LEVELS AWAY	6478
584872	G15-046-GSU134.50	3 LEVELS AWAY	37791.7
588282	G16-151-GSU134.50	3 LEVELS AWAY	19339.3
588291	G16-152XFMR134.50	3 LEVELS AWAY	12130.5
659139	NESET 7 115.0	3 LEVELS AWAY	9101.2
659146	NESET 9 13.80	3 LEVELS AWAY	16958.8
659334	JUDSON 4230.0	3 LEVELS AWAY	8304
659335	JUDSON 913.80	3 LEVELS AWAY	35361.7
659390	PATENTGATE 3345.0	3 LEVELS AWAY	6927.9
661084	TIOGA4 4 230.0	3 LEVELS AWAY	9769.5
85931	J593 230.0	4 LEVELS AWAY	5746
584873	G15-046-GEN10.690	4 LEVELS AWAY	2081452
588283	G16-151-GEN10.690	4 LEVELS AWAY	858705.4
588292	G16-152-GSU134.50	4 LEVELS AWAY	11921
652400	WILISTN4 230.0	4 LEVELS AWAY	8656.6
655909	HESS GAS-MW7115.0	4 LEVELS AWAY	8145.2
655930	WHTEARTH-MW7115.0	4 LEVELS AWAY	8697.7
655947	PWRSLKTP-MW7115.0	4 LEVELS AWAY	6144.4
655952	NTIOGA-MW 7115.0	4 LEVELS AWAY	8145.2
659143	BLAISDELL 4230.0	4 LEVELS AWAY	5206.5
659183	CHAR.CK3 345.0	4 LEVELS AWAY	10881.2
659362	WHEELOCK 4230.0	4 LEVELS AWAY	6700.5
659387	KUMMERRIDGE3345.0	4 LEVELS AWAY	3638.6
659391	PATENTGATE 7115.0	4 LEVELS AWAY	15781.1
659392	PATENTGATE1913.80	4 LEVELS AWAY	24236.8
659393	PATENTGATE2913.80	4 LEVELS AWAY	24236.8
661085	TIOGA4 7 115.0	4 LEVELS AWAY	9152.2
661900	TIOGA4 9 13.80	4 LEVELS AWAY	17018.6
672603	BDV 4 230.0	4 LEVELS AWAY	4586.5

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
85932	J593 COL1 34.50	5 LEVELS AWAY	28809.7
587864	G16-108-TAP 345.0	5 LEVELS AWAY	12384.2
588293	G16-152-GEN10.690	5 LEVELS AWAY	503892.1
652391	WILLISTON27 115.0	5 LEVELS AWAY	15682.6
652421	WILISTN7 115.0	5 LEVELS AWAY	15682.6
652424	BELFELD3 345.0	5 LEVELS AWAY	6582.6
652621	WILISTN9 13.20	5 LEVELS AWAY	22026
652622	WILISTN29 13.20	5 LEVELS AWAY	22026
655844	TIMBERCK-MK7115.0	5 LEVELS AWAY	8790.4
655850	IDEAL -MK7115.0	5 LEVELS AWAY	10610.5
655851	NRTHWEST-MK7115.0	5 LEVELS AWAY	11205.2
655856	G8 -MK7115.0	5 LEVELS AWAY	6795
655902	PVALLEY -MW7115.0	5 LEVELS AWAY	5413.2
655946	POWERSLK-MW7115.0	5 LEVELS AWAY	4203.8
655948	LIBERTY -MW7115.0	5 LEVELS AWAY	5689.8
655953	WSTBNKTP-MW7115.0	5 LEVELS AWAY	8145.2
659108	LOGAN 4 230.0	5 LEVELS AWAY	5212.3
659124	G14_004IS_1 34.50	5 LEVELS AWAY	47039.3
659144	BLAISDELL 7115.0	5 LEVELS AWAY	6853.1
659164	BLAISDELL 913.80	5 LEVELS AWAY	25254.2
659182	CHAR.CK7 115.0	5 LEVELS AWAY	14476
659211	CHARCREEK 1913.80	5 LEVELS AWAY	24657.2
659302	CHAR.CK4 230.0	5 LEVELS AWAY	11645
659318	CHARCREEK 2913.80	5 LEVELS AWAY	23782.3
659319	CHARCREEK 3913.80	5 LEVELS AWAY	31550.7
659349	LSSSWTCHST 7115.0	5 LEVELS AWAY	11874.5
659363	WHEELOCK 7115.0	5 LEVELS AWAY	6719.2
659364	WHEELOCK 913.80	5 LEVELS AWAY	27196.1
659368	TIMBERCREEK4230.0	5 LEVELS AWAY	6363.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659384	ROUNDUP 3345.0	5 LEVELS AWAY	8935
659388	KUMMERRIDGE7115.0	5 LEVELS AWAY	8569.9
659389	KUMMERRIDG1913.80	5 LEVELS AWAY	21209.2
659394	KUMMERRIDG2913.80	5 LEVELS AWAY	21209.2
661080	STANLEY7 115.0	5 LEVELS AWAY	3487.6
661086	TIOGA7 7 115.0	5 LEVELS AWAY	7707.6
672602	BDX 4 230.0	5 LEVELS AWAY	4365.6

3.2.4. Short Circuit Result for Hilken 230kV switching station (652466)

The results of the short circuit analysis for POI i.e., Hilken 230kV switching station (652466) and five bus levels away are tabulated below in Table 3.2.4.

Table 3.2.4: Short circuit results for Hilken 230kV switching station (652466)

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652466	HILKEN 4 230.0	0 LEVELS AWAY	8577.3
652426	BISMARK4 230.0	1 LEVELS AWAY	13911.9
652441	GARRISN4 230.0	1 LEVELS AWAY	11446.1
659365	BALDWIN 4230.0	1 LEVELS AWAY	7527.6
652296	WARD 4 230.0	2 LEVELS AWAY	12268.9
652392	BISMARK9 12.47	2 LEVELS AWAY	27811.8
652427	BISMARK7 115.0	2 LEVELS AWAY	14864.6
652442	GARRISN7 115.0	2 LEVELS AWAY	12849.6
652444	JAMESTN4 230.0	2 LEVELS AWAY	8350.8
652456	WASHBRN4 230.0	2 LEVELS AWAY	10073.5
652457	GARISN1G 13.80	2 LEVELS AWAY	60402.1
652458	GARISN2G 13.80	2 LEVELS AWAY	60369.8
652459	GARISN3G 13.80	2 LEVELS AWAY	60337.6

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652467	BISMARK29 12.47	2 LEVELS AWAY	27812
652499	CAMPBELL 4 230.0	2 LEVELS AWAY	4642.7
659106	LELANDO4 230.0	2 LEVELS AWAY	23038.4
659128	WEBER 4 230.0	2 LEVELS AWAY	4850.3
659284	ECKLUND4 230.0	2 LEVELS AWAY	7527.6
659367	BALDWIN 934.50	2 LEVELS AWAY	16597.9
587030	GEN-2016-004230.0	3 LEVELS AWAY	7376.2
587720	GEN-2016-087230.0	3 LEVELS AWAY	4642.7
615901	GRE-STANTON4230.0	3 LEVELS AWAY	17008
652207	JAMEST29 13.20	3 LEVELS AWAY	20713.2
652208	JAMEST19 13.20	3 LEVELS AWAY	20772.2
652325	WASHBRN9 41.80	3 LEVELS AWAY	3160.9
652435	FARGO 4 230.0	3 LEVELS AWAY	10101.3
652445	JAMESTN7 115.0	3 LEVELS AWAY	10016.4
652449	MAX 7 115.0	3 LEVELS AWAY	5711.4
652460	GARISN4G 13.80	3 LEVELS AWAY	37973
652461	GARISN5G 13.80	3 LEVELS AWAY	37966.5
652590	SNAKECR7 115.0	3 LEVELS AWAY	5204
655642	WARDTERT-CP912.47	3 LEVELS AWAY	18278.1
655643	VOLTAIR -CP7115.0	3 LEVELS AWAY	7765.8
655647	BIS WARD-CP7115.0	3 LEVELS AWAY	7230.7
655652	BIS EXPR-CP7115.0	3 LEVELS AWAY	14864.6
657759	PICKERT4 230.0	3 LEVELS AWAY	4271.7
659105	LELANDO3 345.0	3 LEVELS AWAY	16803.9
659108	LOGAN 4 230.0	3 LEVELS AWAY	5130.6
659109	BASIN 7 115.0	3 LEVELS AWAY	5190.5
659110	LELAN41G 22.00	3 LEVELS AWAY	85354
659200	BASIN 9 13.80	3 LEVELS AWAY	13865.9
659201	LELNDOLD 1913.80	3 LEVELS AWAY	33999

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659202	LELNDOLD 2913.80	3 LEVELS AWAY	26414.7
659322	ECKLUNDWND1934.50	3 LEVELS AWAY	22102.1
659323	ECKLUNDWND2934.50	3 LEVELS AWAY	22100.8
659366	WILTON 3 W0.690	3 LEVELS AWAY	601576.9
659408	CAMPBLCNTY 4230.0	3 LEVELS AWAY	4217.3
659543	PICKCITY RR7115.0	3 LEVELS AWAY	9023.4
661029	ESTBMRK7 115.0	3 LEVELS AWAY	14849.2
661038	GLENHAM4 230.0	3 LEVELS AWAY	4867.8
661053	MANDAN 4 230.0	3 LEVELS AWAY	14850
85111	J511 230.0	4 LEVELS AWAY	6664
85991	J599 230.0	4 LEVELS AWAY	3935.9
560998	WILTON COL2 34.50	4 LEVELS AWAY	18919.6
579294	WILTON COL1 34.50	4 LEVELS AWAY	19060.9
587031	G16-004XFMR134.50	4 LEVELS AWAY	22924.7
587721	G16-087XFMR134.50	4 LEVELS AWAY	11481.5
588210	GEN-2016-130345.0	4 LEVELS AWAY	11385.6
602006	SHEYNNE4 230.0	4 LEVELS AWAY	10989.3
615348	GRE-MCHENRY7115.0	4 LEVELS AWAY	7811.5
615600	GRE-COAL CR4230.0	4 LEVELS AWAY	17028.5
615900	GRE-COAL TP4230.0	4 LEVELS AWAY	14697.4
620167	PICKERT9 41.60	4 LEVELS AWAY	2597
652222	MAX 9 41.60	4 LEVELS AWAY	4737.9
652320	JAMESTN9 41.80	4 LEVELS AWAY	3306.1
652420	NSALEM 7 115.0	4 LEVELS AWAY	1808.9
652428	CARNGTN7 115.0	4 LEVELS AWAY	2602.1
652432	EDGELEY7 115.0	4 LEVELS AWAY	4031.6
652434	FARGOSVC 13.20	4 LEVELS AWAY	33389.1
652436	FARGO 7 115.0	4 LEVELS AWAY	10500.8
652437	GRNDFKS4 230.0	4 LEVELS AWAY	7135

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652440	NELSON 7 115.0	4 LEVELS AWAY	6869.3
652454	VALLEYC7 115.0	4 LEVELS AWAY	4353.4
652464	DENBIGH TAP7115.0	4 LEVELS AWAY	4394.9
652468	HEBRON 4 230.0	4 LEVELS AWAY	5127.2
652527	WHITLOK4 230.0	4 LEVELS AWAY	4855.4
652553	MOORHED4 230.0	4 LEVELS AWAY	6938.8
655644	NBISMRCK-CP7115.0	4 LEVELS AWAY	9505
655648	CIRCLE K-CP7115.0	4 LEVELS AWAY	5503.6
655661	DGLASCRK-CP7115.0	4 LEVELS AWAY	3618.2
657741	ROUGHRIDER 4230.0	4 LEVELS AWAY	15610.7
657756	SQBUTTE4 230.0	4 LEVELS AWAY	22533.4
657923	PICKERT8 69.00	4 LEVELS AWAY	3125.1
659101	ANTELOP3 345.0	4 LEVELS AWAY	16939
659111	LELAN32G 20.00	4 LEVELS AWAY	128633.4
659143	BLAISDELL 4230.0	4 LEVELS AWAY	5030
659155	LOGAN 7 115.0	4 LEVELS AWAY	8104.6
659208	LOGAN 913.80	4 LEVELS AWAY	19124.2
659300	STANTONTAP 7115.0	4 LEVELS AWAY	7395.8
659409	CAMPBLCNTY 934.50	4 LEVELS AWAY	16189.9
659422	LELAND1-LNX3345.0	4 LEVELS AWAY	16803.9
659424	LELAND2-LNX3345.0	4 LEVELS AWAY	16803.9
661009	BISEXP 7 115.0	4 LEVELS AWAY	12545.4
661035	GLENHAM7 115.0	4 LEVELS AWAY	4706.6
661042	HESKETT4 230.0	4 LEVELS AWAY	14096.1
661054	MANDAN 7 115.0	4 LEVELS AWAY	20099
661060	LINTON 7 115.0	4 LEVELS AWAY	1328.4
661119	26TH&D 7 115.0	4 LEVELS AWAY	13495
661600	GLENHAM9 41.60	4 LEVELS AWAY	6131.5
661908	MANDAN 9 13.80	4 LEVELS AWAY	34849.7

