GEN-2017-009
GEN-2017-060
GEN-2017-082

Interim Availability Interconnection System Impact Study

Published September 2020
By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
10/21/2019	SPP	Initial draft report issued.
10/22/2019	SPP	Draft report updated with Transmission Owner Facility Reports.
10/25/2019	SPP	Final report issued. Updates made in: • Stability section • Table 2.2 was updated to include stability generators information • Table 2.3 was removed. Note: Review of the stability analysis has identified that PSS/E was unable to access the Gamesa user-written model during simulation. Prior to achieving commercial operation, this simulation issue must be corrected with all impacted simulations reviewed to verify the study findings.
10/29/2019	SPP	Revise Westar's Facility Report (Appendix A) updated to final report.
8/31/2020	SPP	Moved Revision History to a new page and Note to change description; inserted Contents page, Initial Consultant's Study Report page, and Subsequent Consultant's Study Report page with accompanying EN Plus Consulting study report.
9/9/2020	SPP	Correct typographical error in Section 2.1 of subsequent consultant report

CONTENTS

INITIAL CONSULTANT'S STUDY REPORT

See next page for the initial Consultant's Interim Availability Interconnection System Impact Study report.

Interim Availability Interconnection System Impact Study

Interim Availability Impact Study

IAISIS of Interim
Project No. 115852

Revision 2A
10/25/2019

Interim Availability Interconnection System Impact Study

prepared for

Liberty Utilities
IAISIS of Interim
Joplin, Missouri

Project No. 115852

Revision 2A
10/25/2019

Prepared by

Burns & McDonnell Engineering Company, Inc.
Houston, Texas

TABLE OF CONTENTS

Page No.

LIST OF TABLES

Page No.

LIST OF FIGURES

Page No.

1.0 EXECUTIVE SUMMARY

Liberty Utilities (LU) retained Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) to perform an Interim Availability System Impact Study (the Study or IAISIS) of the interconnection interim requests. This study included load flow analysis, stability analysis, short circuit analysis and limited operation analysis to determine the impacts on the transmission system caused by the interim interconnection requests.

The interconnection interim requests consist of three wind projects, and these wind projects are in two study groups: Group 8 and Group 12. For GEN-2017-009 in Group 8, the requested study capacity is 302MW. For GEN-2017-060 and GEN-2017-082 in Group 12, the requested study capacity is 149.4MW each. The request summary is shown in Table ES-1.

Table ES-1: Interconnection Interim Requests

Group #	Queue Number	Service Type	Capacity (MW)	MW Requested For Study	Type	Point of Interconnection
08	GEN-2017-009	ERIS	302	302	Wind	Neosho - Caney River 345 kV
12	GEN-2017-060	ERIS	149.4	149.4	Wind	LaRussell Energy Center 161kV
12	GEN-2017-082	ERIS	149.4	149.4	Wind	Asbury Plant 161 kV

For this IAISIS, power flow analysis, stability analysis, short circuit analysis and limited operation amount analysis were conducted. The IAISIS assumes that only the higher queued projects listed within Table 2-2 of this report might go into service. If additional generation projects with queue priority equal to or higher than the study interim request rights to go into commercial operation, this IAISIS may need to be restudied to ensure that interconnection service remains for the customer's request. All the analyses were performed using PSS/E v. 33.12.1 and TARA 19.01.

Note that the study focuses on the impact caused by these three interim requests (GEN-2017-009, GEN-2017-060 and GEN-2017-082), other queue projects' impact was not monitored, for example, GEN-2017-005's impact was not monitored. There may be other generation requests that could have limited services, but those are out of the scope of the Study. For GEN-2017-082 (Group 12), the study is also under the assumption that the Asbury thermal plant will be retired.

Power Flow Analysis: For the interim requests, GEN-2017-060 and GEN-2017-082 were studied at its maximum requested capacity (149.4MW each), and GEN-2017-009 was studied at 302MW. The power flow analysis evaluated the system for seven load scenarios (2017 Winter Peak (17WP), 2018 Spring

(18G), 2018 Summer Peak (18SP), 2021 Light (21L), 2021 Summer Peak (21SP), 2021 Winter Peak (21WP), and 2026 Summer Peak (26SP)).

For the interim requests dispatched, overloads were identified only in the Group 08 study. For Group 08, Neosho – GEN-2017-009 Tap 345kV line overloads were identified under different fault conditions. The worst overload on Neosho – GEN-2017-009 Tap was observed at 120.6% at Season 21L case with outage on Waverly – La Cygne 345kV circuit. APEX Clean Energy has requested a sponsored upgrade on Neosho – Caney River 345kV circuit, the upgrade will increase the normal and emergency ratings from 956MVA to 1159MVA. With the sponsored upgrade, the highest loading on Neosho – GEN-2017-009 Tap was observed at 99.5%. No voltage issue was observed for the study cases.

Dynamic Stability Analysis: For the interim requests, GEN-2017-060 and GEN-2017-082 were each studied at its maximum requested capacity (149.4MW each), and GEN-2017-009 was studied at its maximum requested capacity 302MW. The stability analysis evaluated the system for three load scenarios (2017 winter peak, 2018 summer peak and 2026 summer peak) simulating faults that included three-phase and single-line-to-ground faults.

The dynamic simulation indicated that, except some faults related to LaRussell substation, the system remained stable. Further investigation identified that either reclosing only the remote end or reducing the clearing time from 7 cycles to 6 cycles and reclosing only the remote end, as the protection mitigation, can mitigate the unstable conditions. No other transient stability violations were observed for the requested MW capacity for this IAISIS.

Short Circuit Analysis: 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. The short circuit analysis results show increase of short circuit current with the interconnection of the projects, but detailed comparison with the breaker ratings was not performed.

Limit Operation Amount Analysis: As indicated in the prior sections, with the sponsored upgrade and reduction of clearing cycles/reclosing only on the remote end for related faults at LaRussell substation, the maximum operation amount is the same as the requested capacity for each of the study projects. The developers of the three study projects have agreed that all the sponsored upgrades and protection mitigation will be implemented before the interconnection of the project. Based on these assumptions, the overall limited operation amount for each study project is the same as the requested capacity as shown in Table ES-2.

Table ES-2: Limited Operation Amount After Identified Mitigations In-Service

Group #	Queue Number	Limited Operation Amount (MW)
08	GEN-2017-009	302
12	GEN-2017-060	149.4
12	GEN-2017-082	149.4

2.0 INTRODUCTION

Liberty Utilities (Liberty or LU) retained Burns & McDonnell Engineering Company, Inc. (Burns & McDonnell) to perform an Interim Availability System Impact Study (the Study or the IAISIS). The Study evaluated the system impact due to the interconnection of the interim requests within SPP's system.

The Study is to evaluate and identify the adverse system impacts on SPP system due to the interconnection interim requests. This Study included power flow analysis, stability analysis, short circuit analysis and limited operation analysis. Liberty has requested three projects to be included in the Study: GEN-2017-009 (Group 08), GEN-2017-060(Group 12) and GEN-2017-082(Group 12), and the summary of these projects are listed in Table 2-1.

Table 2-1: Interconnection Interim Requests

Group #	Queue Number	Capacity	Type	Point of Interconnection
08	GEN-2017-009	302	Wind	Neosho - Caney River 345 kV
12	GEN-2017-060	149.4	Wind	LaRussell Energy Center 161kV
12	GEN-2017-082	149.4	Wind	Asbury Plant 161 kV

The IAISIS considers the Base Case as well as all Generating Facilities (and with respect to (b) below, any identified Network Upgrades associated with such higher queued interconnection) that, on the date the IAISIS is commenced:

a) are directly interconnected to the Transmission System;

b) are interconnected to Affected Systems and may have an impact on the Interconnection Request;

c) have a pending higher queued Interconnection Request to interconnect to the Transmission System listed in Table 2-2; or

d) have no Queue Position but have executed an LGIA or requested that an unexecuted LGIA be filed with FERC.

Any changes to these assumptions, for example, one or more of the previously queued requests not included within this study executing an interconnection agreement and commencing commercial operation, may require a re-study of this IAISIS.

This IAISIS study included prior queued generation interconnection requests. Table 2-2 lists the generation interconnection requests that are assumed to have rights to either full or partial interconnection service prior to the requested December 2018 in-service for this IAISIS. Also listed in Table 2-2 are the total MWs requested of interconnection service, the fuel type, the point of interconnection (POI), and the current status of each particular prior queued request. In the event that any of the projects achieve commercial operation with a capacity above the amount studied, the interim interconnection service will reduce to 0MW until a restudy is completed that identifies the available interconnection service.

Table 2-2: Generation Requests Included within IAISIS

Project	GEN-2017-009 powerflow capacity (MW)	GEN-2017-009 stability capacity (MW)	GEN-2017-060 & GEN-2017-082 powerflow capacity (MW)	GEN-2017-060 & GEN-2017-082 stability capacity (MW)	Fuel Source	POI	Status
Asbury Plant	0	189	0	0	Coal	Asbury Plant 161 kV	COMMERCIAL OPERATION
GEN-2002-004	200	200	200	200	Wind	Latham 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2005-013	199.8	199.8	199.8	199.8	Wind	Caney River 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2007-025	299.2	299.2	299.2	299.2	Wind	Viola 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2008-013	300	300	300	300	Wind	Hunter 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2008-098	99.5	99.5	99.5	99.5	Wind	Waverly 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2009-025	59.8	59.8	59.8	59.8	Wind	TAP Deer Creek â€“ Sinclair 69kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2010-003	99.5	99.5	99.5	99.5	Wind	Waverly 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2010-005	299.2	299.2	299.2	299.2	Wind	Viola 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2010-055	4.5	4.5	4.5	4.5	Gas	Wekiwa 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2011-057	150	150	150	150	Wind	Creswell 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2012-032	299	299	299	299	Wind	Rose Hill-(Ranch Road) Sooner (Open Sky) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2012-033	98.06	98.06	98.06	98.06	Wind	Tap and Tie South 4th - Bunch Creek & Enid Tap - Fairmont (GEN-2012-033T) 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2012-041	121.5	121.5	121.5	121.5	CT	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION

Project	GEN-2017-009 powerflow capacity (MW)	GEN-2017-009 stability capacity (MW)	GEN-2017-060 & GEN-2017-082 powerflow capacity (MW)	GEN-2017-060 & GEN-2017-082 stability capacity (MW)	Fuel Source	POI	Status
GEN-2013-011	30	30	30	30	Coal	Turk 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2013-012	147	147	147	147	Gas	Redbud 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2013-028	559.5	559.5	559.5	559.5	Gas	Tap N Tulsa - GRDA 1 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2013-029	299	299	299	299	Wind	Renfrow 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2014-001	200.6	200.6	200.6	200.6	Wind	Tap Wichita - Emporia Energy Center 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2014-028	35	35	35	35	CC	Riverton 161kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2014-064	248.4	248.4	248.4	248.4	Wind	Otter 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-001	200	200	200	200	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-015	154.56	154.56	154.56	154.56	Wind	Tap Medford Tap â€“ Coyote 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-016	200	200	200	200	Wind	Tap Marmaton - Centerville 161kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-024	217.7	217.8	217.7	217.8	Wind	Thistle-Wichita Dbl Ckt (Buffalo Flats) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-025	215.9	215.95	215.9	215.95	Wind	Tap Thistle â€“ Wichita 345kV Dbl CKT	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-034	200	200	200	200	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2015-036	304	304	304	304	Wind	Johnston County 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2015-047	297.8	297.8	297.8	297.8	Wind	Sooner 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-052	300	300	300	300	Wind	Open Sky-Rose Hill 345kV	IA FULLY EXECUTED/ON SUSPENSION
GEN-2015-062	4.5	4.5	4.5	4.5	Wind	Breckinridge 138kV, Bus #514815	IA FULLY EXECUTED/ON SCHEDULE
GEN-2015-063	300	300	300	300	Wind	Woodring-Matthewson 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-066	248.4	248.4	248.4	248.4	Wind	Sooner - Cleveland 345kV	IA FULLY EXECUTED/ON SUSPENSION
GEN-2015-069	300	300	300	300	Wind	Union Ridge 230kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-073	200.1	200.1	200.1	200.1	Wind	Emporia 345kV	IA FULLY EXECUTED/ON SCHEDULE

Project	GEN-2017-009 powerflow capacity (MW)	GEN-2017-009 stability capacity (MW)	GEN-2017-060 & GEN-2017-082 powerflow capacity (MW)	GEN-2017-060 & GEN-2017-082 stability capacity (MW)	Fuel Source	POI	Status
GEN-2015-082	200	200	200	200	Wind	Beaver County-Woodward EHV Dbl Ckt (Badger) 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2015-090	220	218.5	220	218.5	Wind	Thistle-Wichita Dbl Ckt (Buffalo Flats) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-095	176	176	176	176	Wind	Tap Mooreland - Knob Hill 138kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-003	248	248	248	248	Wind	Badger-Woodward EHV Dbl Ckt 345kV	IA PENDING
GEN-2016-009	29	29	29	29	Steam Turbine	Osage 69 kV Sub	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-013	10	10	10	10	CT	LaRussell Energy Center 161kV	IA PENDING
GEN-2016-014	10	10	10	10	CT	LaRussell Energy Center 161kV	IA PENDING
GEN-2016-020	150	150	150	150	WIND	Moreland 138kV Substation	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-022	151.8	0	151.8	151.8	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA PENDING
GEN-2016-028	100	100	100	100	Wind	Clayton 138 kV Sub	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-030	99.9	99.9	99.9	99.9	Solar	Brown 138kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-031	1.5	1.5	1.5	1.5	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2016-032	200	200	200	200	Wind	Cottonwood Creek-Marshall Tap 138 kV	IA FULLY EXECUTED/ON SUSPENSION
GEN-2016-047	24	24	24	24	CT	Mustang 69kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2016-051	9.8	9.8	9.8	9.8	Wind	Clinton Junction-Weatherford Southeast 138kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-061	250.7	0	250.7	250.7	Wind	Sooner-Woodring 345 kV line	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-063	200	200	200	200	Wind	Hugo-Sunnyside 345 kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-067	73.6	73.6	73.6	73.6	Wind	Mingo 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-068	250	0	250	250	Wind	Woodring 345kV	IA PENDING
GEN-2016-070	5.3	5.3	5.3	5.3	Wind	Majestic 115 kV Substation	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-071	200.1	0	200.1	200.1	Wind	Middleton Tap 138kV Substation	IA PENDING
GEN-2016-073	220	220	220	220	Wind	Thistle-Wichita Dbl Ckt (Buffalo Flats) 345kV	IA PENDING
GEN-2016-092	0	175	175	175	Wind	Fort Thompson-Leland Olds 345kV	FACILITY STUDY STAGE
GEN-2016-100	0	100	100	100	Wind	Spring Creek-Sooner 345kV	FACILITY STUDY STAGE