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
10651	G830_SUB 115.0	5 LEVELS AWAY	5027.5
83021	J302 POI 230.0	5 LEVELS AWAY	5655.6
85112	J511 COL 34.50	5 LEVELS AWAY	21491.5
85992	J599 COL1 34.50	5 LEVELS AWAY	22573.3
560074	G16-017-TAP 345.0	5 LEVELS AWAY	6486.2
587032	G16-004-GSU134.50	5 LEVELS AWAY	20127
587035	G16-004-GSU234.50	5 LEVELS AWAY	21479.9
587050	GEN-2016-007115.0	5 LEVELS AWAY	3931.2
587722	G16-087-GSU134.50	5 LEVELS AWAY	10825.7
587864	G16-108-TAP 345.0	5 LEVELS AWAY	12405.9
588211	G16-130XFMR134.50	5 LEVELS AWAY	25137.6
603018	SHEYNNE7 115.0	5 LEVELS AWAY	12637.4
603023	MALLARD7 115.0	5 LEVELS AWAY	7460.7
605634	VELVA TAP 115.0	5 LEVELS AWAY	6483.7
605724	SHEYENNE5 9 13.80	5 LEVELS AWAY	12608.3
605730	SHEYENNE6 9 13.80	5 LEVELS AWAY	12471.8
608602	SQBEAST4 230.0	5 LEVELS AWAY	22533.4
615001	GRE-COAL 41G22.00	5 LEVELS AWAY	132875.6
615002	GRE-COAL 42G22.00	5 LEVELS AWAY	132267.7
615347	GRE-MCHENRY4230.0	5 LEVELS AWAY	5746.9
615349	GRE-MCHENRYT12.47	5 LEVELS AWAY	12894.2
615601	GRE-COAL FM869.00	5 LEVELS AWAY	8523.4
615602	GRE-COALFM1T12.47	5 LEVELS AWAY	16546.2
615603	GRE-COALFM2T12.47	5 LEVELS AWAY	16469
620336	AUDUBON4 230.0	5 LEVELS AWAY	5196.3
620381	UNDERWD4 230.0	5 LEVELS AWAY	13616.6
652201	GRNDFKS9 12.47	5 LEVELS AWAY	50464
652203	FARGO 8 69.00	5 LEVELS AWAY	11781.1
652204	VALLEYC8 69.00	5 LEVELS AWAY	2525.3

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
652321	CARNGTN9 41.80	5 LEVELS AWAY	2739.1
652322	EDGELEY9 41.80	5 LEVELS AWAY	3514.4
652323	FARGO 9 41.80	5 LEVELS AWAY	1308.1
652328	EDGELEY 19 13.20	5 LEVELS AWAY	3303.8
652416	DEVAUL 7 115.0	5 LEVELS AWAY	1318
652417	DICKNSN4 230.0	5 LEVELS AWAY	6583.6
652423	BARLOW 7 115.0	5 LEVELS AWAY	2592.7
652433	EDGELEY8 69.00	5 LEVELS AWAY	2692.7
652443	GRNDFKS7 115.0	5 LEVELS AWAY	11106.9
652453	TOWNER 7 115.0	5 LEVELS AWAY	4561.5
652534	ORDWAY 7 115.0	5 LEVELS AWAY	9572.7
652554	MORRIS 4 230.0	5 LEVELS AWAY	4802.4
652587	MOORHED7 115.0	5 LEVELS AWAY	6201.3
652613	VALLEYC9 13.20	5 LEVELS AWAY	3671.3
652638	ENDERLIN 7 115.0	5 LEVELS AWAY	3286.1
652821	SULLYBT-LNX3230.0	5 LEVELS AWAY	6535.8
655646	GVPINES -CP7115.0	5 LEVELS AWAY	4761.3
655657	SWMINOT -CP7115.0	5 LEVELS AWAY	5860.1
655662	ROSEGLEN-CP7115.0	5 LEVELS AWAY	3473.1
657707	CALEDON7 115.0	5 LEVELS AWAY	3352.4
657742	OLIVERWND3 4230.0	5 LEVELS AWAY	10865.1
657751	CENTER 4 230.0	5 LEVELS AWAY	20284.3
657754	MAPLE R4 230.0	5 LEVELS AWAY	12185.9
657755	PRAIRIE4 230.0	5 LEVELS AWAY	8033.9
657791	CENTER 3 345.0	5 LEVELS AWAY	11948.9
657848	YNG2 4 230.0	5 LEVELS AWAY	18355.5
657947	CENTR1TE 13.80	5 LEVELS AWAY	45739.5
657948	CENTR2TE 13.80	5 LEVELS AWAY	45740.5
658080	MPSBROOK 115.0	5 LEVELS AWAY	6453.4

Bus #	Bus Name	Level Away	Fault Current (Amperes)
			3 PH
659103	ANTEL31G 23.00	5 LEVELS AWAY	147226.4
659107	ANTEL32G 23.00	5 LEVELS AWAY	147226.4
659144	BLAISDELL 7115.0	5 LEVELS AWAY	6615.2
659164	BLAISDELL 913.80	5 LEVELS AWAY	24663.7
659190	NDPRAIRWND 7115.0	5 LEVELS AWAY	6869.3
659212	DGC 3345.0	5 LEVELS AWAY	16120.7
659218	COTEAU 3345.0	5 LEVELS AWAY	16939
659273	WILTON 2 W0.690	5 LEVELS AWAY	733252.2
659280	POMONA 7 115.0	5 LEVELS AWAY	3275
659294	WILTON 1 W0.690	5 LEVELS AWAY	735325.9
659305	ROUGHRDRMGS7115.0	5 LEVELS AWAY	10058.7
659384	ROUNDUP 3345.0	5 LEVELS AWAY	8828.8
659400	NDSUNFLWR 4230.0	5 LEVELS AWAY	4606.8
659404	ANTELPHILLS3345.0	5 LEVELS AWAY	11381.9
659410	CAMBLCNTCOL934.50	5 LEVELS AWAY	15298.5
659420	ANTELOP-LNX3345.0	5 LEVELS AWAY	16939
659423	GROTON-LNX3 345.0	5 LEVELS AWAY	6204.8
661008	BEULAH 7 115.0	5 LEVELS AWAY	9670.2
661030	STEIN 7 115.0	5 LEVELS AWAY	12798
661037	BOWDLE 7 115.0	5 LEVELS AWAY	1668.5
661039	MOBRIDG7 115.0	5 LEVELS AWAY	2855
661043	HESKETT7 115.0	5 LEVELS AWAY	20541.4
661051	STH9TH 7 115.0	5 LEVELS AWAY	11240.5
661067	MANDANW7 115.0	5 LEVELS AWAY	13746.3
661084	TIOGA4 4 230.0	5 LEVELS AWAY	8798.8
661906	HESKETT9 13.80	5 LEVELS AWAY	28950.2

4. Stability Analysis for Cluster Scenario

4.1. Faults Simulated

Seventy five (75) faults were considered for the transient stability simulations which included three phase faults, as well as single phase line faults. Single-phase line faults were simulated by applying fault impedance to the positive sequence network at the fault location. As per the SPP current practice to compute the fault levels, the fault impedance was computed to give a positive sequence voltage at the specified fault location of approximately 60% of pre-fault voltage.

Concurrently and previously queued projects as respectively shown in Table-1 and Table-2 of the study request as well as areas number 330, 356, 600, 615, 620, 635, 640, 645, 652, and 661 were monitored during all the simulations. Table 4.1.1 shows the list of simulated contingencies. This Table also shows the fault clearing time and the time delay before re-closing for all the study contingencies.

Simulations were performed with a 0.1-second steady-state run followed by the appropriate disturbance as described in Table 4.1.1. Simulations were run for minimum 20-second duration to confirm proper machine damping.

Table 4.1.1 summarizes the overall results for all faults simulations of cluster scenario. Complete sets of plots for Winter-2017, Summer-2018, and Summer-2026 peak seasons for each fault are included in Appendices A, B and C respectively.

The machines under study, as well as the prior queued projects, and requested monitored areas produce an exhaustive list for system stability simulations results plotting. Therefore for each contingency description, only four (4) plots sheets are included i.e. Page-1, Page-2, Page-3, and page-4 that respectively represent the machines quantities under this study, prior queued machine quantities, and machine and bus voltages for different areas. Overall for each scenario there are 300 plots sheets for seventy five (75) contingency descriptions.