Project	GEN-2017-009 powerflow capacity (MW)	GEN-2017-009 stability capacity (MW)	GEN-2017-060 & GEN-2017-082 powerflow capacity (MW)	GEN-2017-060 & GEN-2017-082 stability capacity (MW)	Fuel Source	POI	Status
GEN-2016-101	0	195	195	195	Wind	Spring Creek-Sooner 345kV	FACILITY STUDY STAGE
GEN-2016-119	0	0	600	600	Wind	Spring Creek-Sooner 345kV	FACILITY STUDY STAGE
GEN-2016-128	0	0	176	176	Wind	Woodring 345kV	FACILITY STUDY STAGE
GEN-2016-132	0	6.1	6.1	6.1	Wind	Sweetwater 230kV	FACILITY STUDY STAGE
GEN-2016-133	0	187.5	187.5	187.5	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-134	0	187.5	187.5	187.5	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-135	0	100	100	100	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-136	0	75	75	75	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-137	0	187.5	187.5	187.5	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-138	0	187.5	187.5	187.5	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-139	0	100	100	100	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-140	0	75	75	75	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-141	0	350	350	350	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-142	0	350	350	350	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-143	0	175	175	175	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-144	0	175	175	175	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-145	0	175	175	175	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-146	0	175	175	175	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-153	0	134	134	134	Wind	Viola 345kV	FACILITY STUDY STAGE
GEN-2016-162	0	252	252	252	Wind	Benton 345kV	FACILITY STUDY STAGE
GEN-2016-163	0	252	252	252	Wind	Benton 345kV	FACILITY STUDY STAGE
GEN-2016-166	0	35	35	35	Solar	Prairie Grove 69 kV Substation	FACILITY STUDY STAGE
GEN-2017-004	202	0	202	0	Wind	Elm Creek - Summit 345 kV	DISIS STAGE
GEN-2017-005	195	0	195	0	Wind	Marmaton - Litchfield 161 kV	DISIS STAGE
GEN-2017-069	3.6	0	3.6	0	Solar	Norton 115kV	DISIS STAGE
GEN-2017-094	200	0	200	0	Wind	Fort Thompson-Huron 230 kV	DISIS STAGE

The study is under the assumption that the Asbury thermal plant will be retired.

2.1 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.

3.0 POWER FLOW ANALYSIS

Power flow analysis is used to determine if the transmission system can accommodate the injection from the request without violating thermal or voltage transmission planning criteria.

3.1 Model Preparation

Power flow analysis for the Interim Study was performed using modified versions of the 2016 series of transmission service request study models including the 2017 Winter Peak (17WP), 2018 Spring (18G), 2018 Summer Peak (18SP), 2021 Light (21L), 2021 Summer Peak (21SP), 2021 Winter Peak (21WP), and 2026 Summer Peak (26SP) seasonal models.

For Variable Energy Resources (VER) (solar/wind) in each power flow case, Energy Resource Interconnection Service (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 for Summer, Winter and Spring seasons and 10% nameplate of maximum generation for the Light season. These projects are dispatched across the SPP footprint using load factor ratios.

Peaking units are not dispatched in the spring, light, or in the "High VER" summer and winter peaks. To study peaking units' impacts, the summer and winter 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 Network Resource Interconnection Service (NRIS) are dispatched in an additional analysis into the interconnecting Transmission Owner's (T.O.) area at 100% nameplate with Energy Resource Interconnection Service (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.

For this IAISIS, only the previous queued requests listed in Table 2-2 were assumed to be in-service at 100% dispatch.

In power flow analysis, Group 08 cases include all requests included in DISIS-2016-001-4. Group 12 cases include all requests included in DISIS-2016-002.

In power flow analysis, the DISIS-2016-001-4 and DISIS-2016-002 models included the Litchfield-Baker-Neosho 69kV circuit as a 161kV circuit. Prior to the Interim Study analysis, this circuit was updated in the models to 69kV.

3.2 Study Methodology and Criteria

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

For Energy Resource Interconnection Service (ERIS), thermal overloads are determined for system intact (n-0) (greater than 100% of Rate A - normal) and for contingency (n-1) (greater than 100% of Rate B – emergency) conditions.

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

- 3% Distribution Factor (DF) for system intact conditions (n-0),
- 20% DF upon outage based conditions (n-1), or
- 3% DF on contingent elements that resulted in a non-converged solution.

Interconnection Requests that requested Network Resource Interconnection Service (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 considered for transmission reinforcement under NRIS.

The contingency set includes all SPP control area branches and ties 69kV and above, first tier Non-SPP control area branches and ties 115 kV and above, any defined contingencies for these control areas, and generation unit outages for the SPP control areas with SPP reserve share program redispatch.

The monitored elements include all SPP control area branches, ties, and buses 69 kV and above, and all first tier Non-SPP control area branches and ties 69 kV and above. NERC Power Transfer Distribution Flowgates for SPP and first tier Non-SPP control area are monitored. Additional NERC Flowgates are monitored in second tier or greater Non-SPP control areas. Voltage monitoring was performed for SPP control area buses 69 kV and above.

3.3 Results

The thermal violations and the corresponding transfer distribution factors are listed in Table 3-1, and the contingency descriptions associated with the thermal violations are listed in Table 3-2. Table 3-1 lists the violations for the monitor facility for each study Group.

For the interim requests dispatched, overloads were identified only in the Group 08 study. For Group 8, Neosho – GEN-2017-009 Tap 345kV line overloads were identified under different contingency conditions. The worst overload on Neosho – GEN-2017-009 Tap was observed at 120.6% in the Season 21L case with outage on Waverly – La Cygne 345kV circuit. GEN-2017-009 has requested a sponsored upgrade on Neosho – Caney River 345kV circuit, the upgrade will increase the normal and emergency ratings from 956MVA to 1159MVA. After the sponsored upgrade, the highest loading on Neosho – GEN-2017-009 Tap was observed at 99.5%.

Table 3-1: Thermal Violation with TDF

Group No.	Season	Monitored Facility	Cont Name	Rating A (MVA)	Rating B (MVA)	BC Loading (%)	TC Loading (%)	New Rating A (MVA)	New Rating B (MVA)	New TC Loading (%)	TDF	Study Project
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	Base Case	956	956	-	92.4	1159	1159	76.2	0.73	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	1404	956	956	-	107.2	1159	1159	88.4	0.72	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	SINGLE_5071	956	956	-	106.8	1159	1159	88.1	0.72	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	1405X	956	956	-	105.6	1159	1159	87.1	0.72	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	2168	956	956	-	104.7	1159	1159	86.4	0.74	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	2177	956	956	-	104.7	1159	1159	86.4	0.74	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	SINGLE_5093	956	956	-	104.7	1159	1159	86.4	0.74	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	SINGLE_5094	956	956	-	103.5	1159	1159	85.4	0.72	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	1007	956	956	-	102.7	1159	1159	84.7	0.72	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	1110	956	956	-	102.7	1159	1159	84.7	0.72	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	1008	956	956	-	102.5	1159	1159	84.6	0.72	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	1111	956	956	-	102.5	1159	1159	84.6	0.72	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	1340	956	956	-	102.5	1159	1159	84.6	0.72	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	1405	956	956	-	102.5	1159	1159	84.6	0.72	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	392	956	956	-	102.5	1159	1159	84.6	0.72	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	SINGLE_5164	956	956	-	98.1	1159	1159	80.9	0.73	GEN-2017-009
G08	17WP0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	4717	956	956	-	96.6	1159	1159	79.7	0.72	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	SINGLE_5188	956	956	95.4	116.0	1159	1159	95.7	0.73	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	4712	956	956	96.6	117.1	1159	1159	96.6	0.73	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	SINGLE_5184	956	956	100.2	120.6	1159	1159	99.5	0.73	GEN-2017-009
G08	21L0	532793 NEOSHO 7 345 588544 G17-009-TAP 345 1	4717	956	956	98.6	118.9	1159	1159	98.1	0.73	GEN-2017-009
G12	NONE											

-: less than 90%.

Table 3-2: Contingency Description for the Thermal Violation

Cont Name	Cont. Description
1404	[520/523] 509852 T.NO.--7 345 512694 CLEVLND7 345 1 [523] 512729 CLEVLND 4 138 998545 CLVAUTO1 138 1 [523] 512694 CLEVLND7 345 998545 CLVAUTO1 138 1 [523] 512817 CLEVLND1 13.8 998545 CLVAUTO1 138 1
SINGLE_5071	[523/524] 512694 CLEVLND7 345 560056 G15066_T 345 1
1405X	[520/523] 509852 T.NO.--7 345 512694 CLEVLND7 345 1 [523/524] 512694 CLEVLND7 345 560056 G15066_T 345 1 [524] 514803 SOONER 7 345 560056 G15066_T 345 1
2168	[524/527] 515576 RANCHRD7 345 529200 OMCDLEC7 345 1 [524] 514803 SOONER 7 345 515576 RANCHRD7 345 1
2177	[524] 514803 SOONER 7 345 515576 RANCHRD7 345 1
SINGLE_5093	[524] 514803 SOONER 7 345 515576 RANCHRD7 345 1
SINGLE_5094	[524] 514803 SOONER 7 345 560056 G15066_T 345 1
1007	[520] 509755 WEKIWA-7 345 509852 T.NO.--7 345 1 [520/523] 509852 T.NO.--7 345 512694 CLEVLND7 345 1
1110	[520] 509755 WEKIWA-7 345 509852 T.NO.--7 345 1 [520/523] 509852 T.NO.--7 345 512694 CLEVLND7 345 1
1008	[520/523] 509852 T.NO.--7 345 512694 CLEVLND7 345 1
1111	[520/523] 509852 T.NO.--7 345 512694 CLEVLND7 345 1
1340	[520/523] 509852 T.NO.--7 345 512694 CLEVLND7 345 1
1405	[520/523] 509852 T.NO.--7 345 512694 CLEVLND7 345 1
392	[520/523] 509852 T.NO.--7 345 512694 CLEVLND7 345 1
SINGLE_5164	[536] 532768 EMPEC 7 345 562476 G14_001T 345 1
4717	[536] 532797 WOLFCRK7 345 532799 WAVERLY7 345 1 [536] 532797 WOLFCRK7 345 998182 WOLF TX-6 69.0 1 [536] 533653 WOLFCRK2 69.0 998182 WOLF TX-6 69.0 1 [536] 532962 WOLFCRK1 17.0 998182 WOLF TX-6 69.0 1
SINGLE_5188	[536] 532797 WOLFCRK7 345 532799 WAVERLY7 345 1
4712	[536] 532797 WOLFCRK7 345 532799 WAVERLY7 345 1 [536] 532799 WAVERLY7 345 532802 WAVERTX7 345 1 [536/541] 532799 WAVERLY7 345 542981 LACYGNE7 345 1
SINGLE_5184	[536/541] 532799 WAVERLY7 345 542981 LACYGNE7 345 1
4717	[536] 532797 WOLFCRK7 345 532799 WAVERLY7 345 1 [536] 532797 WOLFCRK7 345 998173 WOLF TX-6 69.0 1 [536] 533653 WOLFCRK2 69.0 998173 WOLF TX-6 69.0 1 [536] 532962 WOLFCRK1 17.0 998173 WOLF TX-6 69.0 1

No voltage issue was observed for the study cases. .

4.0 STABILITY ANALYSIS

Transient stability analysis is used to determine if the transmission system can maintain angular stability and ensure bus voltages stay within planning criteria bandwidth during and after a disturbance while considering the addition of a generator interconnection request.

4.1 Methodology

Transient stability analysis was performed using modified versions of the 2016 series of Model Development Working Group (MDWG) dynamic study models including the 2017 winter, 2018 summer peak, and 2026 summer peak dynamic cases. The cases were adapted to resemble the power flow study cases with regards to prior queued generation requests and topology. Finally, the prior queued and study generation was dispatched into the SPP footprint. The unit dispatch update for each group is listed in Table 4-1. Initial simulations were carried out for a non-disturbance run of twenty (20) seconds to verify the numerical stability of the model.