Table 4.1.1: List of simulated faults for cluster scenario stability analysis

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
1	FLT01-3PH	3 phase fault on the G16-108 TAP (587864) to CHAR.CK (659183) 345kV line circuit 1, near G16-108 TAP. a. Apply fault at the G16-108 TAP 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
2	FLT02-3PH	3 phase fault on the G16-108 TAP (587864) to ANTELOP (659101) 345kV line circuit 1, near G16-108 TAP. a. Apply fault at the G16-108 TAP 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
3	FLT03-3PH	3 phase fault on CHAR.CK (659183) to BELFELD (652424) 345kV line circuit 1, near CHAR.CK. a. Apply fault at the CHAR.CK 345 bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
4	FLT04-3PH	3 phase fault on CHAR.CK (659183) to ROUNDUP (659384) 345kV line circuit 1, near CHAR.CK. a. Apply fault at the CHAR.CK 345 bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
5	FLT05-3PH	3 phase fault on CHAR.CK (659183) to PATENTGATE (659390) 345kV line circuit 1, near CHAR.CK. a. Apply fault at the CHAR.CK 345 bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
6	FLT06-3PH	3 phase fault on the CHAR.CK 345/230/13.8kV (659183/659302/659319) transformer, near CHAR.CK. a. Apply fault at the CHAR.CK 345kV bus. b. Clear fault after 6 cycles by tripping the faulted transformer.	Stable	Stable	Stable
7	FLT07-3PH	3 phase fault on the CHAR.CK 345/115/13.8kV (659183/659182/659211) transformer, near CHAR.CK. a. Apply fault at the CHAR.CK 345kV bus. b. Clear fault after 6 cycles by tripping the faulted transformer.	Stable	Stable	Stable
8	FLT08-3PH	3 phase fault on the BELFELD 345/230/13.8kV (652424/652425/652220) transformer, near BELFELD. a. Apply fault at the BELFELD 345kV bus. b. Clear fault after 6 cycles by tripping the faulted transformer.	Stable	Stable	Stable
9	FLT09-3PH	3 phase fault on BELFELD (652425) to MEDORA (652413) 230kV line circuit 1, near BELFELD. a. Apply fault at the BELFELD 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
10	FLT10-3PH	3 phase fault on BELFELD (652425) to DICKSN (652417) 230kV line circuit 1, near BELFELD. a. Apply fault at the BELFELD 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
11	FLT11-3PH	3 phase fault on BELFELD (652425) to SHEART (659309) 230kV line circuit 1, near BELFELD. a. Apply fault at the BELFELD 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
12	FLT12-3PH	3 phase fault on BELFELD (652425) to DAGLUM (659448) 230kV line circuit 1, near BELFELD. a. Apply fault at the BELFELD 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
13	FLT13-3PH	3 phase fault on PATENTGATE (659390) to JUDSON (659333) 345kV line circuit 1, near PATENTGATE. a. Apply fault at the PATENTGATE 345 bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
14	FLT14-3PH	3 phase fault on PATENTGATE (659390) to KUMMERRIDGE (659387) 345kV line circuit 1, near PATENTGATE. a. Apply fault at the PATENTGATE 345 bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
15	FLT15-3PH	3 phase fault on the PATENTGATE 345/115/13.8kV (659390/659391/659392) transformer, near PATENTGATE. a. Apply fault at the PATENTGATE 345kV bus. b. Clear fault after 6 cycles by tripping the faulted transformer.	Stable	Stable	Stable
16	FLT16-3PH	3 phase fault on JUDSON (659333) to TANDE-LNX (659427) to TANDE (659336) 345kV line circuit 1, near JUDSON. a. Apply fault at the JUDSON 345 bus. b. Clear fault after 6 cycles by tripping the faulted line.	**UnStable**	**UnStable**	**UnStable**
16a	FLT16a-3PH	**Addition of a 2nd 345/230kV transformer at Tande station** 3 phase fault on JUDSON (659333) to TANDE-LNX (659427) to TANDE (659336) 345kV line circuit 1, near JUDSON. a. Apply fault at the JUDSON 345 bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
16b	FLT16b-3PH	**Addition of a 2nd 345/230kV transformer at Tande station** **Prior Outage of 345/230kV transformer at Tande station** **Curtail current study generation by 110 MW** 3 phase fault on JUDSON (659333) to TANDE-LNX (659427) to TANDE (659336) 345kV line circuit 1, near JUDSON. a. Apply fault at the JUDSON 345 bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
17	FLT17-3PH	3 phase fault on the JUDSON 345/230/13.8kV (659333/659334/659335) transformer, near JUDSON. a. Apply fault at the JUDSON345kV bus. b. Clear fault after 6 cycles by tripping the faulted transformer.	Stable	Stable	Stable
18	FLT18-3PH	3 phase fault on the KUMMERRIDGE 345/115/13.8kV (659387/659388/659394) transformer, near KUMMERRIDGE. a. Apply fault at the KUMMERRIDGE 345kV bus. b. Clear fault after 6 cycles by tripping the faulted transformer.	Stable	Stable	Stable
19	FLT19-3PH	3 phase fault on TANDE (659336) to TANDE_LNX (659427) 345kV line circuit 1, near TANDE. a. Apply fault at the TANDE 345 bus. b. Clear fault after 6 cycles by tripping the faulted line.	**UnStable**	**UnStable**	**UnStable**
19a	FLT19a-3PH	**Addition of a 2nd 345/230kV transformer at Tande station** 3 phase fault on TANDE (659336) to TANDE_LNX (659427) 345kV line circuit 1, near TANDE. a. Apply fault at the TANDE 345 bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
19b	FLT19b-3PH	**Addition of a 2nd 345/230kV transformer at Tande station** **Prior Outage of 345/230kV transformer at Tande station** **Curtail current study generation by 110 MW** 3 phase fault on TANDE (659336) to TANDE_LNX (659427) 345kV line circuit 1, near TANDE. a. Apply fault at the TANDE 345 bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
20	FLT20-3PH	3 phase fault on the TANDE 345/230/13.8kV (659336/659337/659338) transformer, near TANDE. a. Apply fault at the TANDE 345kV bus. b. Clear fault after 6 cycles by tripping the faulted transformer.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
21	FLT21-3PH	3 phase fault on TIOGA (661084) to NESET (659138) 230kV line circuit 1, near TIOGA. a. Apply fault at the TIOGA 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
22	FLT22-3PH	3 phase fault on TIOGA (661084) to BLAISDELL (659143) 230kV line circuit 1, near TIOGA. a. Apply fault at the TIOGA 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
23	FLT23-3PH	3 phase fault on TIOGA (661084) to WHEELOCK (659362) 230kV line circuit 1, near TIOGA. a. Apply fault at the TIOGA 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
24	FLT24-3PH	3 phase fault on TIOGA (661084) to BDV (672603) 230kV line circuit 1, near TIOGA. 3 phase fault on TIOGA (661084) to LARSON (659372) 230kV line circuit 1, near TIOGA (for 2026 Scenario) a. Apply fault at the TIOGA 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
25	FLT25-3PH	3 phase fault on the TIOGA 345/115/13.8kV (661084/661085/661900) transformer, near TIOGA. a. Apply fault at the TIOGA 345kV bus. b. Clear fault after 6 cycles by tripping the faulted transformer.	Stable	Stable	Stable
26	FLT26-3PH	3 phase fault on ANTELOP (659101) to ANTELOP_LNX (659420) to BRDLAND_LNX (659421) to BRDLAND (659120) 345kV line circuit 1, near ANTELOP. a. Apply fault at the ANTELOP 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
27	FLT27-3PH	3 phase fault on ANTELOP (659101) to LELANDO (659105) 345kV line circuit 1, near ANTELOP. a. Apply fault at the ANTELOP 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
28	FLT28-3PH	3 phase fault on ANTELOP (659101) to ROUNDUP (659384) 345kV line circuit 1, near ANTELOP. a. Apply fault at the ANTELOP 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
29	FLT29-3PH	3 phase fault on the LELANDO 345/230/13.8kV (659105/659106/659201) transformer, near LELANDO. a. Apply fault at the LELANDO 345kV bus. b. Clear fault after 6 cycles by tripping the faulted transformer.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
30	FLT30-3PH	3 phase fault on LELANDO (659105) to LELAND2_LNX (659424) to G16-017 TAP (560074) 345kV circuit 1, near LELANDO. a. Apply fault at the LELANDO 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
31	FLT31-3PH	3 phase fault on LELANDO (659105) to LELAND1_LNX (659422) to GROTON_LNX (659423) to GROTON (659160) 345kV circuit 1, near LELANDO. a. Apply fault at the LELANDO 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
32	FLT32-3PH	3 phase fault on G16-017-TAP (560074) to FTTHOM (652806) to FTTHOMP (652506) 345kV line circuit 1, near G16-017-TAP. a. Apply fault at the G16-017-TAP 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	**UnStable**	Stable
32a	FLT32a-3PH	**Addition of an Emmons County to McIntosh County 345kV circuit and upgrade of Broadland 345kV to Huron 230kV transformer** 3 phase fault on G16-017-TAP (560074) to FTTHOM (652806) to FTTHOMP (652506) 345kV line circuit 1, near G16-017-TAP. a. Apply fault at the G16-017-TAP 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
33	FLT33-3PH	3 phase fault on the FTTHOMP 345/230/13.8kV (652506/652507/652274) transformer, near FTTHOMP. a. Apply fault at the FTTHOMP 345kV bus. b. Clear fault after 6 cycles by tripping the faulted transformer.	Stable	Stable	Stable
34	FLT34-3PH	3 phase fault on FTTHOMP (652506) to FTTHOM_LNX (652807) to GRPRAR_LNX (652833) to GRPRAR_LNX (652532) 345kV line circuit 1, near FTTHOMP. a. Apply fault at the FTTHOMP 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
35	FLT35-3PH	3 phase fault on FTTHOMP (652507) to WESSINGTON (652607) 230kV line circuit 1, near FTTHOMP. a. Apply fault at the FTTHOMP 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
36	FLT36-3PH	3 phase fault on FTTHOMP (652507) to FTRANDL (652509) 230kV line circuit 1, near FTTHOMP. a. Apply fault at the FTTHOMP 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
37	FLT37-3PH	3 phase fault on FTTHOMP (652507) to LETCHER (652606) 230kV line circuit 1, near FTTHOMP. a. Apply fault at the FTTHOMP 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
38	FLT38-3PH	3 phase fault on FTTHOMP (652507) to HURON (652514) 230kV line circuit 2, near FTTHOMP. a. Apply fault at the FTTHOMP 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
39	FLT39-3PH	3 phase fault on FTTHOMP (652507) to LAKPLAT (652516) 230kV line circuit 1, near FTTHOMP. a. Apply fault at the FTTHOMP 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
40	FLT40-3PH	3 phase fault on HURON (652514) to WATERTN (652530) 230kV line circuit 1, near HURON. a. Apply fault at the HURON 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
41	FLT41-3PH	3 phase fault on HURON (652514) to CARPENTER (652614) 230kV line circuit 1, near HURON. a. Apply fault at the HURON 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
42	FLT42-3PH	3 phase fault on HURON (652514) to BRDLAND (659205) 230kV line circuit 1, near HURON. a. Apply fault at the HURON 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
43	FLT43-3PH	3 phase fault on the Hilken (652466) to Garrison (652441) 230kV line circuit 1, near Hilken. a. Apply fault at the Hilken 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
44	FLT44-3PH	3 phase fault on the Hilken (652466) to Bismark (652426) 230kV line circuit 1, near Hilken. a. Apply fault at the Hilken 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
45	FLT45-3PH	3 phase fault on the Bismark (652426) to Jamestown (652444) 230kV line circuit 1, near Bismark. a. Apply fault at the Bismark 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
46	FLT46-3PH	3 phase fault on the Bismark (652426) to Weber (659128) 230kV line circuit 1, near Bismark. a. Apply fault at the Bismark 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
47	FLT47-3PH	3 phase fault on the Bismark (652426) to Campbell (652499) 230kV line circuit 1, near Bismark. a. Apply fault at the Bismark 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
48	FLT48-3PH	3 phase fault on the Bismark (652426) to Ward (652296) 230kV line circuit 1, near Bismark. a. Apply fault at the Bismark 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
49	FLT49-3PH	3 phase fault on the Bismark 230/115/12.4kV (652426/652427/652392) transformer circuit 1, near Bismark. a. Apply fault at the Bismark 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
50	FLT50-SB	**Garrison 230 kV Stuck Breaker Scenario 1** a. Apply single line to ground fault at the Garrison 230kV bus. b. Clear fault after 16 cycles and trip the following elements c. Garrison (652441) – Leland Olds (659106) 230kV	Stable	Stable	Stable
51	FLT51-SB	**Garrison 230 kV Stuck Breaker Scenario 2** a. Apply single line to ground fault at the Garrison 230kV bus. b. Clear fault after 16 cycles and trip the following elements c. Garrison (652441) – Jamestown (652444) 230kV	Stable	Stable	Stable
52	FLT52-SB	**Bismark 230 kV Stuck Breaker Scenario 1** a. Apply single line to ground fault at the Bismark 230kV bus. b. Clear fault after 16 cycles and trip the following elements c. Bismark (652426) – Campbell County (652499) 230kV d. Bismark (652426) – Hilken (652466) 230kV e. Bismark (652426/652427/652392) 230/115/12.47kV f. Bismark (652426) – Weber (659128) 230kV	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
53	FLT53-SB	**Bismark 230 kV Stuck Breaker Scenario 2** a. Apply single line to ground fault at the Bismark 230kV bus. b. Clear fault after 16 cycles and trip the following elements c. Bismark (652426) – Washburn (652456) 230kV d. Bismark (652426) – Jamestown (652444) 230kV e. Bismark (652426/652427/652467) 230/115/12.47kV f. Bismark (652426) – Ward (652296) 230kV	Stable	Stable	Stable
54	FLT54-3PH	**Prior Outage of Hilken 230 kV (652466) to Bismark 230 kV (652426) CKT 1;** 3 phase fault on the Garrison (652441) to Jamestown (652444) 230kV line circuit 1, near Garrison. a. Apply fault at the Garrison 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable
55	FLT55-SB	**ANTELOPE (659101) 345KV Stuck Breaker Scenario** a. Apply single line to ground fault at the ANTELOP 345kV bus. b. Run 4 cycles and leave fault on c. Trip BRDLAND_LNX (659421) to BRDLAND (659120) 345kV line d. Run 8 cycles, then clear fault e. Trip COTEAU loads (bus #659222, 659219, 659231, 659218, 659236, 659420) f. Trip ANTELOP (659101) to ANTELOP_LNX (659420) to BRDLAND_LNX (659421) 345kV line	Stable	UnStable	Stable
55a	FLT55a-SB	**Addition of an Emmons County to McIntosh County 345kV circuit and upgrade of Broadland 345kV to Huron 230kV transformer** **ANTELOPE (659101) 345KV Stuck Breaker Scenario** a. Apply single line to ground fault at the ANTELOP 345kV bus. b. Run 4 cycles and leave fault on c. Trip ANTELOP_LNX (659420) to Emmons County (659007) 345kV line d. Run 8 cycles, then clear fault e. Trip COTEAU loads (bus #659222, 659219, 659231, 659218, 659236, 659420) f. Trip ANTELOP (659101) to ANTELOP_LNX (659420) 345kV line	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
56	FLT56-SB	**LELANDO (659105) 345KV Stuck Breaker Scenario 1** a. Apply single line to ground fault at the LELANDO 345kV bus. b. Run 4 cycles and leave fault on c. Trip LELANDO (659105) to LELAND2_LNX (659424) to G16-017-TAP (5600514) 345kV line d. Run 10 cycles, then clear fault	Stable	**UnStable**	Stable
56a	FLT56a-SB	**Addition of an Emmons County to McIntosh County 345kV circuit and upgrade of Broadland 345kV to Huron 230kV transformer** **LELANDO (659105) 345KV Stuck Breaker Scenario 1** a. Apply single line to ground fault at the LELANDO 345kV bus. b. Run 4 cycles and leave fault on c. Trip LELAND2_LNX (659424) to McIntosh County substation 345kV line d. Run 10 cycles, then clear fault e. Trip LELANDO (659105) to LELAND2_LNX (659424) 345kV line	Stable	Stable	Stable
57	FLT57-SB	**LELANDO (659105) 345KV Stuck Breaker Scenario 2** a. Apply single line to ground fault at the LELANDO 345kV bus. b. Run 4 cycles and leave fault on c. Trip GROTON_LNX (659423) to GROTON (659160) 345kV line d. Run 8 cycles, then clear fault e. Trip LELANDO (659105) to LELAND1_LNX (659422) to GROTON_LNX (659423) 345kV line f. Trip LELANDO (659105/659106/659201) 345/230/13.8kV transformer	Stable	**UnStable**	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
57a	FLT57a-SB	**Addition of an Emmons County to McIntosh County 345kV circuit and upgrade of Broadland 345kV to Huron 230kV transformer** **LELANDO (659105) 345KV Stuck Breaker Scenario 2** a. Apply single line to ground fault at the LELANDO 345kV bus. b. Run 4 cycles and leave fault on c. Trip LELAND1_LNX (659422) to Emmons County substation 345kV line d. Run 8 cycles, then clear fault e. Trip LELANDO (659105) to LELAND1_LNX (659422) 345kV line f. Trip LELANDO (659105/659106/659201) 345/230/13.8kV transformer	Stable	Stable	Stable
58	FLT58-SB	**CHAR.CK (659183) 345KV Stuck Breaker Scenario 1** a. Apply single line to ground fault at the CHAR.CK 345kV bus. b. Run 4 cycles and leave fault on c. Trip CHAR.CK (659183) to PATENTGATE (659390) 345kV line d. Run 10 cycles, then clear fault e. Trip CHAR.CK (659183) to ROUNDUP (659384) 345kV line	Stable	Stable	Stable
59	FLT59-SB	**CHAR.CK (659183) 345KV Stuck Breaker Scenario 2** a. Apply single line to ground fault at the CHAR.CK 345kV bus. b. Run 4 cycles and leave fault on c. Trip CHAR.CK (659183) to G16-108-TAP (587864) 345kV line d. Run 10 cycles, then clear fault e. Trip CHAR.CK transformer (659183/659182/659211) 345/115/13.8kV	Stable	Stable	Stable
60	FLT60-SB	**CHAR.CK (659183) 345KV Stuck Breaker Scenario 3** a. Apply single line to ground fault at the CHAR.CK 345kV bus. b. Run 4 cycles and leave fault on c. Trip CHAR.CK (659183) to BELFELD (652424) 345kV line d. Run 10 cycles, then clear fault e. Trip CHAR.CK transformer (659183/659302/659319) 345/115/13.8kV f. Trip CHAR.CK transformer (659183/659302/659318) 345/115/13.8kV	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
61	FLT61-SB	**Addition of an Emmons County to McIntosh County 345kV circuit and upgrade of Broadland 345kV to Huron 230kV transformer** **Emmons County 345KV Substation Stuck Breaker Scenario 1** a. Apply single line to ground fault at Emmons County 345kV substation. b. Run 4 cycles and leave fault on c. Trip LELANDO (659105) to LELAND2_LNX (659424) 345kV line d. Run 10 cycles, then clear fault e. Trip LELAND2_LNX (659424) to Emmons County substation 345kV line f. Trip Emmons County to McIntosh County 345kV circuit	Stable	Stable	Stable
62	FLT62-SB	**Addition of an Emmons County to McIntosh County 345kV circuit and upgrade of Broadland 345kV to Huron 230kV transformer** **Emmons County 345KV Substation Stuck Breaker Scenario 2** a. Apply single line to ground fault at Emmons County 345kV substation. b. Run 4 cycles and leave fault on c. Trip G16-017-TAP (5600514) to Emmons County substation 345kV line d. Run 10 cycles, then clear fault e. Trip Emmons County to McIntosh County 345kV circuit	Stable	Stable	Stable
63	FLT63-SB	**Addition of an Emmons County to McIntosh County 345kV circuit and upgrade of Broadland 345kV to Huron 230kV transformer** **Emmons County 345KV Substation Stuck Breaker Scenario 3** a. Apply single line to ground fault at Emmons County 345kV substation. b. Run 4 cycles and leave fault on c. Trip LELANDO (659105) to LELAND2_LNX (659424) 345kV line d. Run 10 cycles, then clear fault e. Trip LELAND2_LNX (659424) to Emmons County substation 345kV line f. Trip BRDLAND (659120) to BRDLAND_LNX (659421) to Emmons County substation 345kV circuit	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
64	FLT64-SB	**Addition of an Emmons County to McIntosh County 345kV circuit and upgrade of Broadland 345kV to Huron 230kV transformer** **McIntosh County 345KV Substation Stuck Breaker Scenario 1** a. Apply single line to ground fault at McIntosh County 345kV substation. b. Run 4 cycles and leave fault on c. Trip GROTON_LNX (659423) to GROTON (659160) 345kV line d. Run 10 cycles, then clear fault e. Trip GROTON_LNX (659423) to McIntosh County substation 345kV line f. Trip Emmons County to McIntosh County 345kV circuit	Stable	Stable	Stable
65	FLT65-SB	**Addition of an Emmons County to McIntosh County 345kV circuit and upgrade of Broadland 345kV to Huron 230kV transformer** **McIntosh County 345KV Substation Stuck Breaker Scenario 2** a. Apply single line to ground fault at McIntosh County 345kV substation. b. Run 4 cycles and leave fault on c. Trip LELANDO (659105) to LELAND1_LNX (659422) 345kV line d. Run 10 cycles, then clear fault e. Trip LELAND1_LNX (659422) to McIntosh County substation 345kV line	Stable	Stable	Stable
66	FLT66-3PH	**Addition of an Emmons County to McIntosh County 345kV circuit and upgrade of Broadland 345kV to Huron 230kV transformer** **Prior Outage of ANTELOP (659101) to ANTELOP_LNX (659420) to Emmons County 345KV Substation CKT 1;** 3 phase fault on LELANDO (659105) to LELAND2_LNX (659424) to Emmons County substation 345kV circuit 1, near LELANDO. a. Apply fault at the LELANDO 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	UnStable	Stable