Table 4-1: Dynamic Case Update

Group Number	Unit Dispatch Update
08	Add Study Project GEN-2017-009, GEN-2017-2017-060, and GEN-2017-082
	Turn off Prior Queue Project GEN-2016-022, GEN-2016-061, GEN-2016-068, GEN-2016-071, GEN-2016-072, GEN-2016-119 and GEN-2016-128
12	Add Study Project GEN-2017-009, GEN-2017-2017-060, and GEN-2017-082
	Retire Asbury Thermal Unit.
	Adjust LaRussell Thermal Unit to its maximum output.

Except those adjustment listed in Table 4-1, for stability analysis, Group 08 cases include all requests included in DISIS-2016-002-1. Group 12 cases include all requests included in DISIS-2016-002.

4.2 Fault Definitions

The study contingencies included three-phase faults and single-phase line-ground faults at locations defined by SPP. Single-phase line faults were simulated by applying fault impedance to the positive sequence network at the fault location to represent the effect of the negative and zero sequence networks on the positive sequence network. The fault impedance was computed to give a positive sequence voltage at the specified fault location of approximately 60% of pre-fault voltage. This method is in agreement with SPP current practice.

With exception to transformers, the typical sequence of events for a three-phase and single-phase fault is as follows:

1. apply fault at a particular location;
2. continue fault for five (5) cycles, clear the fault by tripping the faulted facility;
3. after an additional twenty (20) cycles, re-close the previous facility back into the fault;
4. continue fault for five (5) additional cycles;
5. trip the faulted facility and remove the fault.

Transformer faults are typically only performed for three-phase faults, unless otherwise noted. The sequence of events for a transformer is to 1) apply a three-phase fault for five (5) cycles and 2) clear the fault by tripping the affected transformer facility. Unless otherwise noted there will be no re-closing into a transformer fault.

Based on the configuration of interconnection of the study projects, total of forty-two (42) contingencies for Group 08 near the POI of GEN-2017-009 were identified for this study, and total of ninety (90) contingencies for Group 12 near the POIs of GEN-2017-060 and GEN-2017-082 were identified for this study. These faults are listed within Table 4-2, Table 4-3 and Table 4-4 .

Table 4-2: Contingencies Evaluated for GEN-2017-009

Fault Number	Fault Name	Contingency (Fault) Description
01	**009FLT01-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to NEOSHO 5 (532937) 345/161 kV Transformer , CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345/161 kV Transformer (532793-532937, CKT 1)
02	**009FLT02-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to NEOSHO 4 (533021) 345/138 kV Transformer , CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345/138 kV Transformer (532793-533021, CKT 1)
03_R	**009FLT03_R-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to 7BLACKBERRY (300739) 345 kV Line, CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-300739, 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
04_R	**009FLT04_R-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to LACYGNE7 (542981) 345 kV Line, CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-542981, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault

Fault Number	Fault Name	Contingency (Fault) Description
		d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
05_R	**009FLT05_R-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to DELWARE7 (510380) 345 kV Line, CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-510380, 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
06_R	**009FLT06_R-3PH**	**3 Phase Fault on G17-009-TAP (588544) 345 kV Bus to NEOSHO 7 (532793) 345 kV Line, CKT 1**
		a. Apply Fault at the G17-009-TAP (588544) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (588544-532793, 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
07_R	**009FLT07_R-3PH**	**3 Phase Fault on G17-009-TAP (588544) 345 kV Bus to CANEYRV7 (532780) 345 kV Line, CKT 1**
		a. Apply Fault at the G17-009-TAP (588544) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (588544-532780, 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
08_R	**009FLT08_R-3PH**	**3 Phase Fault on CANEYRV7 (532780) 345 kV Bus to LATHAMS7 (532800) 345 kV Line, CKT 1**
		a. Apply Fault at the CANEYRV7 (532780) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532780-532800, 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
10_R	**009FLT10_R-3PH**	**3 Phase Fault on LATHAMS7 (532800) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1**
		a. Apply Fault at the LATHAMS7 (532800) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532800-532794, 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
11_R	**009FLT11_R-3PH**	**3 Phase Fault on Wolf Creek (532797) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1**
		a. Apply Fault at the Wolf Creek (532797) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532797-532794, 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
12_R	**009FLT12_R-3PH**	**3 Phase Fault on Wolf Creek (532797) 345 kV Bus to Benton (532791) 345 kV Line, CKT 1**
		a. Apply Fault at the Wolf Creek (532797) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532797-532791, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault

Fault Number	Fault Name	Contingency (Fault) Description
		d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
13_R	**009FLT13_R-3PH**	**3 Phase Fault on Wolf Creek (532797) 345 kV Bus to Waverly (532799) 345 kV Line, CKT 1**
		a. Apply Fault at the Wolf Creek (532797) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532797-532799, 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
14_R	**009FLT14_R-3PH**	**3 Phase Fault on Waverly (532799) 345 kV Bus to LACYGNE7 (542981) 345 kV Line, CKT 1**
		a. Apply Fault on the Waverly to LaCygne 345 kV circuit at the Waverly end
		b. After 3.6 cycles, open Waverly to LaCygne 345 kV Line, CKT 1 at Waverly end
		c. Clear Fault after an additional 0.65 Cycles and Trip the Faulted 345 kV Line (532799-542981, CKT 1) by opening the LaCygne end
15_R	**009FLT15_R-3PH**	**3 Phase Fault on Benton (532791) 345 kV Bus to Wichita (532796) 345 kV Line, CKT 1**
		a. Apply Fault at the Benton (532791) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532791-532796, 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
16_R	**009FLT16_R-3PH**	**3 Phase Fault on ROSEHIL7 (532794) 345 kV Bus to Benton (532791) 345 kV Line, CKT 1**
		a. Apply Fault at the ROSEHIL7 (532794) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532794-532791, 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
17	**009FLT17-3PH**	**3 Phase Fault on ROSEHIL7 (532794) 345 kV Bus to ROSEHIL4 (533062) 345/138 kV Transformer, CKT 1**
		a. Apply Fault at the ROSEHIL7 (532794) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345/138 kV Transformer (532794-533062, CKT 1)
18_R	**009FLT18_R-3PH**	**3 Phase Fault on Ranch Road (515576) 345 kV Bus to Sooner (514803) 345 kV Line, CKT 1**
		a. Apply Fault at the Ranch Road (515576) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (515576-514803, 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
19_R	**009FLT19_R-3PH**	**3 Phase Fault on LACYGNE7 (542981) 345 kV Bus to West Gardner (542965) 345 kV Line, CKT 1**
		a. Apply Fault at the LACYGNE7 (542981) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (542981-542965, 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 Number	Fault Name	Contingency (Fault) Description
20_R	009FLT20_R-3PH	**3 Phase Fault on LACYGNE7 (542981) 345 kV Bus to Stilwell (542968) 345 kV Line, CKT 1**
		a. Apply Fault at the LACYGNE7 (542981) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (542981-542968, 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
21_R	009FLT21_R-3PH	**3 Phase Fault on DELWARE7 (510380) 345 kV Bus to Northeastern (510406) 345 kV Line, CKT 1**
		a. Apply Fault at the DELWARE7 (510380) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (510380-510406, 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
22_R	009FLT22_R-3PH	**3 Phase Fault on Northeastern (510406) 345 kV Bus to Tulsa North (509852) 345 kV Line, CKT 1**
		a. Apply Fault at the Northeastern (510406) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (510406-509852, 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
23_R	009FLT23_R-3PH	**3 Phase Fault on Northeastern (510406) 345 kV Bus to Oneta (509807) 345 kV Line, CKT 1**
		a. Apply Fault at the Northeastern (510406) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (510406-509807, 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
24_R	009FLT24_R-3PH	**3 Phase Fault on 7BLACKBERRY (300739) 345 kV Bus to Sportsman (300740) 345 kV Line, CKT 1**
		a. Apply Fault at the 7BLACKBERRY (300739) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (300739-300740, 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
25_R	009FLT25_R-3PH	**3 Phase Fault on 7BLACKBERRY (300739) 345 kV Bus to 7JASPER (300949) 345 kV Line, CKT 1**
		a. Apply Fault at the 7BLACKBERRY (300739) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (300739-300949, 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
26_R	009FLT26_R-3PH	**3 Phase Fault on 7MORGAN (300045) 345 kV Bus to BROOKLINE 7 (549984) 345 kV Line, CKT 1**
		a. Apply Fault at the 7MORGAN (300045) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (300045-549984, 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 Number	Fault Name	Contingency (Fault) Description
27_R	009FLT27_R-3PH	**3 Phase Fault on 7MORGAN (300045) 345 kV Bus to Huben (300042) 345 kV Line, CKT 1**
		a. Apply Fault at the 7MORGAN (300045) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (300045-300042, 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
28_P4	009FLT28_P4-1PH	**SLG Fault with breaker failure cleared by opening LATHAMS7 (532800) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT**
		SLG Fault with breaker failure on ROSEHIL7 (532794) 345 kV Bus to ROSEHIL4 (533062) 345/161 kV Transformer , CKT 1
		a. Apply Fault at the ROSEHIL7 (532794) 345 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 345/161 kV Transformer (532794-533062, CKT 1) and345 kV Line (532800-532794, CKT)
29_P4	009FLT29_P4-1PH	**SLG Fault with breaker failure cleared by opening Wolf Creek (532797) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1**
		SLG Fault with breaker failure on ROSEHIL7 (532794) 345 kV Bus to ROSEHIL4 (533062) 345/161 kV Transformer , CKT 1
		a. Apply Fault at the ROSEHIL7 (532794) 345 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 345/161 kV Transformer (532794-533062, CKT 1) and 345 kV Line (532797-532794, CKT 1)
30_P4	009FLT30_P4-1PH	**SLG Fault with breaker failure cleared by opening ROSEHIL7 (532794) 345 kV Bus to Benton (532791) 345 kV Line, CKT 1**
		SLG Fault with breaker failure on ROSEHIL7 (532794) 345 kV Bus to ROSEHIL4 (533062) 345/161 kV Transformer , CKT 1
		a. Apply Fault at the ROSEHIL7 (532794) 345 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 345/161 kV Transformer (532794-533062, CKT 1) and 345 kV Line (532794-532791, CKT 1)
31_P4	009FLT31_P4-1PH	**SLG Fault with breaker failure cleared by opening Sooner (514803) 345 kV Bus to Woodring (514715) 345 kV Line, CKT 1**
		SLG Fault with breaker failure on Sooner (514803) 345 kV Bus to Ranch Road (515576) 345/161 kV Transformer , CKT 1
		a. Apply Fault at the Sooner (514803) 345 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 345/161 kV Transformer (514803-515576, CKT 1) and 345 kV Line (514803-514715, CKT 1)
32_P4	009FLT32_P4-1PH	**SLG Fault with breaker failure cleared by opening G17-009-TAP (588544) 345 kV Bus to NEOSHO 7 (532793) 345 kV Line, CKT 1**
		SLG Fault with breaker failure on NEOSHO 7 (532793) 345 kV Bus to DELWARE7 (510380) 345 kV Line, CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 345 kV Line (532793-510380, CKT 1) and 345 kV Line (588544-532793, CKT 1)
33_P4	009FLT33_P4-1PH	**SLG Fault with breaker failure cleared by opening NEOSHO 7 (532793) 345 kV Bus to 7BLACKBERRY (300739) 345 kV Line, CKT 1**
		SLG Fault with breaker failure on NEOSHO 7 (532793) 345 kV Bus to NEOSHO 5 (532937) 345/161 kV Transformer , CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 345/161 kV Transformer (532793-532937, CKT 1) and 345 kV Line (532793-300739, CKT 1)

Fault Number	Fault Name	Contingency (Fault) Description
34_P4	**009FLT34_P4-1PH**	**SLG Fault with breaker failure cleared by opening NEOSHO 7 (532793) 345 kV Bus to LACYGNE7 (542981) 345 kV Line, CKT 1**
		SLG Fault with breaker failure on NEOSHO 7 (532793) 345 kV Bus to NEOSHO 4 (533021) 345/138 kV Transformer , CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 345/138 kV Transformer (532793-533021, CKT 1) and 345 kV Line (532793-542981, CKT 1)
35_P6	**009FLT35_P6-3PH**	**Prior outage of LATHAMS7 (532800) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to NEOSHO 5 (532937) 345/161 kV Transformer, CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345/161 kV Transformer (532793-532937, CKT 1)
36_P6	**009FLT36_P6-3PH**	**Prior outage of LATHAMS7 (532800) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to NEOSHO 4 (533021) 345/138 kV Transformer, CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345/138 kV Transformer (532793-533021, CKT 1)
37_P6_R	**009FLT37_P6_R-3PH**	**Prior outage of LATHAMS7 (532800) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to 7BLACKBERRY (300739) 345 kV Line, CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-300739, 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
38_P6_R	**009FLT38_P6_R-3PH**	**Prior outage of LATHAMS7 (532800) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to LACYGNE7 (542981) 345 kV Line, CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-542981, 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
39_P6_R	**009FLT39_P6_R-3PH**	**Prior outage of LATHAMS7 (532800) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to DELWARE7 (510380) 345 kV Line, CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-510380, 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
40_P6_R	**009FLT40_P6_R-3PH**	**Prior outage of G17-009-TAP (588544) 345 kV Bus to NEOSHO 7 (532793) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**