Cont. #	Contingency Name	Description	2017 Winter Results	2018 Summer Results	2026 Summer Results
66a	FLT66a-3PH	**Addition of an Emmons County to McIntosh County 345kV circuit and upgrade of Broadland 345kV to Huron 230kV transformer** **Prior Outage of ANTELOP (659101) to ANTELOP_LNX (659420) to Emmons County 345KV Substation CKT 1** **Curtail current study generation by 500 MW** 3 phase fault on LELANDO (659105) to LELAND2_LNX (659424) to Emmons County substation 345kV circuit 1, near LELANDO. a. Apply fault at the LELANDO 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.	Stable	Stable	Stable

4.2. Simulation Results for unstable faults

For cluster scenario, there are no impacts on the stability performance of the SPP system for the contingencies tested on the SPP provided base cases, except for the following critical contingencies in the each scenario:

- Winter-2017 scenario: FLT16-3PH and FLT19-3PH.
- Summer-2018 Scenario: FLT16-3PH, FLT19-3PH, FLT32-3PH, FLT55-SB, FLT56-SB, FLT57-SB, and FLT66-3PH.
- Summer-2026 Scenario: FLT16-3PH and FLT19-3PH.

The instability observed for FLT16-3PH and FLT19-3PH was mitigated with the addition of a 2nd 345/230kV transformer at TANDE (659336) as demonstrated in FLT16a-3PH and FLT19a-3PH. During an outage of either transformer, generation curtailments may be required to maintain system reliability as demonstrated in FLT16b-3PH and FLT19b-3PH.

The instability observed for FLT32-3PH, FLT55-SB, FLT56-SB, and FLT57-SB was mitigated with the addition of a new Emmons County substation along Antelope Valley Station to Broadland 345kV (500kV) and Fort Thompson to Leland Olds 345kV circuits, new McIntosh County substation along Groton to Leland Olds 345kV circuit, a new approximately 45 mile Emmons County to McIntosh County 345kV circuit, and upgrading the Broadland 345kV (500kV) to Huron 230kV transformer as demonstrated in FLT32a-3PH, FLT55a-SB, FLT56a-SB, FLT57a-SB, FLT-61-SB, and FLT-62-SB.

The instability observed for FLT66-3PH demonstrated that during an outage of any of the circuits connected to either new Emmons County or McIntosh County 345kV substation, generation curtailments may be required to maintain system reliability as demonstrated in FLT66a-3PH.

5. Conclusions

The findings of the impact study for the proposed interconnection projects under DISIS-2016-002 (Group 16) considered 100% of their proposed installed capacity are as follows:

1. Except for the following contingencies in each scenario, there are no impacts on the stability performance of the SPP system during cluster scenarios for the contingencies tested on the provided base cases:
   - Winter-2017 scenario: FLT16-3PH and FLT19-3PH.
   - Summer-2018 Scenario: FLT16-3PH, FLT19-3PH, FLT32-3PH, FLT55-SB, FLT56-SB, FLT57-SB, and FLT66-3PH.
   - Summer-2026 Scenario: FLT16-3PH and FLT19-3PH.
2. The instability observed for FLT16-3PH and FLT19-3PH was mitigated with the additional of a 2nd 345/230kV transformer at Tande station.
3. The instability observed for FLT32-3PH, FLT55-SB, FLT56-SB, and FLT57-SB was mitigated with the addition of a new Emmons County substation along Antelope Valley Station to Broadland 345kV (500kV) and Fort Thompson to Leland Olds 345kV circuits, new McIntosh County substation along Groton to Leland Olds 345kV circuit, a new approximately 45 mile Emmons County to McIntosh County 345kV circuit, and upgrading the Broadland 345kV (500kV) to Huron 230kV transformer.
4. The instability observed for FLT16-3PH, FLT19-3PH, FLT66-3PH demonstrate that during an outage of any of several transmission circuits, generation curtailments may be required to maintain system reliability in preparation of a subsequent circuit outage.
5. For the other contingencies, the study machines stayed on-line and stable for all simulated faults. The project stability simulations specified test disturbances did not show instability problems in the SPP system. Any oscillations were damped out.

6. **Appendix A: 2017 winter Peak Case Stability Run Plots – Cluster**
7. **Appendix B: 2018 summer Peak Case Stability Run Plots – Cluster**
8. **Appendix C: 2026 Summer Peak Case Stability Run Plots – Cluster**
9. **Appendix D: Project Model Data**

(Appendices available from SPP upon request.)

J17: GROUP 17 DYNAMIC STABILITY ANALYSIS REPORT

Southwest Power Pool
DISIS-2016-002 Group17 Study Report
Final Report

Report No. E21996

22 June 2018

CONFIDENTIAL
Contains Proprietary Information
DO NOT RELEASE

LEGAL NOTICE

This document, prepared by ABB Inc, is an account of work sponsored by Southwest Power Pool (SPP). Neither SPP nor ABB Inc nor any person or persons acting on behalf of either party: (i) makes any warranty or representation, expressed or implied, with respect to the use of any information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights, or (ii) assumes any liabilities with respect to the use of or for damages resulting from the use of any information, apparatus, method, or process disclosed in this document.

CONFIDENTIAL

This report contains proprietary information and is not to be released or reproduced without the express, written consent of ABB and SPP.

Prepared for: Southwest Power Pool
Report No.: E21996
Date: 22 June 2018

Author(s): Huaxi Zheng
Reviewed by: Shu Liu
Approved by: Willie Wong

ABB Inc.
Power Grid Division
Power Consulting
901 Main Campus Drive, Suite 300
Raleigh, NC 27606

EXECUTIVE SUMMARY

Southwest Power Pool (SPP) has commissioned ABB Inc., to perform a System Impact Study for interconnection request DISIS-2016-002 (Group 17) which includes a single generation interconnection request GEN-2016-094 (200 MW wind farm tapped on the Ft Thompson – Oahe 230 kV transmission line).

The objective of this study is to evaluate the impact of the interconnection request on the existing and future planning system. The study is performed on three system scenarios provided by SPP:

- 2017 Winter Peak Case
- 2018 Summer Peak Case
- 2026 Summer Peak Case

Study results show that all online generating units were stable and showed adequate angular damping, and all voltages recovered after fault clearing and met the study criteria for all studied disturbances.

System three-phase short-circuit current levels at up to five buses away from the point of interconnection were calculated and tabulated for SPP's reference.

The results of this analysis are based on available data and assumptions made at the time of conducting this study. If any of the data and/or assumptions made in developing the study model change, the results provided in this report may not apply.

Contents

1 INTRODUCTION

Southwest Power Pool (SPP) has commissioned ABB Inc., to perform a System Impact Study for interconnection request DISIS-2016-002 (Group 17) which includes a single generation interconnection request GEN-2016-094 (200 MW wind farm tapped on the Ft Thompson – Oahe 230 kV transmission line) as shown in Table 1-1.

Table 1-1 Table 1 - Generation Interconnection Request Group 17

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2016-094	200	Wind	Tap Ft Thompson – Oahe 230 kV transmission line

The objective of this study is to evaluate the impact of GEN-2016-094 on the existing and future planning system. The study is performed on three system scenarios provided by SPP:

- 2017 Winter Peak Case
- 2018 Summer Peak Case
- 2026 Summer Peak Case

SPP provided the study cases for all three system scenarios with study project included. One line diagrams of the local area for all three seasons are show in Figure 1-1, Figure 1-2, and Figure 1-3 respectively. The detailed machine parameters are listed in Appendix A.

Three system scenarios provided by SPP included the following prior queued projects for Group 17.