Fault Number	Fault Name	Contingency (Fault) Description
		3 Phase Fault on Wolf Creek (532797) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1
		a. Apply Fault at the Wolf Creek (532797) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532797-532794, 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
41_P6_R	**009FLT41_P6_R-3PH**	**Prior outage of G17-009-TAP (588544) 345 kV Bus to NEOSHO 7 (532793) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on ROSEHIL7 (532794) 345 kV Bus to Benton (532791) 345 kV Line, CKT 1
		a. Apply Fault at the ROSEHIL7 (532794) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532794-532791, 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
42_P6_R	**009FLT42_P6_R-3PH**	**Prior outage of G17-009-TAP (588544) 345 kV Bus to NEOSHO 7 (532793) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on ROSEHIL7 (532794) 345 kV Bus to ROSEHIL4 (533062) 345/138 kV Transformer, CKT 1
		a. Apply Fault at the ROSEHIL7 (532794) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345/138 kV Transformer (532794-533062, CKT 1)
43_P6_R	**009FLT43_P6_R-3PH**	**Prior outage of G17-009-TAP (588544) 345 kV Bus to NEOSHO 7 (532793) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on Ranch Road (515576) 345 kV Bus to Sooner (514803) 345 kV Line, CKT 1
		a. Apply Fault at the Ranch Road (515576) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (515576-514803, 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

Table 4-3: Contingencies Evaluated for GEN-2017-060

Fault Number	Fault Name	Contingency (Fault) Description
01_R	**060FLT01_R-3PH**	**3 Phase Fault on LAR382 5 (547479) 161 kV Bus to SPRGFLD5 (505492) 161 kV Line, CKT 1**
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-505492, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
02_R	**060FLT02_R-3PH**	**3 Phase Fault on SPRGFLD5 (505492) 161 kV Bus to SPRGFLD2 (505494) 161/69 kV Transformer , CKT 1**
		a. Apply Fault at the SPRGFLD5 (505492) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161/69 kV Transformer (505492-505494, CKT 1)

Fault Number	Fault Name	Contingency (Fault) Description
03_R	060FLT03_R-3PH	**3 Phase Fault on SPRGFLD5 (505492) 161 kV Bus to 5NIXA-1 (300678) 161 kV Line, CKT 1**
		a. Apply Fault at the SPRGFLD5 (505492) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (505492-300678, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
04_R	060FLT04_R-3PH	**3 Phase Fault on SPRGFLD5 (505492) 161 kV Bus to BROOKLINE 5 (549969) 161 kV Line, CKT 1**
		a. Apply Fault at the SPRGFLD5 (505492) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (505492-549969, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
05_R	060FLT05_R-3PH	**3 Phase Fault on MON383 5 (547480) 161 kV Bus to AUR124 5 (547468) 161 kV Line, CKT 1**
		a. Apply Fault at the MON383 5 (547480) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547480-547468, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
06_R	060FLT06_R-3PH	**3 Phase Fault on MON383 5 (547480) 161 kV Bus to MON383 2 (547591) 161/69 kV Transformer , CKT 1**
		a. Apply Fault at the MON383 5 (547480) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161/69 kV Transformer (547480-547591, CKT 1)
07_R	060FLT07_R-3PH	**3 Phase Fault on MON383 5 (547480) 161 kV Bus to TIP292 5 (547472) 161 kV Line, CKT 1**
		a. Apply Fault at the MON383 5 (547480) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547480-547472, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
08_R	060FLT08_R-3PH	**3 Phase Fault on MON383 5 (547480) 161 kV Bus to LAR382 5 (547479) 161 kV Line, CKT 1**
		a. Apply Fault at the MON383 5 (547480) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547480-547479, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
09_R	060FLT09_R-3PH	**3 Phase Fault on LAR382 5 (547479) 161 kV Bus to Monett (547480) 161 kV Line, CKT 1**
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-547480, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
10_R	060FLT10_R-3PH	**3 Phase Fault on LAR382 5 (547479) 161 kV Bus to CARTHAG5 (505488) 161 kV Line, CKT 1**
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-505488, CKT 1)

Fault Number	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 7 Cycles, then Trip the Line in (b) and Clear the Fault
11_R	**060FLT11_R-3PH**	**3 Phase Fault on SPRGFLD5 (505492) 161 kV Bus to NIXA 5 (505496) 161 kV Line, CKT 1**
		a. Apply Fault at the SPRGFLD5 (505492) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (505492-505496, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
12_R	**060FLT12_R-3PH**	**3 Phase Fault on SPRGFLD5 (505492) 161 kV Bus to BATTLEFIELD5 (549959) 161 kV Line, CKT 1**
		a. Apply Fault at the SPRGFLD5 (505492) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (505492-549959, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
13_R	**060FLT13_R-3PH**	**3 Phase Fault on SPRGFLD5 (505492) 161 kV Bus to CLAY 5 (549970) 161 kV Line, CKT 1**
		a. Apply Fault at the SPRGFLD5 (505492) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (505492-549970, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
14_R	**060FLT14_R-3PH**	**3 Phase Fault on MON383 5 (547480) 161 kV Bus to TIP292 5 (547472) 161 kV Line, CKT 1**
		a. Apply Fault at the MON383 5 (547480) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547480-547472, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
15_R	**060FLT15_R-3PH**	**3 Phase Fault on CARTHAG5 (505488) 161 kV Bus to NEO SPA5 (505486) 161 kV Line, CKT 1**
		a. Apply Fault at the CARTHAG5 (505488) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (505488-505486, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
16_R	**060FLT16_R-3PH**	**3 Phase Fault on CARTHAG5 (505488) 161 kV Bus to ATL109 5 (547466) 161 kV Line, CKT 1**
		a. Apply Fault at the CARTHAG5 (505488) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (505488-547466, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
17	**060FLT17-3PH**	**3 Phase Fault on CARTHAG5 (505488) 161 kV Bus to CARTHG 2 (505490) 161/69 kV Transformer , CKT 1**
		a. Apply Fault at the CARTHAG5 (505488) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161/69 kV Transformer (505488-505490, CKT 1)
18_R	**060FLT18_R-3PH**	**3 Phase Fault on CARTHAG5 (505488) 161 kV Bus to CAR395 5 (547485) 161 kV Line, CKT 1**

Fault Number	Fault Name	Contingency (Fault) Description
		a. Apply Fault at the CARTHAG5 (505488) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (505488-547485, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
19_R	**060FLT19_R-3PH**	**3 Phase Fault on ASB349 5 (547476) 161 kV Bus to LITCH 5 (532932) 161 kV Line, CKT 1**
		a. Apply Fault at the ASB349 5 (547476) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547476-532932, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
20_R	**060FLT20_R-3PH**	**3 Phase Fault on ASB349 5 (547476) 161 kV Bus to CJ 366 5 (547477) 161 kV Line, CKT 1**
		a. Apply Fault at the ASB349 5 (547476) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547476-547477, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
21_R	**060FLT21_R-3PH**	**3 Phase Fault on RIV4525 (547469) 161 kV Bus to NEOSHO 5 (532937) 161 kV Line, CKT 1**
		a. Apply Fault at the RIV4525 (547469) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547469-532937, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
22_R	**060FLT22_R-3PH**	**3 Phase Fault on RIV4525 (547469) 161 kV Bus to HOC404 5 (547487) 161 kV Line, CKT 1**
		a. Apply Fault at the RIV4525 (547469) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547469-547487, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
23_R	**060FLT23_R-3PH**	**3 Phase Fault on RIV4525 (547469) 161 kV Bus to STL439 5 (547498) 161 kV Line, CKT 1**
		a. Apply Fault at the RIV4525 (547469) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547469-547498, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
24_R	**060FLT24_R-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to NEOSHO 5 (532937) 345/161 kV Transformer, CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345/161 kV Transformer (532793-532937, CKT 1)
25_R	**060FLT25_R-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to 7BLACKBERRY (300739) 345 kV Line, CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-300739, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault

Fault Number	Fault Name	Contingency (Fault) Description
		d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
26_R	**060FLT26_R-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to LACYGNE7 (542981) 345 kV Line, CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-542981, 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
27_R	**060FLT27_R-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to DELWARE7 (510380) 345 kV Line, CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-510380, 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
28_R	**060FLT28_R-3PH**	**3 Phase Fault on G17-009-TAP (588544) 345 kV Bus to NEOSHO 7 (532793) 345 kV Line, CKT 1**
		a. Apply Fault at the G17-009-TAP (588544) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (588544-532793, 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
29_R	**060FLT29_R-3PH**	**3 Phase Fault on BROOKLINE 7 (549984) 345 kV Bus to 7MORGAN (300045) 345 kV Line, CKT 1**
		a. Apply Fault at the BROOKLINE 7 (549984) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (549984-300045, 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
30_R	**060FLT30_R-3PH**	**3 Phase Fault on BROOKLINE 7 (549984) 345 kV Bus to FLINTCR7 (506935) 345 kV Line, CKT 1**
		a. Apply Fault at the BROOKLINE 7 (549984) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (549984-506935, 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
31_R	**060FLT31_R-3PH**	**3 Phase Fault on 7BLACKBERRY (300739) 345 kV Bus to Sportsman (300740) 345 kV Line, CKT 1**
		a. Apply Fault at the 7BLACKBERRY (300739) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (300739-300740, 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
32_R	**060FLT32_R-3PH**	**3 Phase Fault on 7BLACKBERRY (300739) 345 kV Bus to 7JASPER (300949) 345 kV Line, CKT 1**
		a. Apply Fault at the 7BLACKBERRY (300739) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (300739-300949, 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 Number	Fault Name	Contingency (Fault) Description
33_R	060FLT33_R-3PH	**3 Phase Fault on 7MORGAN (300045) 345 kV Bus to Huben (300042) 345 kV Line, CKT 1**
		a. Apply Fault at the 7MORGAN (300045) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (300045-300042, 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
34_P4	060FLT34_P4-1PH	**SLG Fault on LAR382 5 (547479) 161 kV Bus to CARTHAG5 (505488) 161 kV Line, CKT 1**
		Open CARTHAG5 (505488) 161 kV Bus to clear the fault
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 161 kV Line (547479-505488, CKT 1) and bus
35_P4	060FLT35_P4-1PH	**SLG Fault on LAR382 5 (547479) 161 kV Bus to Monett (547480) 161 kV Line, CKT 1**
		Open Monett (547480) 161 kV Bus to () 161/ kV Transformer , CKT to clear the fault
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 161 kV Line (547479-547480, CKT 1) and bus
36_P4	060FLT36_P4-1PH	**SLG Fault on LAR382 5 (547479) 161 kV Bus to SPRGFLD5 (505492) 161 kV Line, CKT 1**
		Open SPRGFLD5 (505492) 161 kV Bus to NIXA 5 (505496) 161 kV Line, CKT 1 to clear the fault
		Open SPRGFLD5 (505492) 161 kV Bus to BATTLEFIELD5 (549959) 161 kV Line, CKT 1 to clear the fault
		Open SPRGFLD5 (505492) 161 kV Bus to SPRGFLD2 (505494) 161/69 kV Transformer , CKT TX2 to clear the fault
		Open SPRGFLD5 (505492) 161 kV Bus to SPRGFLD2 (505494) 161/69 kV Transformer , CKT TX3 to clear the fault
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 161 kV Line (547479-505492, CKT 1) and other circuits
37_P4	060FLT37_P4-1PH	**SLG Fault on SPRGFLD5 (505492) 161 kV Bus to BROOKLINE 5 (549969) 161 kV Line, CKT 1**
		Open SPRGFLD5 (505492) 161 kV Bus to 5NIXA-1 (300678) 161 kV Line, CKT 1 to clear the fault
		Open SPRGFLD5 (505492) 161 kV Bus to CLAY 5 (549970) 161 kV Line, CKT 1 to clear the fault
		Open SPRGFLD5 (505492) 161 kV Bus to SPRGFLD2 (505494) 161/69 kV Transformer , CKT TX1 to clear the fault
		a. Apply Fault at the SPRGFLD5 (505492) 161 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 161 kV Line (505492-549969, CKT 1) and other circuits
38_P6_R	060FLT38_P6_R-3PH	**Prior outage of LAR382 5 (547479) 161 kV Bus to SPRGFLD5 (505492) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on LAR382 5 (547479) 161 kV Bus to Monett (547480) 161 kV Line, CKT 1
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-547480, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
39_P6_R	060FLT39_P6_R-3PH	**Prior outage of LAR382 5 (547479) 161 kV Bus to SPRGFLD5 (505492) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**

Fault Number	Fault Name	Contingency (Fault) Description
		3 Phase Fault on LAR382 5 (547479) 161 kV Bus to CARTHAG5 (505488) 161 kV Line, CKT 1
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-505488, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
40_P6_R	**060FLT40_P6_R-3PH**	**Prior outage of LAR382 5 (547479) 161 kV Bus to CARTHAG5 (505488) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on LAR382 5 (547479) 161 kV Bus to Monett (547480) 161 kV Line, CKT 1
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-547480, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
41_P6_R	**060FLT41_P6_R-3PH**	**Prior outage of RIV4525 (547469) 161 kV Bus to HOC404 5 (547487) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on LAR382 5 (547479) 161 kV Bus to SPRGFLD5 (505492) 161 kV Line, CKT 1
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-505492, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
42_P6_R	**060FLT42_P6_R-3PH**	**Prior outage of RIV4525 (547469) 161 kV Bus to HOC404 5 (547487) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on LAR382 5 (547479) 161 kV Bus to Monett (547480) 161 kV Line, CKT 1
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-547480, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
43_P6_R	**060FLT43_P6_R-3PH**	**Prior outage of RIV4525 (547469) 161 kV Bus to NEOSHO 5 (532937) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on LAR382 5 (547479) 161 kV Bus to SPRGFLD5 (505492) 161 kV Line, CKT 1
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-505492, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
44_P6_R	**060FLT44_P6_R-3PH**	**Prior outage of RIV4525 (547469) 161 kV Bus to NEOSHO 5 (532937) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on LAR382 5 (547479) 161 kV Bus to Monett (547480) 161 kV Line, CKT 1
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-547480, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault

Fault Number	Fault Name	Contingency (Fault) Description
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault

Table 4-4: Contingencies Evaluated for GEN-2017-082

Fault Number	Fault Name	Contingency (Fault) Description
01_R	**082FLT01_R-3PH**	**3 Phase Fault on ASB349 5 (547476) 161 kV Bus to LITCH 5 (532932) 161 kV Line, CKT 1**
		a. Apply Fault at the ASB349 5 (547476) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547476-532932, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
02_R	**082FLT02_R-3PH**	**3 Phase Fault on ASB349 5 (547476) 161 kV Bus to PUR421 5 (547491) 161 kV Line, CKT 1**
		a. Apply Fault at the ASB349 5 (547476) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547476-547491, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
03_R	**082FLT03_R-3PH**	**3 Phase Fault on ASB349 5 (547476) 161 kV Bus to CJ 366 5 (547477) 161 kV Line, CKT 1**
		a. Apply Fault at the ASB349 5 (547476) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547476-547477, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
05_R	**082FLT05_R-3PH**	**3 Phase Fault on ORO110 5 (547467) 161 kV Bus to FIR417 5 (547490) 161 kV Line, CKT 1**
		a. Apply Fault at the ORO110 5 (547467) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547467-547490, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
09_R	**082FLT09_R-3PH**	**3 Phase Fault on LITCH 5 (532932) 161 kV Bus to FRANKLIN5 (532938) 161 kV Line, CKT 1**
		a. Apply Fault at the LITCH 5 (532932) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (532932-532938, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
10	**082FLT10-3PH**	**3 Phase Fault on LITCH 5 (532932) 161 kV Bus to LITCH S2 (533766) 161/69 kV Transformer, CKT 1**
		a. Apply Fault at the LITCH 5 (532932) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161/69 kV Transformer (532932-533766, CKT 1)
11	**082FLT11-3PH**	**3 Phase Fault on FRANKLIN5 (532938) 161 kV Bus to FRANKLIN2 (533876) 161/69 kV Transformer, CKT 1**
		a. Apply Fault at the FRANKLIN5 (532938) 161 kV Bus

Fault Number	Fault Name	Contingency (Fault) Description
		b. Clear Fault after 7 Cycles and Trip the Faulted 161/69 kV Transformer (532938-533876, CKT 1)
12_R	**082FLT12_R-3PH**	**3 Phase Fault on MARMTNE5 (532934) 161 kV Bus to NEOSHO 5 (532937) 161 kV Line, CKT 1**
		a. Apply Fault at the MARMTNE5 (532934) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (532934-532937, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
13_R	**082FLT13_R-3PH**	**3 Phase Fault on MARMTNE5 (532934) 161 kV Bus to FRANKLIN5 (532938) 161 kV Line, CKT 1**
		a. Apply Fault at the MARMTNE5 (532934) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (532934-532938, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
14_R	**082FLT14_R-3PH**	**3 Phase Fault on MARMTNE5 (532934) 161 kV Bus to G15-016T (543650) 161 kV Line, CKT 1**
		a. Apply Fault at the MARMTNE5 (532934) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (532934-543650, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
15	**082FLT15-3PH**	**3 Phase Fault on MARMTNE5 (532934) 161 kV Bus to MARMATN2 (533639) 161/69 kV Transformer, CKT 1**
		a. Apply Fault at the MARMTNE5 (532934) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161/69 kV Transformer (532934-533639, CKT 1)
16_R	**082FLT16_R-3PH**	**3 Phase Fault on ORO110 5 (547467) 161 kV Bus to RIV4525 (547469) 161 kV Line, CKT 1**
		a. Apply Fault at the ORO110 5 (547467) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547467-547469, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
17_R	**082FLT17_R-3PH**	**3 Phase Fault on ORO110 5 (547467) 161 kV Bus to JOP145 5 (547470) 161 kV Line, CKT 1**
		a. Apply Fault at the ORO110 5 (547467) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547467-547470, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
18_R	**082FLT18_R-3PH**	**3 Phase Fault on ORO110 5 (547467) 161 kV Bus to OAK432 5 (547494) 161 kV Line, CKT 1**
		a. Apply Fault at the ORO110 5 (547467) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547467-547494, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
19	**082FLT19-3PH**	**3 Phase Fault on ORO110 5 (547467) 161 kV Bus to ORO110 2 (547534) 161/69 kV Transformer, CKT 1**
		a. Apply Fault at the ORO110 5 (547467) 161 kV Bus

Fault Number	Fault Name	Contingency (Fault) Description
		b. Clear Fault after 7 Cycles and Trip the Faulted 161/69 kV Transformer (547467-547534, CKT 1)
20_R	**082FLT20_R-3PH**	**3 Phase Fault on CARTHAG5 (505488) 161 kV Bus to NEO SPA5 (505486) 161 kV Line, CKT 1**
		a. Apply Fault at the CARTHAG5 (505488) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (505488-505486, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
21_R	**082FLT21_R-3PH**	**3 Phase Fault on CARTHAG5 (505488) 161 kV Bus to ATL109 5 (547466) 161 kV Line, CKT 1**
		a. Apply Fault at the CARTHAG5 (505488) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (505488-547466, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
22_R	**082FLT22_R-3PH**	**3 Phase Fault on CARTHAG5 (505488) 161 kV Bus to LAR382 5 (547479) 161 kV Line, CKT 1**
		a. Apply Fault at the CARTHAG5 (505488) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (505488-547479, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
23_R	**082FLT23_R-3PH**	**3 Phase Fault on CARTHAG5 (505488) 161 kV Bus to CAR395 5 (547485) 161 kV Line, CKT 1**
		a. Apply Fault at the CARTHAG5 (505488) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (505488-547485, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
24	**082FLT24-3PH**	**3 Phase Fault on CARTHAG5 (505488) 161 kV Bus to CARTHG 2 (505490) 161/69 kV Transformer, CKT 1**
		a. Apply Fault at the CARTHAG5 (505488) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161/69 kV Transformer (505488-505490, CKT 1)
25_R	**082FLT25_R-3PH**	**3 Phase Fault on LAR382 5 (547479) 161 kV Bus to SPRGFLD5 (505492) 161 kV Line, CKT 1**
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-505492, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
26_R	**082FLT26_R-3PH**	**3 Phase Fault on LAR382 5 (547479) 161 kV Bus to Monett (547480) 161 kV Line, CKT 1**
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-547480, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
27_R	**082FLT27_R-3PH**	**3 Phase Fault on RIV4525 (547469) 161 kV Bus to NEOSHO 5 (532937) 161 kV Line, CKT 1**
		a. Apply Fault at the RIV4525 (547469) 161 kV Bus

Fault Number	Fault Name	Contingency (Fault) Description
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547469-532937, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
28_R	**082FLT28_R-3PH**	**3 Phase Fault on RIV4525 (547469) 161 kV Bus to HOC404 5 (547487) 161 kV Line, CKT 1**
		a. Apply Fault at the RIV4525 (547469) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547469-547487, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
29_R	**082FLT29_R-3PH**	**3 Phase Fault on RIV4525 (547469) 161 kV Bus to STL439 5 (547498) 161 kV Line, CKT 1**
		a. Apply Fault at the RIV4525 (547469) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547469-547498, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
30_R	**082FLT30_R-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to NEOSHO 5 (532937) 345/161 kV Transformer, CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345/161 kV Transformer (532793-532937, CKT 1)
31_R	**082FLT31_R-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to 7BLACKBERRY (300739) 345 kV Line, CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-300739, 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
32_R	**082FLT32_R-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to LACYGNE7 (542981) 345 kV Line, CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-542981, 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
33_R	**082FLT33_R-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to DELWARE7 (510380) 345 kV Line, CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-510380, 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
34_R	**082FLT34_R-3PH**	**3 Phase Fault on G17-009-TAP (588544) 345 kV Bus to NEOSHO 7 (532793) 345 kV Line, CKT 1**
		a. Apply Fault at the G17-009-TAP (588544) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (588544-532793, 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 Number	Fault Name	Contingency (Fault) Description
35_R	082FLT35_R-3PH	**3 Phase Fault on BROOKLINE 7 (549984) 345 kV Bus to 7MORGAN (300045) 345 kV Line, CKT 1**
		a. Apply Fault at the BROOKLINE 7 (549984) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (549984-300045, 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
36_R	082FLT36_R-3PH	**3 Phase Fault on BROOKLINE 7 (549984) 345 kV Bus to FLINTCR7 (506935) 345 kV Line, CKT 1**
		a. Apply Fault at the BROOKLINE 7 (549984) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (549984-506935, 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
37_R	082FLT37_R-3PH	**3 Phase Fault on 7BLACKBERRY (300739) 345 kV Bus to Sportsman (300740) 345 kV Line, CKT 1**
		a. Apply Fault at the 7BLACKBERRY (300739) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (300739-300740, 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
38_R	082FLT38_R-3PH	**3 Phase Fault on 7BLACKBERRY (300739) 345 kV Bus to 7JASPER (300949) 345 kV Line, CKT 1**
		a. Apply Fault at the 7BLACKBERRY (300739) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (300739-300949, 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
39_R	082FLT39_R-3PH	**3 Phase Fault on 7MORGAN (300045) 345 kV Bus to Huben (300042) 345 kV Line, CKT 1**
		a. Apply Fault at the 7MORGAN (300045) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (300045-300042, 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
40_P4	082FLT40_P4-1PH	**SLG Fault on ASB349 5 (547476) 161 kV Bus to LITCH 5 (532932) 161 kV Line, CKT 1**
		Open ASB349 5 (547476) 161 kV Bus to CJ 366 5 (547477) 161 kV Line, CKT 1 to clear the fault
		a. Apply Fault at the ASB349 5 (547476) 161 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 161 kV Line (547476-532932, CKT 1) and other circuits
41_P4	082FLT41_P4-1PH	**SLG Fault on ASB349 5 (547476) 161 kV Bus to PUR421 5 (547491) 161 kV Line, CKT 1**
		Open ASB349 5 (547476) 161 kV Bus to CJ 366 5 (547477) 161 kV Line, CKT 1 to clear the fault
		a. Apply Fault at the ASB349 5 (547476) 161 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 161 kV Line (547476-547491, CKT 1) and other circuits
42_P4	082FLT42_P4-1PH	**SLG Fault on CARTHAG5 (505488) 161 kV Bus to CAR395 5 (547485) 161 kV Line, CKT 1**
		Open CARTHAG5 (505488) 161 kV Bus to clear the fault
		a. Apply Fault at the CARTHAG5 (505488) 161 kV Bus

Fault Number	Fault Name	Contingency (Fault) Description
		b. Clear Fault after 16 Cycles and Trip the Faulted 161 kV Line (505488-547485, CKT 1) and bus
43_P4	**082FLT43_P4-1PH**	**SLG Fault on ORO110 5 (547467) 161 kV Bus to FIR417 5 (547490) 161 kV Line, CKT 1**
		Open ORO110 5 (547467) 161 kV Bus to clear the fault
		a. Apply Fault at the ORO110 5 (547467) 161 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 161 kV Line (547467-547490, CKT 1) and bus
44_P4	**082FLT44_P4-1PH**	**SLG Fault on LITCH 5 (532932) 161 kV Bus to ASB349 5 (547476) 161 kV Line, CKT 1**
		Open LITCH 5 (532932) 161 kV Bus to clear the fault
		a. Apply Fault at the LITCH 5 (532932) 161 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 161 kV Line (532932-547476, CKT 1) and bus
45_P6_R	**082FLT45_P6_R-3PH**	**Prior outage of ASB349 5 (547476) 161 kV Bus to LITCH 5 (532932) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on ASB349 5 (547476) 161 kV Bus to CJ 366 5 (547477) 161 kV Line, CKT 1
		a. Apply Fault at the ASB349 5 (547476) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547476-547477, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
46_P6_R	**082FLT46_P6_R-3PH**	**Prior outage of ASB349 5 (547476) 161 kV Bus to PUR421 5 (547491) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on ASB349 5 (547476) 161 kV Bus to CJ 366 5 (547477) 161 kV Line, CKT 1
		a. Apply Fault at the ASB349 5 (547476) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547476-547477, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
47_P6_R	**082FLT47_P6_R-3PH**	**Prior outage of ASB349 5 (547476) 161 kV Bus to LITCH 5 (532932) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on ASB349 5 (547476) 161 kV Bus to PUR421 5 (547491) 161 kV Line, CKT 1
		a. Apply Fault at the ASB349 5 (547476) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547476-547491, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
48_P6_R	**082FLT48_P6_R-3PH**	**Prior outage of NEOSHO 7 (532793) 345 kV Bus to NEOSHO 5 (532937) 345/161 kV Transformer, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on ASB349 5 (547476) 161 kV Bus to PUR421 5 (547491) 161 kV Line, CKT 1
		a. Apply Fault at the ASB349 5 (547476) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547476-547491, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault

Fault Number	Fault Name	Contingency (Fault) Description
49_P6_R	**082FLT49_P6_R-3PH**	**Prior outage of NEOSHO 7 (532793) 345 kV Bus to NEOSHO 5 (532937) 345/161 kV Transformer, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on ASB349 5 (547476) 161 kV Bus to CJ 366 5 (547477) 161 kV Line, CKT 1
		a. Apply Fault at the ASB349 5 (547476) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547476-547477, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
50_P6_R	**082FLT50_P6_R-3PH**	**Prior outage of NEOSHO 7 (532793) 345 kV Bus to NEOSHO 5 (532937) 345/161 kV Transformer, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on ASB349 5 (547476) 161 kV Bus to LITCH 5 (532932) 161 kV Line, CKT 1
		a. Apply Fault at the ASB349 5 (547476) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547476-532932, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault

For the stability analysis, the maximum MW capacity for each of the study projects as shown in Table 2-1 were tested.

4.3 Results

Table 4-5 summarizes results 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 D.

Table 4-5: Stability Analysis Results for IAISIS

GEN#&Group#	Fault Number	Fault Name	17W	18S	26S
GEN-2017-009 (Group 08)	1	009FLT01-3PH	Stable	Stable	Stable
	2	009FLT02-3PH	Stable	Stable	Stable
	03_R	009FLT03_R-3PH	Stable	Stable	Stable
	04_R	009FLT04_R-3PH	Stable	Stable	Stable
	05_R	009FLT05_R-3PH	Stable	Stable	Stable
	06_R	009FLT06_R-3PH	Stable	Stable	Stable
	07_R	009FLT07_R-3PH	Stable	Stable	Stable
	08_R	009FLT08_R-3PH	Stable	Stable	Stable
	10_R	009FLT10_R-3PH	Stable	Stable	Stable
	11_R	009FLT11_R-3PH	Stable	Stable	Stable
	12_R	009FLT12_R-3PH	Stable	Stable	Stable
	13_R	009FLT13_R-3PH	Stable	Stable	Stable
	14_R	009FLT14_R-3PH	Stable	Stable	Stable

GEN#&Group#	Fault Number	Fault Name	17W	18S	26S
	15_R	009FLT15_R-3PH	Stable	Stable	Stable
	16_R	009FLT16_R-3PH	Stable	Stable	Stable
	17	009FLT17-3PH	Stable	Stable	Stable
	18_R	009FLT18_R-3PH	Stable	Stable	Stable
	19_R	009FLT19_R-3PH	Stable	Stable	Stable
	20_R	009FLT20_R-3PH	Stable	Stable	Stable
	21_R	009FLT21_R-3PH	Stable	Stable	Stable
	22_R	009FLT22_R-3PH	Stable	Stable	Stable
	23_R	009FLT23_R-3PH	Stable	Stable	Stable
	24_R	009FLT24_R-3PH	Stable	Stable	Stable
	25_R	009FLT25_R-3PH	Stable	Stable	Stable
	26_R	009FLT26_R-3PH	Stable	Stable	Stable
	27_R	009FLT27_R-3PH	Stable	Stable	Stable
	28_P4	009FLT28_P4-1PH	Stable	Stable	Stable
	29_P4	009FLT29_P4-1PH	Stable	Stable	Stable
	30_P4	009FLT30_P4-1PH	Stable	Stable	Stable
	31_P4	009FLT31_P4-1PH	Stable	Stable	Stable
	32_P4	009FLT32_P4-1PH	Stable	Stable	Stable
	33_P4	009FLT33_P4-1PH	Stable	Stable	Stable
	34_P4	009FLT34_P4-1PH	Stable	Stable	Stable
	35_P6	009FLT35_P6-3PH	Stable	Stable	Stable
	36_P6	009FLT36_P6-3PH	Stable	Stable	Stable
	37_P6_R	009FLT37_P6_R-3PH	Stable	Stable	Stable
	38_P6_R	009FLT38_P6_R-3PH	Stable	Stable	Stable
	39_P6_R	009FLT39_P6_R-3PH	Stable	Stable	Stable
	40_P6_R	009FLT40_P6_R-3PH	Stable	Stable	Stable
	41_P6_R	009FLT41_P6_R-3PH	Stable	Stable	Stable
	42_P6_R	009FLT42_P6_R-3PH	Stable	Stable	Stable
	43_P6_R	009FLT43_P6_R-3PH	Stable	Stable	Stable
GEN-2017-060 (Group 12)	01_R	060FLT01_R-3PH	Stable	Unstable	Unstable
	01_RB	060FLT01_RB-3PH	N/A	Stable	Stable
	02_R	060FLT02_R-3PH	Stable	Stable	Stable
	03_R	060FLT03_R-3PH	Stable	Stable	Stable
	04_R	060FLT04_R-3PH	Stable	Stable	Stable
	05_R	060FLT05_R-3PH	Stable	Stable	Stable
	06_R	060FLT06_R-3PH	Stable	Stable	Stable
	07_R	060FLT07_R-3PH	Stable	Stable	Stable
	08_R	060FLT08_R-3PH	Stable	Stable	Stable
	09_R	060FLT09_R-3PH	Stable	Stable	Stable
	10_R	060FLT10_R-3PH	Unstable	Unstable	Unstable

GEN#&Group#	Fault Number	Fault Name	17W	18S	26S
	10_RA	060FLT10_RA-3PH	Stable	Stable	Stable
	11_R	060FLT11_R-3PH	Stable	Stable	Stable
	12_R	060FLT12_R-3PH	Stable	Stable	Stable
	13_R	060FLT13_R-3PH	Stable	Stable	Stable
	14_R	060FLT14_R-3PH	Stable	Stable	Stable
	15_R	060FLT15_R-3PH	Stable	Stable	Stable
	16_R	060FLT16_R-3PH	Stable	Stable	Stable
	17	060FLT17-3PH	Stable	Stable	Stable
	18_R	060FLT18_R-3PH	Stable	Stable	Stable
	19_R	060FLT19_R-3PH	Stable	Stable	Stable
	20_R	060FLT20_R-3PH	Stable	Stable	Stable
	21_R	060FLT21_R-3PH	Stable	Stable	Stable
	22_R	060FLT22_R-3PH	Stable	Stable	Stable
	23_R	060FLT23_R-3PH	Stable	Stable	Stable
	24_R	060FLT24_R-3PH	Stable	Stable	Stable
	25_R	060FLT25_R-3PH	Stable	Stable	Stable
	26_R	060FLT26_R-3PH	Stable	Stable	Stable
	27_R	060FLT27_R-3PH	Stable	Stable	Stable
	28_R	060FLT28_R-3PH	Stable	Stable	Stable
	29_R	060FLT29_R-3PH	Stable	Stable	Stable
	30_R	060FLT30_R-3PH	Stable	Stable	Stable
	31_R	060FLT31_R-3PH	Stable	Stable	Stable
	32_R	060FLT32_R-3PH	Stable	Stable	Stable
	33_R	060FLT33_R-3PH	Stable	Stable	Stable
	34_P4	060FLT34_P4-1PH	Stable	Stable	Stable
	35_P4	060FLT35_P4-1PH	Stable	Stable	Stable
	36_P4	060FLT36_P4-1PH	Stable	Stable	Stable
	37_P4	060FLT37_P4-1PH	Stable	Stable	Stable
	38_P6_R	060FLT38_P6_R-3PH	Stable	Unstable	Unstable
	38_P6_RB	060FLT38_P6_RB-3PH	N/A	Stable	Stable
	39_P6_R	060FLT39_P6_R-3PH	Unstable	Unstable	Unstable
	39_P6_RA	060FLT39_P6C_RR	Stable	Stable	Stable
	40_P6_R	060FLT40_P6_R-3PH	Unstable	Unstable	Unstable
	40_P6_RA	060FLT40_P6C_RR	Stable	Stable	Stable
	41_P6_R	060FLT41_P6_R-3PH	Stable	Unstable	Unstable
	41_P6_RB	060FLT41_P6_RB-3PH	N/A	Stable	Stable
	42_P6_R	060FLT42_P6_R-3PH	Stable	Unstable	Unstable
	42_P6_RB	060FLT42_P6_RB-3PH	N/A	Stable	Stable
	43_P6_R	060FLT43_P6_R-3PH	Stable	Unstable	Unstable
	43_P6_RB	060FLT43_P6_RB-3PH	N/A	Stable	Stable

GEN#&Group#	Fault Number	Fault Name	17W	18S	26S
	44_P6_R	060FLT44_P6_R-3PH	Stable	Unstable	Unstable
	44_P6_RB	060FLT44_P6_RB-3PH	N/A	Stable	Stable
GEN-2017-082 (Group 12)	01_R	082FLT01_R-3PH	Stable	Stable	Stable
	02_R	082FLT02_R-3PH	Stable	Stable	Stable
	03_R	082FLT03_R-3PH	Stable	Stable	Stable
	05_R	082FLT05_R-3PH	Stable	Stable	Stable
	09_R	082FLT09_R-3PH	Stable	Stable	Stable
	10	082FLT10-3PH	Stable	Stable	Stable
	11	082FLT11-3PH	Stable	Stable	Stable
	12_R	082FLT12_R-3PH	Stable	Stable	Stable
	13_R	082FLT13_R-3PH	Stable	Stable	Stable
	14_R	082FLT14_R-3PH	Stable	Stable	Stable
	15	082FLT15-3PH	Stable	Stable	Stable
	16_R	082FLT16_R-3PH	Stable	Stable	Stable
	17_R	082FLT17_R-3PH	Stable	Stable	Stable
	18_R	082FLT18_R-3PH	Stable	Stable	Stable
	19	082FLT19-3PH	Stable	Stable	Stable
	20_R	082FLT20_R-3PH	Stable	Stable	Stable
	21_R	082FLT21_R-3PH	Stable	Stable	Stable
	22_R	082FLT22_R-3PH	Stable	Stable	Stable
	23_R	082FLT23_R-3PH	Stable	Stable	Stable
	24	082FLT24-3PH	Stable	Stable	Stable
	25_R	082FLT25_R-3PH	Stable	Unstable	Unstable
	25_RB	082FLT25_RB-3PH	N/A	Stable	Stable
	26_R	082FLT26_R-3PH	Stable	Unstable	Unstable
	26_RB	082FLT26_RB-3PH	N/A	Stable	Stable
	27_R	082FLT27_R-3PH	Stable	Stable	Stable
	28_R	082FLT28_R-3PH	Stable	Stable	Stable
	29_R	082FLT29_R-3PH	Stable	Stable	Stable
	30_R	082FLT30_R-3PH	Stable	Stable	Stable
	31_R	082FLT31_R-3PH	Stable	Stable	Stable
	32_R	082FLT32_R-3PH	Stable	Stable	Stable
	33_R	082FLT33_R-3PH	Stable	Stable	Stable
	34_R	082FLT34_R-3PH	Stable	Stable	Stable
	35_R	082FLT35_R-3PH	Stable	Stable	Stable
	36_R	082FLT36_R-3PH	Stable	Stable	Stable
	37_R	082FLT37_R-3PH	Stable	Stable	Stable
	38_R	082FLT38_R-3PH	Stable	Stable	Stable
	39_R	082FLT39_R-3PH	Stable	Stable	Stable
	40_P4	082FLT40_P4-1PH	Stable	Stable	Stable

GEN#&Group#	Fault Number	Fault Name	17W	18S	26S
	41_P4	082FLT41_P4-1PH	Stable	Stable	Stable
	42_P4	082FLT42_P4-1PH	Stable	Stable	Stable
	43_P4	082FLT43_P4-1PH	Stable	Stable	Stable
	44_P4	082FLT44_P4-1PH	Stable	Stable	Stable
	45_P6_R	082FLT45_P6_R-3PH	Stable	Stable	Stable
	46_P6_R	082FLT46_P6_R-3PH	Stable	Stable	Stable
	47_P6_R	082FLT47_P6_R-3PH	Stable	Stable	Stable
	48_P6_R	082FLT48_P6_R-3PH	Stable	Stable	Stable
	49_P6_R	082FLT49_P6_R-3PH	Stable	Stable	Stable
	50_P6_R	082FLT50_P6_R-3PH	Stable	Stable	Stable

The dynamic simulation for GEN-2017-060 & GEN-2017-082 indicated that the system remained stable except for several faults related to LaRussell substation. These faults include:

- Unstable Fault Group A: Fault 10, 39 and 40 for GEN-2017-060 under all seasons, and
- Unstable Fault Group B: Fault 01, 38, 41-44 for GEN-2017-060 under season 18SP and 26SP, and Fault 25 and 26 for GEN-2017-082 under season 18SP and 26SP.

Further investigation identified the mitigation for each unstable fault group:

- For Unstable Fault Group A: reclosing the fault at the corresponding remote end only, and reducing the clearing time from 7 cycles to 6 cycles; and
- For Unstable Fault Group B: reclosing the fault at the corresponding remote end only retaining the clearing time at 7 cycles.

The post-mitigation fault descriptions are listed in Table 4-6 and Table 4-7 for Group A and Group B, respectively.