Table 1-2 Group 17 Prior Queued Projects

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2006-002IS & GEN-2016-054	54.40	GE 1.6 MW WTG (662101)	Wessington Springs 230kV (652607)
GEN-2009-020AIS	130	GE 1.85 MW WTG (660016)	Tripp Junction 115kV (660005)
GEN-2012-009IS	99.00	Siemens 3.0 MW WTG (952511)	Fort Randall 115kV (652510)
J599 (MISO)	200.00	Vestas 2.0 MW WTG (85994)	Glenham 230kV Substation (661038)

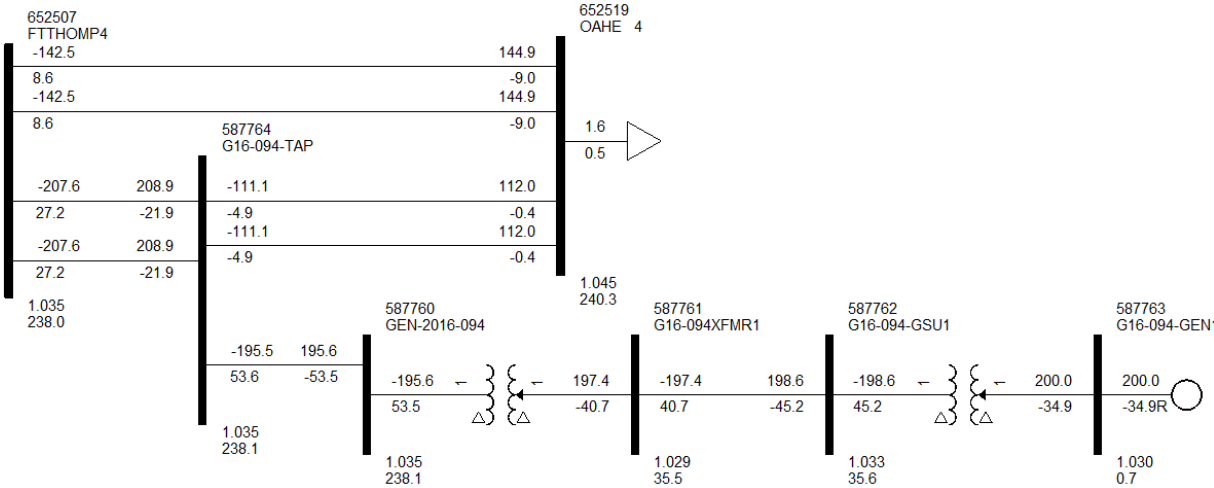


Figure 1-1 One Line Diagram for 2017 Winter Peak Case

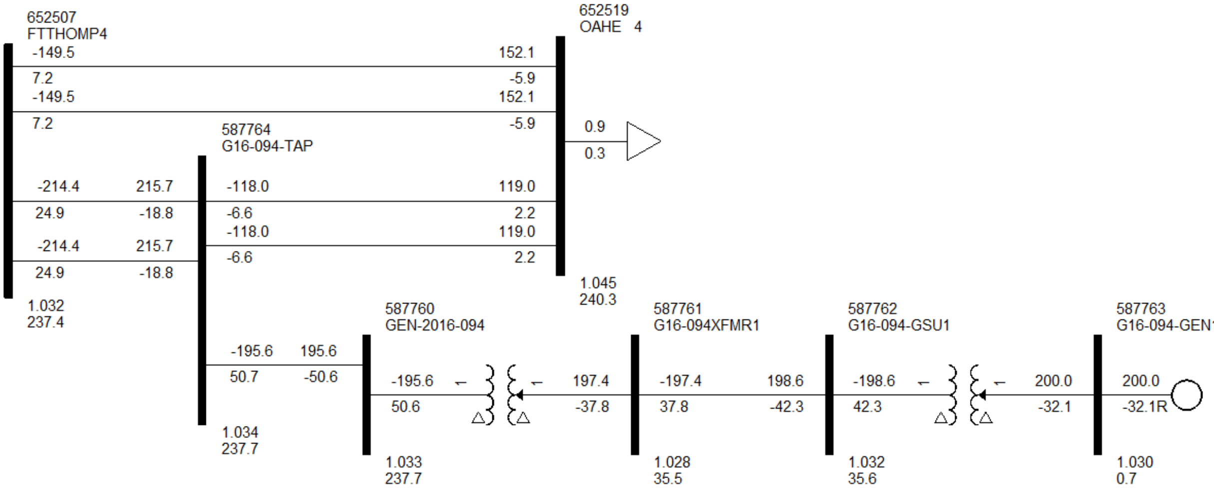


Figure 1-2 One Line Diagram for 2018 Summer Peak Case

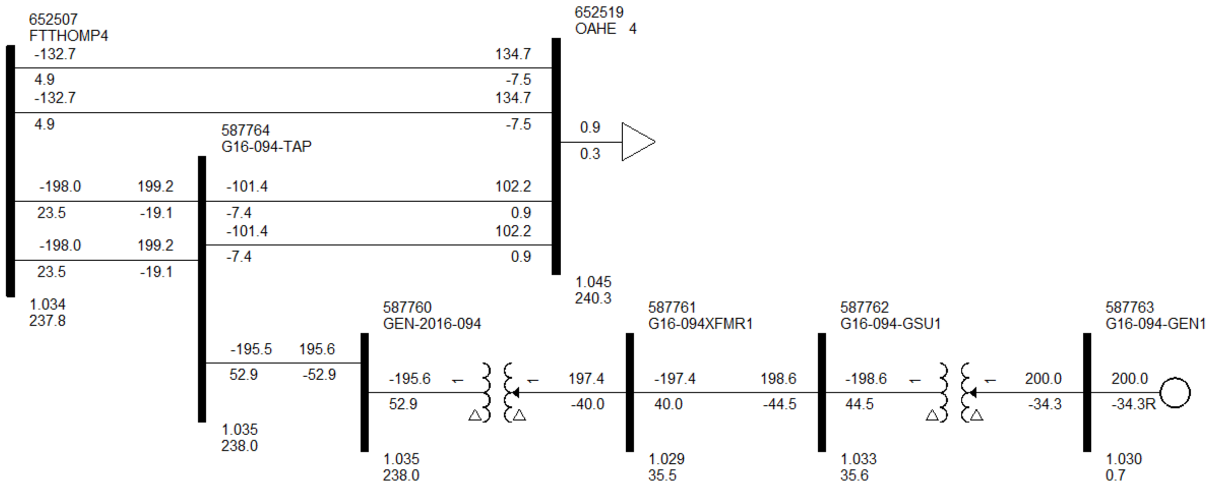


Figure 1-3 One Line Diagram for 2026 Summer Peak Case

2 STABILITY ANALYSIS

In this study, ABB investigated the stability of the system for faults in the vicinity of the study request. The studied faults involve three-phase (3PH) transformer/line faults with normal clearing, and single-line-to-ground (SLG) faults with stuck breaker.

2.1 Contingency (Fault Definitions) Development

Stability analysis was performed to determine whether the electric system would meet stability criteria following the addition of project GEN-2016-094; therefore, faults in the vicinity of the point of interconnection were developed under the approval of SPP.

Three phase faults were developed at point of interconnection and nearby buses with six cycles of duration without reclosing. Prior outage faults were also developed at point of interconnection and nearby buses.

Single-line-to-ground faults with stuck breaker were simulated with the standard method of applying fault impedance to the positive sequence network to represent the effect of the negative and zero sequence networks on the positive sequence network. It simulated potential breaker-failure situations for the substations. The SLG fault impedance was computed by assuming a positive sequence voltage at the fault location at approximately 60% of pre-fault voltage.

The full list and description of developed faults are shown in Table 2-1.

Table 2-1 List of Faults for Stability Analysis

Cont. No.	Cont. Name	Description
1	FLT01-3PH	3 phase fault on G16-094-TAP (587764) to FT THOMPSON 230kV (652507) CKT 1, near G16-094-TAP. a. Apply fault at the G16-094-TAP 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
2	FLT02-3PH	3 phase fault on the G16-094-TAP (587764) to OAHE 230kV (652519) CKT 1, near G16-094-TAP. a. Apply fault at the G16-094-TAP 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
3	FLT03-3PH	3 phase fault on the OAHE (652519) to FT THOMPSON 230kV (652507) CKT 3, near OAHE 230kV bus. a. Apply fault at the OAHE 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
4	FLT04-3PH	3 phase fault on the OAHE (652519) 230/(652520) 115/(652589)13.8kV transformer OA No. 5, near OAHE 230kV bus. a. Apply fault at the OAHE 230kV bus. b. Clear fault after 6 cycles by tripping the faulted transformer.
5	FLT05-3PH	3 phase fault on the OAHE (652519) to SULLY BUTTES 230kV (652521) CKT 1, near OAHE 230kV bus. a. Apply fault at the OAHE 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
6	FLT06-3PH	3 phase fault on the FT THOMPSON 230kV (652507) to OAHE (652519) CKT 3, near FT THOMPSON 230kV bus. a. Apply fault at the FT THOMPSON 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
7	FLT07-3PH	3 phase fault on the FT THOMPSON (652506) 345/ (652507) 230/ (652273) 13.8kV transformer FT2 KU1A, near FT THOMPSON 230kV bus. a. Apply fault at the FT THOMPSON 230kV bus. b. Clear fault after 6 cycles by tripping the faulted transformer.
8	FLT08-3PH	3 phase fault on the FT THOMPSON 230kV (652507) to WESSINGTON (652607) CKT 1, near FT THOMPSON 230kV bus. a. Apply fault at the FT THOMPSON 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
9	FLT09-3PH	3 phase fault on the FT THOMPSON 230kV (652507) to LETCHER (652606) CKT 1, near FT THOMPSON 230kV bus. a. Apply fault at the FT THOMPSON 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
10	FLT10-3PH	3 phase fault on the FT THOMPSON 230kV (652507) to LAKE PLATTE (652516) CKT 1, near FT THOMPSON 230kV bus. a. Apply fault at the FT THOMPSON 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
11	FLT11-3PH	3 phase fault on the FT THOMPSON 230kV (652507) to FT RANDALL (652509) CKT 1, near FT THOMPSON 230kV bus. a. Apply fault at the FT THOMPSON 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
12	FLT12-3PH	3 phase fault on the FT THOMPSON 230kV (652507) to Huron 230kV (652514) near FT THOMPSON 230kV bus a. Apply fault at the FT. THOMPSON 230kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
13	FLT13-PH	3 phase fault on the FT THOMPSON 345kV (652506) to G16-017-TAP 345kV (560074) line near FT THOMPSON 345kV bus a. Apply fault at the FT THOMPSON 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line (652506-652806-560074)
14	FLT14-3PH	3 phase fault on the FT THOMPSON 345kV (652506) to GRANDE PRAIRIE 345kV (652532) line near FT THOMPSON 345kV bus a. Apply fault at the FT THOMPSON 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line (652506-652807-652833-652532).
15	FLT15-3PH	3 phase fault on the SPLIT ROCK 345kV (601006) to WHITE 345kV (652537) line near SPLIT ROCK 345kV bus a. Apply fault at the SPLIT ROCK 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
16	FLT16-3PH	3 phase fault on the SPLIT ROCK 345kV (601006) to NOBLES 345kV (601034) line near SPLIT ROCK 345kV bus a. Apply fault at the SPLIT ROCK 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line.
17	FLT17-3PH	3 phase fault on the SPLIT ROCK 345kV (601006) to SIOUX CITY 345kV (652564) line near SPLIT ROCK 345kV bus a. Apply fault at the SPLIT ROCK 345kV bus. b. Clear fault after 6 cycles by tripping the faulted line (601006-652864-652564).
18	FLT18-PO	**Prior Outage of G16-094-TAP to FT THOMPSON 230kV CKT 1.** 3 phase fault on G16-094-TAP – FT THOMPSON 230kV CKT 2, near G16-094-TAP 230kV. a. Prior outage G16-094-TAP (587764) to FT THOMPSON (652507) 230kV CKT 1 line (solve network for steady state solution). b. 3 phase fault on G16-094-TAP (587764) – FT THOMPSON (652507) 230kV CKT 2, near G16-094-TAP 230kV c. Leave fault on for 6 cycles, then trip the faulted line in (b).
19	FLT19-PO	**Prior Outage of G16-094-TAP to OAHE 230kV CKT 1.** 3 phase fault on G16-094-TAP – OAHE CKT 2, near G16-094-TAP 230kV. a. Prior outage G16-094-TAP (587764) to OAHE (652519) 230kV CKT 1 line (solve network for steady state solution). b. 3 phase fault on G16-094-TAP (587764) – OAHE (652519)230kV CKT 2, near G16-094-TAP 230kV c. Leave fault on for 6 cycles, then trip the faulted line in (b).
20	FLT20-PO	**Prior Outage of OAHE to FT THOMPSON 230kV CKT 4.** 3 phase fault on OAHE – FT THOMPSON 230kV CKT 3, near OAHE 230kV a. Prior outage OAHE (652519) to FT THOMPSON (652507) 230kV CKT 4 (solve network for steady state solution). b. 3 phase fault on OAHE (652519) – FT THOMPSON (652507) 230kV CKT 3, near OAHE 230kV c. Leave fault on for 6 cycles, then trip the faulted line in (b).
21	FLT21-PO	**Prior Outage of OAHE to FT THOMPSON 230kV CKT 4.** 3 phase fault on G16-094-TAP – OAHE230kV CKT 1, near G16-094-TAP 230kV a. Prior outage OAHE (652519) to FT THOMPSON (652507) 230kV CKT 4 (solve network for steady state solution). b. 3 phase fault on G16-094-TAP (587764) – OAHE (652519)230kV CKT 1, near G16-094-TAP 230kV c. Leave fault on for 6 cycles, then trip the faulted line in (b).
22	FLT22-PO	**Prior Outage of FT THOMPSON to LAKE PLATTE 230kV CKT 1.** 3 phase fault on FT THOMPSON – FT RANDALL 230kV CKT 1, near FT THMPSON 230kV. a. Prior outage FT THOMPSON (652507) to LAKE PLATTE (652516) 230kV CKT1 (solve network for steady state solution). b. 3 phase fault on FT THMPSON (652507) – FT RANDALL (652509) 230kV CKT 1, near FT THMPSON 230kV. c. Leave fault on for 6 cycles, then trip the faulted line in (b).
23	FLT23-PO	**Prior Outage of FT THOMPSON to LETCHER 230kV CKT 1.** 3 phase fault on FT THOMPSON – WESSINGTON 230kV CKT 1, near FT THMPSON 230kV. a. Prior outage FT THOMPSON (652507) to LETCHER (652606) 230kV CKT1 (solve network for steady state solution).