Table 4-6: Fault Description with Mitigation (Group A)

Fault Number	Fault Name	Contingency (Fault) Description
10_RA	**060FLT10_R-3PH**	**3 Phase Fault on LAR382 5 (547479) 161 kV Bus to CARTHAG5 (505488) 161 kV Line, CKT 1**
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 6 Cycles and Trip the Faulted 161 kV Line (547479-505488, CKT 1)
		c. Wait 20 Cycles, and then reclose **CARTHAG5 (505488)** in (b) back into the Fault

Fault Number	Fault Name	Contingency (Fault) Description
		d. Leave Fault on for 6 Cycles, then Trip the Line in (b) and Clear the Fault
39_P6_RA	**060FLT39_P6_R-3PH**	**Prior outage of LAR382 5 (547479) 161 kV Bus to SPRGFLD5 (505492) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on LAR382 5 (547479) 161 kV Bus to CARTHAG5 (505488) 161 kV Line, CKT 1
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 6 Cycles and Trip the Faulted 161 kV Line (547479-505488, CKT 1)
		c. Wait 20 Cycles, and then reclose **CARTHAG5 (505488)** in (b) back into the Fault
		d. Leave Fault on for 6 Cycles, then Trip the Line in (b) and Clear the Fault
40_P6_RA	**060FLT40_P6_R-3PH**	**Prior outage of LAR382 5 (547479) 161 kV Bus to CARTHAG5 (505488) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on LAR382 5 (547479) 161 kV Bus to Monett (547480) 161 kV Line, CKT 1
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 6 Cycles and Trip the Faulted 161 kV Line (547479-547480, CKT 1)
		c. Wait 20 Cycles, and then reclose **Monett (547480)** in (b) back into the Fault
		d. Leave Fault on for 6 Cycles, then Trip the Line in (b) and Clear the Fault

Table 4-7: Fault Description with Mitigation (Group B)

Fault Number	Fault Name	Contingency (Fault) Description
01_RB	**060FLT01_R-3PH**	**3 Phase Fault on LAR382 5 (547479) 161 kV Bus to SPRGFLD5 (505492) 161 kV Line, CKT 1**
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-505492, CKT 1)
		c. Wait 20 Cycles, and then reclose **SPRGFLD5 (505492)** in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
38_P6_RB	**060FLT38_P6_R-3PH**	**Prior outage of LAR382 5 (547479) 161 kV Bus to SPRGFLD5 (505492) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on LAR382 5 (547479) 161 kV Bus to Monett (547480) 161 kV Line, CKT 1
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-547480, CKT 1)
		c. Wait 20 Cycles, and then reclose **Monett (547480)** in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
41_P6_RB	**060FLT41_P6_R-3PH**	**Prior outage of RIV4525 (547469) 161 kV Bus to HOC404 5 (547487) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on LAR382 5 (547479) 161 kV Bus to SPRGFLD5 (505492) 161 kV Line, CKT 1
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-505492, CKT 1)
		c. Wait 20 Cycles, and then reclose **SPRGFLD5 (505492)** in (b) back into the Fault

Fault Number	Fault Name	Contingency (Fault) Description
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
42_P6_RB	**060FLT42_P6_R-3PH**	**Prior outage of RIV4525 (547469) 161 kV Bus to HOC404 5 (547487) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on LAR382 5 (547479) 161 kV Bus to Monett (547480) 161 kV Line, CKT 1
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-547480, CKT 1)
		c. Wait 20 Cycles, and then reclose **Monett (547480)** in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
43_P6_RB	**060FLT43_P6_R-3PH**	**Prior outage of RIV4525 (547469) 161 kV Bus to NEOSHO 5 (532937) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on LAR382 5 (547479) 161 kV Bus to SPRGFLD5 (505492) 161 kV Line, CKT 1
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-505492, CKT 1)
		c. Wait 20 Cycles, and then reclose **SPRGFLD5 (505492)** in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
44_P6_RB	**060FLT44_P6_R-3PH**	**Prior outage of RIV4525 (547469) 161 kV Bus to NEOSHO 5 (532937) 161 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on LAR382 5 (547479) 161 kV Bus to Monett (547480) 161 kV Line, CKT 1
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-547480, CKT 1)
		c. Wait 20 Cycles, and then reclose **Monett (547480)** in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
25_RB	**082FLT25_R-3PH**	**3 Phase Fault on LAR382 5 (547479) 161 kV Bus to SPRGFLD5 (505492) 161 kV Line, CKT 1**
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-505492, CKT 1)
		c. Wait 20 Cycles, and then reclose **SPRGFLD5 (505492)** in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault
26_RB	**082FLT26_R-3PH**	**3 Phase Fault on LAR382 5 (547479) 161 kV Bus to Monett (547480) 161 kV Line, CKT 1**
		a. Apply Fault at the LAR382 5 (547479) 161 kV Bus
		b. Clear Fault after 7 Cycles and Trip the Faulted 161 kV Line (547479-547480, CKT 1)
		c. Wait 20 Cycles, and then reclose **Monett (547480)** in (b) back into the Fault
		d. Leave Fault on for 7 Cycles, then Trip the Line in (b) and Clear the Fault

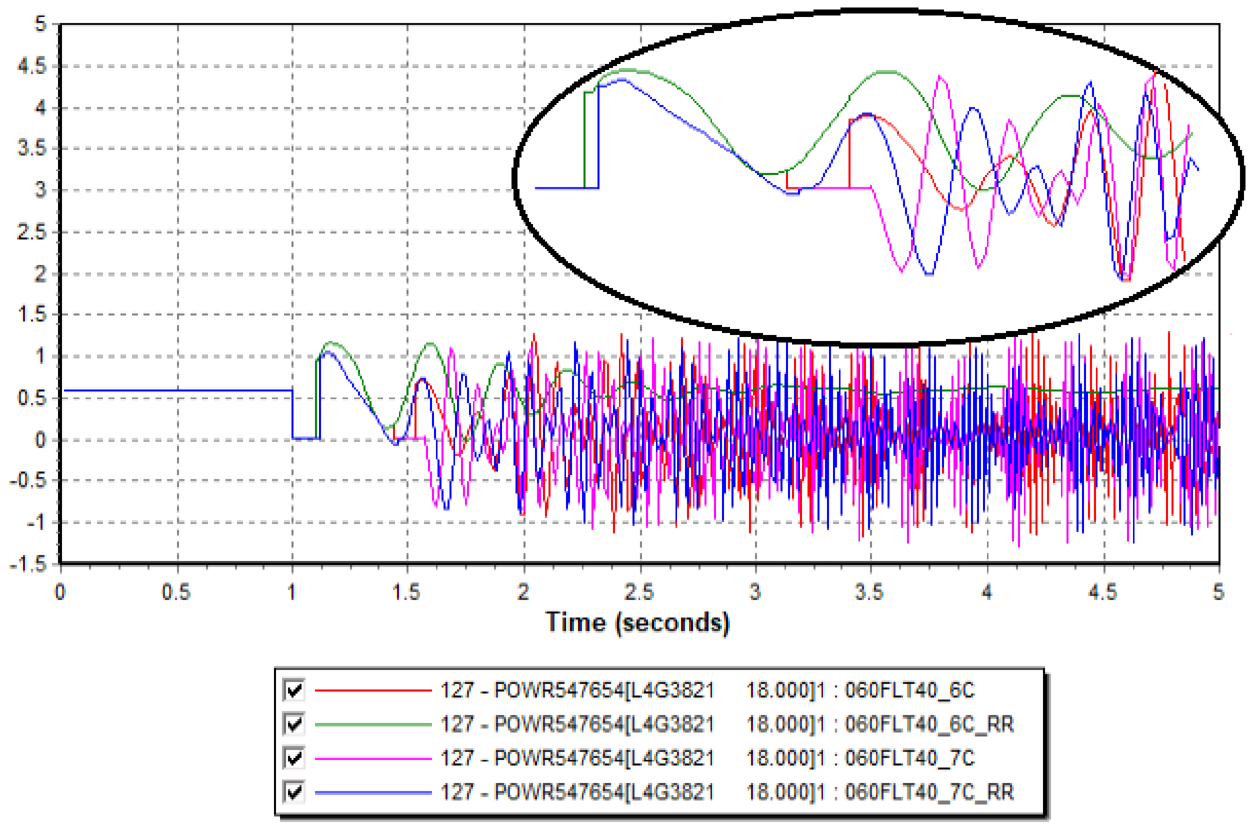
Figure 4-1 demonstrates the comparison among different reclosing scenarios of Fault 40 for GEN-2017-060 under 17WP case. These reclosing scenarios include:

- 060FLT40_6C: clearing at 6 cycles, and reclosing at both end;

- 060FLT40_6C_RR: clearing at 6 cycles, and reclosing at remote end only;
- 060FLT40_7C: clearing at 7 cycles, and reclosing at both ends only; and
- 060FLT40_7C_RR: clearing at 7 cycles, and reclosing at remote end only.

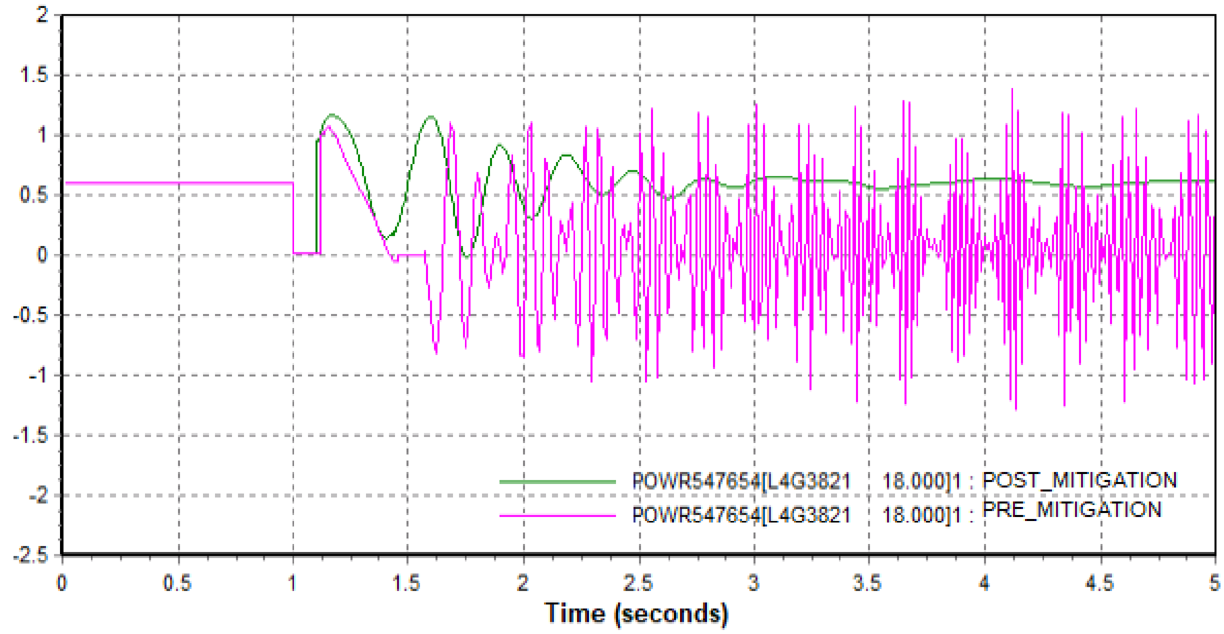
The comparison shows that clearing at 6 cycles and reclosing at the remote end only can mitigate the system stability issue among the four reclosing scenarios.

Figure 4-1: Sample Comparison Among Different Reclosing



The comparison plot between pre-mitigation (7 cycle clearing time and reclosing at both end) and post-mitigation (6 cycle clearing time and reclosing at remote end only) is shown in Figure 4-2.

Figure 4-2: Sample Comparison Between Pre- and Post-Mitigation



Overall, with the mitigation in place, the stability simulation shows that there is no adverse impact from the study projects (GEN-2017-009, GEN-2017-060 and GEN-2017-082).

5.0 SHORT CIRCUIT ANALYSIS

The short circuit analysis was performed on the 2018 & 2026 Summer Peak stability analysis power flow cases using the PSS/E ASCC program. Since the power flow model does not contain negative and zero sequence data, only three-phase symmetrical fault current levels were calculated at the point of interconnection up to and including five levels away.

5.1 Methodology

Short Circuit Analysis was conducting using flat conditions with the following PSS/E ASCCC program settings:

- BUS VOLTAGES SET TO 1 PU AT 0 PHASE ANGLE
- GENERATOR P=0, Q=0
- TRANSFORMER TAP RATIOS=1.0 PU and PHASE ANGLES=0.0
- LINE CHARGING=0.0 IN +/-/0 SEQUENCE
- LOAD=0.0 IN +/- SEQUENCE, CONSIDERED IN ZERO SEQUENCE
- LINE/FIXED/SWITCHED SHUNTS=0.0 AND MAGNETIZING ADMITTANCE=0.0 IN +/-/0 SEQUENCE
- DC LINES AND FACTS DEVICES BLOCKED
- TRANSFORMER ZERO SEQUENCE IMPEDANCE CORRECTIONS IGNORED

5.2 Results

Table 5-1 through Table 5-3 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 5-1: Summary of GEN-2017-009 Three Phase Fault Currents

Bus Dist. From POI	BUS NUMBER	BUS NAME	Voltage (kV)	AREA	ZONE	3 Phase Fault Current (kA)	
						2018SP	2026SP
1	532780	CANEYRV7	345	536	1537	10.043	10.037
1	532793	NEOSHO 7	345	536	1536	16.401	16.238
1	588540	GEN-2017	345	536	1536	10.439	10.393
2	532781	CANEYWF7	345	536	1537	9.770	9.765
2	532800	LATHAMS7	345	536	1537	10.627	10.625
2	300739	7BLACKBE	345	330	304	12.334	12.303
2	510380	DELWARE7	345	520	547	11.507	10.932
2	542981	LACYGNE7	345	541	1544	25.421	25.395
2	533021	NEOSHO 4	138	536	1536	22.793	22.709
2	532824	N345 1 1	13	536	1536	40.299	40.261
2	532937	NEOSHO 5	161	536	1536	21.100	21.019
2	532825	N345 2 1	13	536	1536	47.430	47.398
2	588541	G17-009X	34	536	1536	18.972	18.961
2	588545	G17-009X	34	536	1536	18.763	18.752
2	533020	NEOSHOS4	138	536	1536	22.793	22.709
2	533022	NEOSHON4	138	536	1536	22.793	22.709
2	533778	NEOSHOS2	69	536	1536	22.178	22.155