Cont. No.	Cont. Name	Description
		b. 3 phase fault on FT THOMPSON (652507) – WESSINGTON (652607) 230kV CKT 1, near FT THMPSON 230kV c. Leave fault on for 6 cycles, then trip the faulted line in (b).
24	FLT24-PO	**Prior Outage of FT THOMPSON to HURON 230kV CKT 1.** 3 phase fault on FT THOMPSON – HURON 230kV CKT 2, near FT THMPSON 230kV. a. Prior outage FT THOMPSON (652507) to HURON (652514) 230kV CKT1 (solve network for steady state solution). b. 3 phase fault on FT THOMPSON (652507) – HURON (652514) 230kV CKT 2, near FT THMPSON 230kV. c. Leave fault on for 6 cycles, then trip the faulted line in (b).
25	FLT25-PO	**Prior Outage of FT. THOMPSON to HURON 230kV circuit 1.** 3 phase fault on the 345/230/13.8kV FT. THOMPSON Transformer, near FT THMPSON 230kV. a. Prior outage FT. THOMPSON (652507) 230kV to Huron (652514) 230kV (solve network for steady state solution) circuit 1. b. 3 phase fault on the 345/230/13.8kV FT. THOMPSON (652507) transformer #3 (652506) 13.8kV (652274), near FT THMPSON 230kV c. Leave fault on for 6 cycles, then trip the faulted line in (b).
26	FLT26-SB	**G16-094-TAP 230kV Stuck Breaker** a. Apply single phase fault on G16-094-TAP (587764) 230kV to OAHE (652519) 230kV CKT 1, near G16-094-TAP. b. Wait 16 cycles, and then trip the faulted line c. Trip G16-094-TAP (587764) to FT THOMPSON 230kV (652507) CKT 1 and remove the fault.
27	FLT27-SB	**FT. THOMPSON 230kV Stuck Breaker** a. Apply single phase fault on FT THOMPSON (652507) 230kV to G16-094-TAP (587764) 230kV CKT 1, near FT THOMPSON. b. Wait 16 cycles, and then trip the faulted line c. Trip FT THOMPSON (652507) 230kV to HURON 230kV (652514) CKT 1 and remove the fault.
28	FLT28-SB	**FT. THOMPSON 230kV Stuck Breaker** a. Apply single phase fault on FT THOMPSON (652507) 230kV to OAHE (652519) 230kV CKT 3 near FT THOMPSON. b. Wait 16 cycles, and then trip the faulted line c. Trip FT THOMPSON (652507) 230kV to WESSINGTON SPRINGS 230kV (652607) CKT 1 and remove the fault.
29	FLT29-SB	**FT. THOMPSON 230kV Stuck Breaker** a. Apply single phase fault on FT THOMPSON (652507) 230kV to OAHE (652519) 230kV CKT 4 near FT THOMPSON. b. Wait 16 cycles, and then trip the faulted line c. Trip FT THOMPSON (652507) 230kV to LETCHER 230kV (652606) CKT 1 and remove the fault.
30	FLT30-SB	**FT. THOMPSON 230kV Stuck Breaker** a. Apply single phase fault on FT THOMPSON (652507) 230kV to FT RANDALL (652509) 230kV CKT1 near FT THOMPSON. b. Wait 16 cycles, and then trip the faulted line c. Trip BIG BEND GENERATORS G1-G4 (652542, 652543, 652540) and remove the fault.
31	FLT31-SB	**FT. THOMPSON 230kV Stuck Breaker** a. Apply single phase fault on FT THOMPSON (652507) 230kV to LAKE PLATTE (652516) 230kV CKT1 near FT THOMPSON. b. Wait 16 cycles, and then trip the faulted line c. Trip BIG BEND GENERATORS G5-G8 (652544, 652545, 652541) and remove the fault.
32	FLT32-SB	**FT. THOMPSON 230kV Stuck Breaker** a. Apply single phase fault on FT THOMPSON (652506) 345kV / (652507) 230kV / (652273) 13.8kV transformer KU1A near FT THOMPSON 230kV (652507). b. Wait 16 cycles, and then trip the faulted transformer c. Trip FT THOMPSON (652506) 345kV / (652507) 230kV / (652274) 13.8kV transformer KU1B and remove the fault.
33	FLT33-SB	**OAHE 230kV Stuck Breaker** a. Apply single phase fault on OAHE (652519) 230kV to FT THOMPSON (652507) 230kV CKT 3 near OAHE. b. Wait 16 cycles, and then trip the faulted line c. Trip OAHE (652519) to FT THOMPSON (652507) 230kV CKT 4, OAHE GENERATORS 6&7, and remove the fault.
34	FLT34-SB	**OAHE 230kV Stuck Breaker** a. Apply single phase fault on OAHE (652519) 230kV to G16-094-TAP (587764) 230kV CKT 2 near OAHE. b. Wait 16 cycles, and then trip the faulted line c. Trip PHILIP TAP (652488) 230kV bus, OAHE (652519) to SULLY BUTTES 230kV (652521), OAHE GENERATORS 4&5, and remove the fault.
35	FLT35-SB	**OAHE 230kV Stuck Breaker** a. Apply single phase fault on OAHE (652519) 230kV to G16-094-TAP (587764) 230kV CKT 1 near OAHE. b. Wait 16 cycles, and then trip the faulted line c. Trip OAHE 230/115 kV transformers OA NO. 5&6, OAHE GENERATORS 2&3, and remove the fault.
36	FLT36-SB	**FT. THOMPSON 345kV Stuck Breaker**

Cont. No.	Cont. Name	Description
		a. Apply single phase fault on the 345kV FT. THOMPSON (652506) bus to 345kV G16-017-TAP (560074) bus near FT. THOMPSON. b. Wait 16 cycles, and then trip FT. THOMPSON (652506) – G16-017-TAP (560074) 345kV line (652506-652806-560074 345kV line) c. Trip FT THOMPSON (652506) 345kV / (652507) 230kV / (652273) 13.8kV transformer KU1A and remove the fault.

2.2 Study Methodology

Stability analysis was performed using Siemens-PTI's PSS/E dynamic program V33.7.0. The Southwest Pool Disturbance Performance Criteria Requirements in Reference [1] were used to evaluate the system response during the initial transient period following a disturbance on the system. Generator response and bus voltages (115 kV and above) in Areas 520, 524, 525, 526, 531, 534, 536, 640, 645, 650, and 652 were monitored to ensure the system performance meets criteria requirements. Bus voltage at point of interconnection and nearby 69 kV buses were also monitored to ensure proper transient response. Rotor angles of the nearby synchronous machines were investigated to make sure they maintained synchronism and had adequate damping following system faults.

To maintain system reliability generators must be designed in accordance with Good Utility Practice and comply with all applicable standards including NERC standard PRC-024-2 Generator Frequency and Voltage Protective Relay Settings. Therefore, the generators should be designed to ride through and not be tripped off line for faults on the transmission system, including those at or near the POI, that are cleared within normal clearing times. Generator speed of pre-queued projects was also monitored to ensure they stay online under system contingencies. For contingencies that result in a prior queued project tripping off-line; the contingency shall be re-run with the prior queued project's voltage and frequency tripping disabled.

2.3 Stability Analysis Results

Stability analysis was performed in PSS/E 33.7.0 and all disturbances listed in Table 2-1 were simulated for 20 seconds. Simulation results indicate that all online generating units were stable and showed adequate angular damping, and all voltages recovered after fault clearing and met the study criteria for all studied disturbances. The entire simulation results were summarized in Appendix B Stability Analysis Results.

3 SHORT CIRCUIT ANALYSIS

Short circuit analysis was performed on the 2018 Summer Peak and 2026 Summer Peak power flow cases using ASCC function of PSS/E. Since the provided cases do not have complete sequence data, only three-phase symmetrical fault current levels were calculated at up to five buses away from the point of interconnection. And following simulation settings were used when performing such analysis:

- Use 3 phase fault
- Impose flat condition
- Output option – total fault currents in amps

The detailed analysis results are tabulated in Appendix C Short Circuit Analysis Result for SPP's reference.

4 REFERENCES

[1] Southwest Power Pool Disturbance Performance Requirements, Revision 3.0, July 21, 2016.

Appendix A GEN-2016-094 Machine Parameters

Appendix A.1 Power Flow Model

Power flow model data is in separate file which is listed below:
AppendixA1_Power_Flow_Model.txt

(Available upon request to SPP)

Appendix A.2 Dynamic Model

Dynamic model data is in separate file which is listed below:
AppendixA2_Dynamic_Model.txt

(Available upon request to SPP)

Appendix B Stability Analysis Results

Appendix B.1 Study Result Summary

Index	Fault Name	2017 Winter Peak			2018 Summer Peak			2026 Summer Peak		
		Stable	Volt & Angle Violation	Study Generator Tripped	Stable	Volt & Angle Violation	Study Generator Tripped	Stable	Volt & Angle Violation	Study Generator Tripped
1	FLT01-3PH	Yes	No	No	Yes	No	No	Yes	No	No
2	FLT02-3PH	Yes	No	No	Yes	No	No	Yes	No	No
3	FLT03-3PH	Yes	No	No	Yes	No	No	Yes	No	No
4	FLT04-3PH	Yes	No	No	Yes	No	No	Yes	No	No
5	FLT05-3PH	Yes	No	No	Yes	No	No	Yes	No	No
6	FLT06-3PH	Yes	No	No	Yes	No	No	Yes	No	No
7	FLT07-3PH	Yes	No	No	Yes	No	No	Yes	No	No
8	FLT08-3PH	Yes	No	No	Yes	No	No	Yes	No	No
9	FLT09-3PH	Yes	No	No	Yes	No	No	Yes	No	No
10	FLT10-3PH	Yes	No	No	Yes	No	No	Yes	No	No
11	FLT11-3PH	Yes	No	No	Yes	No	No	Yes	No	No
12	FLT12-3PH	Yes	No	No	Yes	No	No	Yes	No	No
13	FLT13-3PH	Yes	No	No	Yes	No	No	Yes	No	No
14	FLT14-3PH	Yes	No	No	Yes	No	No	Yes	No	No
15	FLT15-3PH	Yes	No	No	Yes	No	No	Yes	No	No
16	FLT16-3PH	Yes	No	No	Yes	No	No	Yes	No	No
17	FLT17-3PH	Yes	No	No	Yes	No	No	Yes	No	No
18	FLT18-PO	Yes	No	No	Yes	No	No	Yes	No	No
19	FLT19-PO	Yes	No	No	Yes	No	No	Yes	No	No
20	FLT20-PO	Yes	No	No	Yes	No	No	Yes	No	No
21	FLT21-PO	Yes	No	No	Yes	No	No	Yes	No	No
22	FLT22-PO	Yes	No	No	Yes	No	No	Yes	No	No
23	FLT23-PO	Yes	No	No	Yes	No	No	Yes	No	No
24	FLT24-PO	Yes	No	No	Yes	No	No	Yes	No	No
25	FLT25-PO	Yes	No	No	Yes	No	No	Yes	No	No
26	FLT26-SB	Yes	No	No	Yes	No	No	Yes	No	No
27	FLT27-SB	Yes	No	No	Yes	No	No	Yes	No	No
28	FLT28-SB	Yes	No	No	Yes	No	No	Yes	No	No
29	FLT29-SB	Yes	No	No	Yes	No	No	Yes	No	No
30	FLT30-SB	Yes	No	No	Yes	No	No	Yes	No	No
31	FLT31-SB	Yes	No	No	Yes	No	No	Yes	No	No
32	FLT32-SB	Yes	No	No	Yes	No	No	Yes	No	No
33	FLT33-SB	Yes	No	No	Yes	No	No	Yes	No	No
34	FLT34-SB	Yes	No	No	Yes	No	No	Yes	No	No
35	FLT35-SB	Yes	No	No	Yes	No	No	Yes	No	No
36	FLT36-SB	Yes	No	No	Yes	No	No	Yes	No	No

Appendix B.2 Study Result Plot

Plots of stability simulations for all three scenarios are in separate file which is listed below:
AppendixB2_Study_Result_Plot.zip

(Plots are available upon request to SPP)

Appendix C Short Circuit Analysis Result

Appendix C.1 2018 Summer Peak Case

Bus Number	Bus Name	3PH (Amp)	Bus Number	Bus Name	3PH (Amp)
560074	G16-017-TAP 345.00	6527.2	652525	TYNDALL7 115.00	3772.8
560347	G10-051-TAP 230.00	7081.8	652526	UTICAJC4 230.00	7846.2
560997	WESSINGTON1C34.500	13530.6	652527	WHITLOK4 230.00	4860.5
563230	GEN-2015-089230.00	5352.4	652528	WOONSKT7 115.00	5257.6
563231	G15-089XFMR134.500	17881.7	652529	WATERTN3 345.00	10272.8
587130	GEN-2016-017345.00	6471	652530	WATERTN4 230.00	14170.6
587750	GEN-2016-092345.00	6471	652531	WATERTN7 115.00	12434.7
587760	GEN-2016-094230.00	12767.7	652532	GR PRAIRIE 3345.00	6829.6
587761	G16-094XFMR134.500	34831.2	652535	REDFELD7 115.00	4035.2
587762	G16-094-GSU134.500	32510.7	652536	RASMUSN4 230.00	6583.6
587763	G16-094-GEN10.6900	1197042.2	652539	WATERSVC 20.000	23114
587764	G16-094-TAP 230.00	13107.6	652540	BIGBND14 230.00	12069.6
587830	GEN-2016-103345.00	6472	652541	BIGBND24 230.00	11991.9
602004	SPLT RK4 230.00	12557.4	652542	BGBND12G 13.800	56482.7
603009	GRANT 7 115.00	3948.7	652543	BGBND34G 13.800	56583
603012	LAWRENC7 115.00	28883.7	652544	BGBND56G 13.800	56636.4
603016	SPLT RK7 115.00	36570.7	652545	BGBND78G 13.800	56636.4
605725	SPLT RK161 913.800	33991.5	652546	FTRDL12G 13.800	44664.3
620314	BIGSTON4 230.00	16421.4	652547	FTRDL34G 13.800	42320.5
635200	RAUN 3 345.00	25370.2	652548	FTRDL56G 13.800	42320.5
635223	PLYMOTH5 161.00	19711.6	652549	FTRDL78G 13.800	42320.5
640126	E.COL. 4 230.00	9474.9	652550	GRANITF4 230.00	12973.6
640131	COLMB.W4 230.00	9593.7	652556	OAHE2-3G 13.800	89162.7
640133	COLMBUS4 230.00	11129.6	652557	OAHE4-5G 13.800	89162.7
640134	KELLY 7 115.00	17492.4	652558	OAHE6-7G 13.800	89162.7
640135	COLMBS19 13.200	24590.6	652559	OAHE 1G 13.800	47573.6
640305	ONEILL 7 115.00	3892.4	652561	DENISON5 161.00	5230.3
640343	SHELCRK4 230.00	10611.8	652563	SPENCER5 161.00	8848.3
640349	SPENCER7 115.00	4584.2	652564	SIOUXCY3 345.00	14848.7
640350	SPENCER9 34.500	1394.1	652565	SIOUXCY4 230.00	19350.2
640386	TWIN CH4 230.00	8459.3	652566	SIOUXCY5 161.00	20155.3
640387	TWIN CH7 115.00	10554.9	652567	DENISON4 230.00	4272.9
640404	WAYSIDE4 230.00	2738.6	652568	GROTONSOUTH 115.00	13758.3
640405	WAYSIDE7 115.00	3949.9	652574	SIOUXCY8 69.000	17586.4
640406	WAYSIDE9 13.800	14987.8	652578	PAHOJA 4 230.00	7246.6
640540	MEADOWGROVE4230.00	5558	652579	WANBLEE 7 115.00	2369.7
642079	PB_III_SUB 34.500	5418.9	652582	APPLEDORN 4 230.00	7089.4
642080	PB_III_TRT 13.800	10761	652583	DENISON8 69.000	10945.9
643140	SPENCER T1 913.800	2218.5	652588	CLEVELD4 230.00	4741.8
643155	TWIN CH T4 913.800	20810.3	652589	OAHE 9 13.800	6701.7

Bus Number	Bus Name	3PH (Amp)	Bus Number	Bus Name	3PH (Amp)
643156	TWIN CH T6 913.800	21790.4	652591	HANLON 7 115.00	5510.4
648506	PR BRZ 4 230.00	4210.1	652592	HANLON 9 13.800	14556.5
648507	PR BR1X9 34.500	14731.8	652598	OAHE 29 13.800	6232.8
648508	PR BR1Y9 13.800	25510.3	652600	ASH TAP 115.00	8699.5
648510	PR BR2X9 34.500	14921.1	652601	ASH ST 7 115.00	7253.1
648511	PR BR2Y9 13.800	25820.8	652602	EVANS ST 115.00	7661.8
650102	PR BRZ B9 34.500	9758.5	652604	APPLEDORN 8 69.000	2499.2
650103	PR BRZ Y9 13.800	22620.3	652605	APPLEDORN 9 13.200	5863.5
652001	G13_001IST 115.00	5258.5	652606	LETCHER4 230.00	4728.2
652175	G09_001IST 345.00	5939.1	652607	WESSINGTON 4230.00	6810.4
652223	PIERRE 8 69.000	1592.2	652608	LETCHER9 13.200	16272.9
652224	BLAIR 8 69.000	2536.7	652609	LETCHER7 115.00	6035.7
652232	SIOUXF19 13.200	31418.5	652614	CARPENTER 4 230.00	6805.3
652233	SIOUXF29 13.200	31330.5	652626	UTICAJC7 115.00	8728.1
652235	SIOUXFL8 69.000	3880.6	652627	UTICAJC9 13.200	18055.3
652237	WATERT19 13.800	38163	652630	WATERTNCAP 4230.00	14170.6
652239	WATERT29 13.200	21375.8	652657	DENISON 9 13.800	18464
652240	WATERT39 13.200	21367.1	652806	FTTHOM1-LNX3345.00	9485.5
652242	WATERT18 69.000	3879.2	652807	FTTHOM2-LNX3345.00	9485.5
652243	FAITH 7 115.00	2315.9	652821	SULLYBT-LNX3230.00	6554.4
652246	ARMOUR 9 34.500	2678.1	652829	WATERTN-LNX3345.00	10272.8
652249	ARMOUR 8 69.000	2438.6	652833	GRPRAR2-LNX3345.00	6829.6
652259	EAGLEBE8 69.000	1636.8	652864	SIOUXCY-LNX3345.00	14848.7
652260	EAGLEBW8 69.000	2141.7	652873	STEGALL-LNX3230.00	5263.6
652263	MIDLAND8 69.000	2079.8	652884	NUNDRWD-LNX3230.00	3396.6
652266	NUNDRWD10 13.800	24115.8	655063	SW341-ER8 69.000	3587.4
652267	NUNDRWD9 13.800	20313.5	655066	SW352-ER8 69.000	3625.8
652268	PHILIP 8 69.000	2383.3	655067	SW353-ER8 69.000	3629.7
652273	FTTHMP19 13.800	26015.3	655073	MOS-CRPN-ER869.000	2429.1
652274	FTTHMP29 13.800	26016.1	655079	MOS-KLKP-ER869.000	768.1
652276	FTTHOMP8 69.000	4426.3	655080	MOS-HLTP-ER869.000	1306.4
652277	LAKPLAT8 69.000	4018.1	655153	MOS-AMES-ER869.000	4365.9
652278	HANLON18 69.000	3017.3	655155	MOS-SLY1-ER869.000	2366.5
652279	HANLON28 69.000	3017.3	655158	MOS-HYDE-ER869.000	3451.6
652281	HURON419 13.328	33805.2	655250	CHMBRLAN-ER869.000	1581.7
652282	HURON429 13.328	33801.8	655328	BIGBEND-ER8 69.000	3233.9
652284	HURON 8 69.000	3641.2	655329	GANNVALL-ER869.000	863
652285	SULLYBT8 69.000	2380.3	655333	ONIDA-ER8 69.000	1515.2
652287	RASMUSN8 69.000	3159.7	655334	OKOBOJO-ER8 69.000	2370
652291	REDFELD8 69.000	2784.7	655352	AMES-ER8 69.000	1338.7
652304	SIOUXC19 13.800	26631.8	655355	WOONSKT-ER8 69.000	3565.9
652305	SIOUXC29 13.800	26698.7	655373	MOS-SLY2-ER869.000	2376.6
652308	SIOUXC39 13.800	18552.9	655377	SW1145-ER7 115.00	24323.2

Bus Number	Bus Name	3PH (Amp)	Bus Number	Bus Name	3PH (Amp)
652310	SIOUXC49 13.800	18770.9	655384	NWPS8645-ER869.000	2177.5
652396	VFODNS19 12.500	20765.5	655385	MOS-LKPL-ER869.000	4003.5
652397	VFODNES7 115.00	6282.2	655386	MOS-RVR1-ER869.000	2086.7
652398	VFODNES4 230.00	6985.7	655412	CRPNTR-ER8 69.000	2809.6
652399	VFODNES8 69.000	4198.1	655415	ROSKPS22-ER94.2000	16645.4
652463	WH SWAN7 115.00	12639.3	655417	ROSWELL-ER7 115.00	2603.3
652475	BONESTL7 115.00	3507.8	655418	FREEMAN-ER7 115.00	2557.5
652476	EAGLEBT7 115.00	1946.9	658088	WTREAST7 115.00	9591
652477	ELSWRTH7 115.00	3755.8	658094	WTRPELI7 115.00	8523.5
652478	GREGORY7 115.00	2124.5	658120	GARFLD 7 115.00	7127
652480	MAURINE7 115.00	3916.7	659119	STORLA 9 13.200	16148.5
652481	MIDLAND7 115.00	3277.3	659120	BRDLAND3 345.00	3989.9
652484	NUNDRWD4 230.00	3396.6	659122	STORLA 4 230.00	6056
652485	NUNDRWD7 115.00	5727	659123	STORLA 7 115.00	6608.2
652486	PHILIP 4 230.00	3104.3	659196	CARPENTER 8 69.000	3167.7
652487	PHILIP 7 115.00	5074.9	659204	BROADLAND 913.800	22956.2
652488	PHILTAP4 230.00	3692.2	659205	BRDLAND4 230.00	9740.7
652489	PIERRE 7 115.00	8226.2	659271	RCDC EAST 4230.00	2633.1
652491	IRVSIMM7 115.00	8173.2	659295	SDPRAIRWND 4230.00	5620.2
652492	WALL 7 115.00	3316.8	659296	WESSINGTON1W0.5750	2253076.8
652493	WICKSVL7 115.00	3890.2	659324	HYDE 934.500	7074.3
652496	RUSHMRE7 115.00	4226	659327	SDPRAIRWND 934.500	32108.8
652497	MAURINE4 230.00	2758.2	659376	DRY CREEK 4230.00	2638.6
652498	PHILIP9 13.200	12120.4	659377	DRY CREEK 7115.00	4289.5
652500	ARLNGTN7 115.00	4293	659378	DRY CREEK 913.800	13510.7
652501	ARMOUR 7 115.00	4166.2	659421	BRDLAND-LNX3345.00	3989.9
652502	BERSFRD7 115.00	3177.5	659424	LELAND2-LNX3345.00	16726.5
652503	BLAIR 4 230.00	9842.3	659716	MAPLETAP-LO7115.00	13107
652504	BROOKNG7 115.00	7139.8	659900	EAGLE 4 230.00	7094.8
652505	FLANDRU7 115.00	4048.8	659901	EAGLE 8 69.000	13575.5
652506	FTTHOMP3 345.00	9485.5	660002	REDFLD 7 115.00	3953.2
652507	FTTHOMP4 230.00	20511.7	660003	HURONWP7 115.00	9598.7
652509	FTRANDL4 230.00	11029.2	660004	MITCHEL7 115.00	5862.6
652510	FTRANDL7 115.00	12980	660005	TRIPP 7 115.00	4233.4
652513	HANLON 4 230.00	5996.8	660007	MENNOJT7 115.00	6554.4
652514	HURON 4 230.00	10735.8	660008	MITCLNW7 115.00	5482.5
652515	HURON 7 115.00	14844.2	660009	BTAP WP7 115.00	14418
652516	LAKPLAT4 230.00	5618.5	660012	HURON WP 869.000	5912.4
652518	MTVERN 7 115.00	4301.5	660026	NAPA JCT7 115.00	7837.4
652519	OAHE 4 230.00	14210.1	661038	GLENHAM4 230.00	4864.1
652520	OAHE 7 115.00	11684.4	662100	WESSINGTON 934.500	16621.2
652521	SULLYBT4 230.00	6554.4	662101	WESSINGTON1W0.6900	420787.6
652523	SIOUXFL4 230.00	12951.1	952509	G12_009IS 115.00	6514.3

Bus Number	Bus Name	3PH (Amp)	Bus Number	Bus Name	3PH (Amp)
652524	SIOUXFL7 115.00	25556.2	952510	G12_009IS_1 34.500	9099.4

Appendix C.2 2026 Summer Peak Case

Bus Number	Bus Name	3PH (Amp)	Bus Number	Bus Name	3PH (Amp)
560074	G16-017-TAP 345.00	6531.5	652525	TYNDALL7 115.00	3795.4
560347	G10-051-TAP 230.00	7092	652526	UTICAJC4 230.00	7893.1
560997	WESSINGTON1C34.500	13534.1	652527	WHITLOK4 230.00	4863.4
563230	GEN-2015-089230.00	5372.8	652528	WOONSKT7 115.00	5263
563231	G15-089XFMR134.500	17907	652529	WATERTN3 345.00	10697.5
587130	GEN-2016-017345.00	6475.2	652530	WATERTN4 230.00	14508.3
587750	GEN-2016-092345.00	6475.3	652531	WATERTN7 115.00	12584.6
587760	GEN-2016-094230.00	12780.9	652532	GR PRAIRIE 3345.00	6840
587761	G16-094XFMR134.500	34843.7	652535	REDFELD7 115.00	4106.8
587762	G16-094-GSU134.500	32521.2	652536	RASMUSN4 230.00	6603.6
587763	G16-094-GEN10.6900	1197293	652539	WATERSVC 20.000	23189.7
587764	G16-094-TAP 230.00	13121.5	652540	BIGBND14 230.00	12082.6
587830	GEN-2016-103345.00	6476.3	652541	BIGBND24 230.00	12004.7
602004	SPLT RK4 230.00	12691	652542	BGBND12G 13.800	56490.5
603009	GRANT 7 115.00	3953.9	652543	BGBND34G 13.800	56590.8
603012	LAWRENC7 115.00	29287.7	652544	BGBND56G 13.800	56644.2
603016	SPLT RK7 115.00	37046.6	652545	BGBND78G 13.800	56644.2
605725	SPLT RK161 913.800	34038.9	652546	FTRDL12G 13.800	44681.5
620314	BIGSTON4 230.00	16563.7	652547	FTRDL34G 13.800	42330.6
635200	RAUN 3 345.00	25494.2	652548	FTRDL56G 13.800	42330.6
635223	PLYMOTH5 161.00	19893	652549	FTRDL78G 13.800	42330.6
640126	E.COL. 4 230.00	9502.5	652550	GRANITF4 230.00	13080.7
640131	COLMB.W4 230.00	9624.7	652556	OAHE2-3G 13.800	89171.8
640133	COLMBUS4 230.00	11167.3	652557	OAHE4-5G 13.800	89171.8
640134	KELLY 7 115.00	17557.9	652558	OAHE6-7G 13.800	89171.8
640135	COLMBS19 13.200	24605.3	652559	OAHE 1G 13.800	47587.3
640305	ONEILL 7 115.00	3893.6	652561	DENISON5 161.00	5242.3
640343	SHELCRK4 230.00	10643.7	652563	SPENCER5 161.00	10147.8
640349	SPENCER7 115.00	4586.4	652564	SIOUXCY3 345.00	14931.6
640350	SPENCER9 34.500	1394.2	652565	SIOUXCY4 230.00	19501
640386	TWIN CH4 230.00	8480.5	652566	SIOUXCY5 161.00	20350.1
640387	TWIN CH7 115.00	10574.2	652567	DENISON4 230.00	4283.9
640404	WAYSIDE4 230.00	2739.6	652568	GROTONSOUTH 115.00	18187
640405	WAYSIDE7 115.00	3950.7	652574	SIOUXCY8 69.000	17657
640406	WAYSIDE9 13.800	14989.3	652578	PAHOJA 4 230.00	7308.5
640540	MEADOWGROVE4230.00	5562.3	652579	WANBLEE 7 115.00	2370.3
642079	PB_III_SUB 34.500	5419.3	652582	APPLEDORN 4 230.00	7128.8
642080	PB_III_TRT 13.800	10761.5	652583	DENISON8 69.000	10977
643140	SPENCER T1 913.800	2218.6	652588	CLEVELD4 230.00	4782.6
643155	TWIN CH T4 913.800	20819.5	652589	OAHE 9 13.800	6233.6

Bus Number	Bus Name	3PH (Amp)	Bus Number	Bus Name	3PH (Amp)
643156	TWIN CH T6 913.800	21800.7	652591	HANLON 7 115.00	5520.5
648506	PR BRZ 4 230.00	4211.8	652592	HANLON 9 13.800	14565
648507	PR BR1X9 34.500	14733.1	652598	OAHE 29 13.800	6233.6
648508	PR BR1Y9 13.800	25512.8	652600	ASH TAP 115.00	8710.2
648510	PR BR2X9 34.500	14922.4	652601	ASH ST 7 115.00	7261.2
648511	PR BR2Y9 13.800	25823.3	652602	EVANS ST 115.00	7670.5
650102	PR BRZ B9 34.500	9759.6	652604	APPLEDORN 8 69.000	2500.6
650103	PR BRZ Y9 13.800	22622.9	652605	APPLEDORN 9 13.200	5865
652001	G13_001IST 115.00	5353.2	652606	LETCHER4 230.00	4737.5
652175	G09_001IST 345.00	6391.5	652607	WESSINGTON 4230.00	6817.3
652223	PIERRE 8 69.000	1592.4	652608	LETCHER9 13.200	16280.2
652224	BLAIR 8 69.000	2538	652609	LETCHER7 115.00	6044.3
652232	SIOUXF19 13.200	31492.7	652614	CARPENTER 4 230.00	6845.3
652233	SIOUXF29 13.200	31406.4	652626	UTICAJC7 115.00	8820.2
652235	SIOUXFL8 69.000	3886.2	652627	UTICAJC9 13.200	18106.3
652237	WATERT19 13.800	38411.8	652630	WATERTNCAP 4230.00	14508.3
652239	WATERT29 13.200	21427.4	652657	DENISON 9 13.800	18477.1
652240	WATERT39 13.200	21418.6	652806	FTTHOM1-LNX3345.00	9496.6
652242	WATERT18 69.000	3887.9	652807	FTTHOM2-LNX3345.00	9496.6
652243	FAITH 7 115.00	2316.1	652821	SULLYBT-LNX3230.00	6557.5
652246	ARMOUR 9 34.500	2678.4	652829	WATERTN-LNX3345.00	10697.5
652249	ARMOUR 8 69.000	2439	652833	GRPRAR2-LNX3345.00	6840
652259	EAGLEBE8 69.000	1636.9	652864	SIOUXCY-LNX3345.00	14931.6
652260	EAGLEBW8 69.000	2141.9	652873	STEGALL-LNX3230.00	5266.3
652263	MIDLAND8 69.000	2080.2	652884	NUNDRWD-LNX3230.00	3400.8
652266	NUNDRWD10 13.800	24663.2	655063	SW341-ER8 69.000	3591.3
652267	NUNDRWD9 13.800	24663.2	655066	SW352-ER8 69.000	3629.8
652268	PHILIP 8 69.000	2384.1	655067	SW353-ER8 69.000	3633.6
652273	FTTHMP19 13.800	26019.7	655073	MOS-CRPN-ER869.000	2430.6
652274	FTTHMP29 13.800	26020.4	655079	MOS-KLKP-ER869.000	768.1
652276	FTTHOMP8 69.000	4426.6	655080	MOS-HLTP-ER869.000	1306.4
652277	LAKPLAT8 69.000	4018.7	655153	MOS-AMES-ER869.000	4366.2
652278	HANLON18 69.000	3018.9	655155	MOS-SLY1-ER869.000	2366.7
652279	HANLON28 69.000	3018.9	655158	MOS-HYDE-ER869.000	3451.7
652281	HURON419 13.328	33875.2	655250	CHMBRLAN-ER869.000	1581.8
652282	HURON429 13.328	33871.7	655328	BIGBEND-ER8 69.000	3234.1
652284	HURON 8 69.000	3645.2	655329	GANNVALL-ER869.000	863
652285	SULLYBT8 69.000	2380.4	655333	ONIDA-ER8 69.000	1515.2
652287	RASMUSN8 69.000	3161.1	655334	OKOBOJO-ER8 69.000	2370.1
652291	REDFELD8 69.000	2802.8	655352	AMES-ER8 69.000	1338.8
652304	SIOUXC19 13.800	26650.1	655355	WOONSKT-ER8 69.000	3567.5

Bus Number	Bus Name	3PH (Amp)	Bus Number	Bus Name	3PH (Amp)
652305	SIOUXC29 13.800	26716.9	655373	MOS-SLY2-ER869.000	2376.8
652308	SIOUXC39 13.800	18570.5	655377	SW1145-ER7 115.00	24699.2
652310	SIOUXC49 13.800	18788.9	655384	NWPS8645-ER869.000	2177.5
652396	VFODNS19 12.500	20783.2	655385	MOS-LKPL-ER869.000	4004.1
652397	VFODNES7 115.00	6297.3	655386	MOS-RVR1-ER869.000	2086.9
652398	VFODNES4 230.00	7025.4	655412	CRPNTR-ER8 69.000	2811.7
652399	VFODNES8 69.000	4202.4	655415	ROSKPS22-ER94.2000	16647.8
652463	WH SWAN7 115.00	12660.2	655417	ROSWELL-ER7 115.00	2604.9
652475	BONESTL7 115.00	3509.1	655418	FREEMAN-ER7 115.00	2565.2
652476	EAGLEBT7 115.00	1947.2	658088	WTREAST7 115.00	9679.7
652477	ELSWRTH7 115.00	3806.5	658094	WTRPELI7 115.00	8593.4
652478	GREGORY7 115.00	2124.9	658120	GARFLD 7 115.00	7134.9
652480	MAURINE7 115.00	3917.2	659119	STORLA 9 13.200	16152.7
652481	MIDLAND7 115.00	3278.8	659120	BRDLAND3 345.00	4002.3
652484	NUNDRWD4 230.00	3400.8	659122	STORLA 4 230.00	6063.6
652485	NUNDRWD7 115.00	5939.5	659123	STORLA 7 115.00	6614.1
652486	PHILIP 4 230.00	3105.1	659196	CARPENTER 8 69.000	3170.3
652487	PHILIP 7 115.00	5080.3	659204	BROADLAND 913.800	22978
652488	PHILTAP4 230.00	3692.8	659205	BRDLAND4 230.00	9803.9
652489	PIERRE 7 115.00	8235.8	659271	RCDC EAST 4230.00	2633.4
652491	IRVSIMM7 115.00	8182.4	659295	SDPRAIRWND 4230.00	5624
652492	WALL 7 115.00	3338.3	659296	WESSINGTON1W0.5750	2253351
652493	WICKSVL7 115.00	3955.2	659324	HYDE 934.500	7074.5
652496	RUSHMRE7 115.00	4275.5	659327	SDPRAIRWND 934.500	32115.7
652497	MAURINE4 230.00	2758.8	659376	DRY CREEK 4230.00	2638.9
652498	PHILIP9 13.200	12124.6	659377	DRY CREEK 7115.00	4304.8
652500	ARLNGTN7 115.00	4309	659378	DRY CREEK 913.800	13535.7
652501	ARMOUR 7 115.00	4168.2	659421	BRDLAND-LNX3345.00	4002.3
652502	BERSFRD7 115.00	3906.5	659424	LELAND2-LNX3345.00	16809.6
652503	BLAIR 4 230.00	9924.3	659716	MAPLETAP-LO7115.00	13213
652504	BROOKNG7 115.00	7184.3	659900	EAGLE 4 230.00	7142.6
652505	FLANDRU7 115.00	4058.3	659901	EAGLE 8 69.000	13658.2
652506	FTTHOMP3 345.00	9496.6	660002	REDFLD 7 115.00	3976.7
652507	FTTHOMP4 230.00	20555.1	660003	HURONWP7 115.00	9637
652509	FTRANDL4 230.00	11053.1	660004	MITCHEL7 115.00	5872.1
652510	FTRANDL7 115.00	13001.5	660005	TRIPP 7 115.00	4243.6
652513	HANLON 4 230.00	6018.7	660007	MENNOJT7 115.00	6600.3
652514	HURON 4 230.00	10814.8	660008	MITCLNW7 115.00	5490.7
652515	HURON 7 115.00	14955	660009	BTAP WP7 115.00	14523
652516	LAKPLAT4 230.00	5622.7	660012	HURON WP 869.000	5919.8
652518	MTVERN 7 115.00	4303.6	660026	NAPA JCT7 115.00	8031.4

Bus Number	Bus Name	3PH (Amp)	Bus Number	Bus Name	3PH (Amp)
652519	OAHE 4 230.00	14220.3	661038	GLENHAM4 230.00	4870.7
652520	OAHE 7 115.00	11702.1	662100	WESSINGTON 934.500	16626.9
652521	SULLYBT4 230.00	6557.5	662101	WESSINGTON1W0.6900	420848
652523	SIOUXFL4 230.00	13094.6	952509	G12_009IS 115.00	6519.1
652524	SIOUXFL7 115.00	25972	952510	G12_009IS_1 34.500	9101