Table 5-2: Summary of GEN-2017-060 Three Phase Fault Currents

Bus Dist. From POI	BUS NUMBER	BUS NAME	Voltage (kV)	AREA	ZONE	3 Phase Fault Current (kA)	
						2018SP	2026SP
0	547479	LAR382 5	161	544	1560	13.418	13.435
1	505488	CARTHAG5	161	515	521	16.041	16.065
1	505492	SPRGFLD5	161	515	521	27.874	28.206
1	547480	MON383 5	161	544	1560	11.013	11.027
1	547651	L1G382 1	13	544	1560	30.552	30.559
1	547652	L2G382 1	13	544	1560	30.854	30.861
1	547653	L3G3821	18	544	1561	30.994	30.997
1	547654	L4G3821	18	544	1561	31.016	31.019
1	588980	GEN-2017	161	544	1560	12.251	12.265
2	505486	NEO SPA5	161	515	521	15.052	15.112
2	547466	ATL109 5	161	544	1564	15.768	15.787
2	547485	CAR395 5	161	544	1564	12.050	12.062
2	505490	CARTHG 2	69	515	521	14.456	14.463
2	505487	CRG X1 1	13	515	521	10.195	10.195
2	505489	CRG X2 1	13	515	521	9.539	9.539
2	300678	5NIXA-1	161	330	304	19.296	19.450

Bus Dist. From POI	BUS NUMBER	BUS NAME	Voltage (kV)	AREA	ZONE	3 Phase Fault Current (kA)	
						2018SP	2026SP
2	505496	NIXA 5	161	515	521	12.417	12.476
2	549959	BATTLEFI	161	546	1583	27.230	27.545
2	549969	BROOKLIN	161	546	1583	28.932	29.265
2	549970	CLAY	161	546	1583	18.461	18.744
2	505494	SPRGFLD2	69	515	521	15.633	15.677
2	505491	SPF X1 1	13	515	521	16.748	16.758
2	505493	SPF X2 1	13	515	521	16.748	16.758
2	505495	SPF X3 1	13	515	521	16.748	16.758
2	547468	AUR124 5	161	544	1560	9.481	9.493
2	547472	TIP292 5	161	544	1563	17.093	17.131
2	547591	MON383 2	69	544	1560	11.720	11.729
2	547712	MON383 1	12	544	1560	13.525	13.527
2	588981	G17-060X	34	544	1560	15.327	15.330
2	588985	G17-060X	34	544	1560	14.327	14.330

Table 5-3: Summary of GEN-2017-082 Three Phase Fault Currents

Bus Dist. From POI	BUS NUMBER	BUS NAME	Voltage (kV)	AREA	ZONE	3 Phase Fault Current (kA)	
						2018SP	2026SP
0	547476	ASB349 5	161	544	1564	12.641	12.653
1	532932	LITCH 5	161	536	1536	9.500	9.512
1	547477	CJ 366 5	161	544	1564	12.643	12.653
1	547491	PUR421 5	161	544	1564	9.846	9.853
1	547649	A1G349 1	13	544	1564	82.009	82.027
1	547650	A2G349 1	13	544	1564	14.444	14.445
1	589200	GEN-2017	161	544	1564	11.610	11.621
2	532938	FRANKLIN	161	536	1536	7.797	7.804
2	533766	LITCH S2	69	536	1536	13.009	13.044
2	532952	LITCH1 1	13	536	1536	15.474	15.477
2	533765	LITCH N2	69	536	1536	13.009	13.044
2	532953	LITCH2 1	13	536	1536	15.539	15.549
2	547490	FIR417 5	161	544	1564	14.348	14.359
2	547485	CAR395 5	161	544	1564	12.108	12.121
2	589201	G17-082X	34	544	1564	14.451	14.453
2	589205	G17-082X	34	544	1564	14.875	14.878

6.0 LIMITED OPERATION AMOUNT

Burns & McDonnell used both load flow analysis and stability analysis to determine the amount of interconnection service that can be provided. As indicated in the prior sections, with the sponsor upgrade and reduction of clearing cycles for related faults at LaRussell substation, the maximum operation amount is the same as the requested capacity for each of the study projects.

The overall limited operation amount for each study project is shown in Table 6-1.

Table 6-1: Limited Operation Amount

Group #	Queue Number	Limited Operation Amount (MW)
08	GEN-2017-009	302
12	GEN-2017-060	149.4
12	GEN-2017-082	149.4

7.0 CONCLUSION

Liberty Utilities (LU) retained Burns & McDonnell to perform an Interim Availability System Impact Study (the Study or IAISIS) of the interconnection interim requests. This study included load flow, stability analysis and short circuit analysis to determine the impacts on the transmission system caused by the interim interconnection request.

The interconnection interim requests consist three wind projects, and these wind projects are in two study groups: Group 8 and Group 12. For GEN-2017-009 in Group 8, the requested study capacity is 302MW. For GEN-2017-060 and GEN-2017-082 in Group 12, the requested study capacity is 149.4MW each.

For this IAISIS, power flow analysis, stability analysis, short circuit analysis and limited operation amount analysis were conducted. The IAISIS assumes that only the higher queued projects listed within Table 2-2 of this report might go into service. If additional generation projects with queue priority equal to or higher than the study interim request rights to go into commercial operation, this IAISIS may need to be restudied to ensure that interconnection service remains for the customer’s request. All the analyses were performed using PSS/E v. 33.12.1 and TARA 19.01.

Note that the study focuses on the impact caused by these three interim requests (GEN-2017-009, GEN-2017-060 and GEN-2017-082), other queue projects’ impact was not monitored, for example, GEN-2017-005’s impact was not monitored. There may be other generation requests that could have limited services, but those are out of the scope of the Study. For GEN-2017-082 (Group 12), the study is also under the assumption that the Asbury thermal plant will be retired.

Power Flow Analysis: For the interim requests, GEN-2017-060 and GEN-2017-082 were studied at its maximum requested capacity (149.4MW each), and GEN-2017-009 was studied at 302MW. The power flow analysis evaluated the system for seven load scenarios (2017 Winter Peak (17WP), 2018 Spring (18G), 2018 Summer Peak (18SP), 2021 Light (21L), 2021 Summer Peak (21SP), 2021 Winter Peak (21WP), and 2026 Summer Peak (26SP)).

For the interim requests dispatched, overloads were identified only in the Group 08 study. For Group 8, Neosho – GEN-2017-009 Tap 345kV line overloads were identified under different fault conditions. The worst overload on Neosho – GEN-2017-009 Tap was observed at 120.6% at Season 21L case with outage on Waverly – La Cygne 345kV circuit. APEX Clean Energy has requested a sponsored upgrade on Neosho – Caney River 345kV circuit, the upgrade will increase the normal and emergency ratings from

956MVA to 1159MVA. With the sponsored upgrade, the highest loading on Neosho – GEN-2017-009 Tap was observed at 99.5%. No voltage issue was observed for the study cases.

Dynamic Stability Analysis: For the interim requests, GEN-2017-060 and GEN-2017-082 were each modeled at its maximum requested capacity (149.4MW each), and GEN-2017-009 was modeled at 302MW. The stability analysis evaluated the system for three load scenarios (2017 winter peak, 2018 summer peak and 2026 summer peak) simulating faults that included three-phase and single-line-to-ground faults.

The dynamic simulation indicated that the system remained stable except some faults related to LaRussell substation. Further investigation identified that either reclosing only the remote end or reducing the clearing time from 7 cycles to 6 cycles and reclosing only the remote end, as the protection mitigation, can mitigate the unstable conditions. No other transient stability violations were observed for the requested MW capacity for this IAISIS.

Short Circuit Analysis: 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. The short circuit analysis results show increase of short circuit current with the interconnection of the projects, but detailed comparison with the breaker ratings was not performed.

Limit Operation Amount Analysis: As indicated in the prior sections, with the sponsored upgrade and reduction of clearing cycles/reclosing only on the remote end for related faults at LaRussell substation, the maximum operation amount is the same as the requested capacity for each of the study projects. The developers of the three study projects have agreed that all the sponsored upgrades and protection mitigation will be implemented before the interconnection of the project. Based on these assumptions, the overall limited operation amount for each study project is the same as the requested capacity.

.

APPENDIX A FACILITIES STUDY FOR GEN-2017-009

Interim - Generation Interconnection Facility Study

For

Generation Interconnection Request GEN-2017-009

June 27, 2019

Introduction

This report summarizes the scope of the Interim Generation Interconnection Facility Study to evaluate the Generation Interconnection Request for GEN-2017-009. GEN-2017-009 is proposing to build a 302 MW wind-powered generation facility in south east Kansas with an in-service date of April 15, 2020.

Southwest Power Pool Generation Interconnection Request:

Southwest Power Pool (SPP) GI requested Kansas City Power & Light (KCPL) and Westar, Evergy Companies, to perform an Interim Interconnection Facility Study (IFS).

GI Request #	Point of Interconnection	Capacity (MW)	Fuel Type	Comments
GEN-2017-009	Neosho - Caney River 345 kV	302.0	Wind	Please provide Interconnection upgrades and costs estimates needed to interconnect the following Interconnection Customer facility, GEN-2017-009 (302.0 MW/Wind), into the Point of Interconnection (POI) at Neosho - Caney River 345 kV

Estimated Costs for TOIF and Network Upgrades

Transmission Owner Interconnection Facilities (TOIF)

This estimated cost includes work necessary to install one (1) switch, three (3) standalone CT's, and three (3) 345 PT's to accept a transmission line from the Interconnection Customer's Generating Facility.

345kV Transmission Line Work

The estimated cost is for approximately 0.5 miles of new bundled 1590 Lapwing ACSR line with 64mm OPGW static wire, two (2) steal dead end structures, two (2) wood H-Frame tangents, and no distribution underbuild.

345kV Neosho Ridge Substation Work

The estimated cost is for constructing a new greenfield 345kV ring bus substation consisting of three (3) breakers, eight (8) switches, four (4) wavetraps, and six (6) CCVTs.

345kV Neosho Substation Work

The estimated cost is for upgrading two (2) wavetraps.

345kV Caney River Substation Work

The estimated cost is for upgrading two (2) wavetraps.

The total cost estimate for the required Network Upgrades and the Transmission Owner Interconnection Facilities (TOIF).

$	**687,518**	**TOIF (Substation)**
$	**2,062**	**TOIF (AFUDC)**
$	**753,503**	**345kV Transmission Line Work**
$	**12,035,063**	**345kV Substation Work (Neosho Ridge, Neosho, and Caney River)**
$	**1,304,880**	**AFUDC**
$	**73,552**	**Contingency**
$	**14,856,578**	**Total**

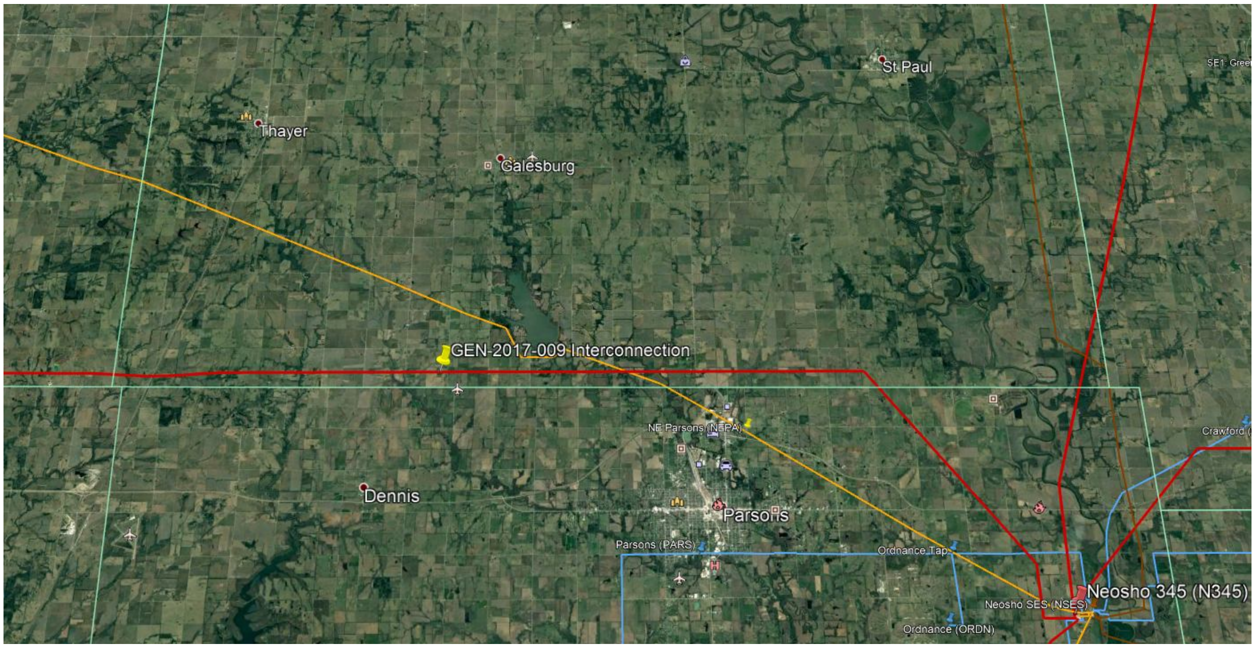
This estimate is accurate to +/- twenty (20) percent, based on current prices, in accordance with Attachment A of Appendix 4 of the Interconnection Facilities Study Agreement. However, recent cost fluctuations in materials are very significant and the accuracy of this estimate at the time of actual settings cannot be assured.

Time Estimate

Time estimates are based on current version of the project schedule and some processes of each category run concurrently.

Engineering Time	8 Months
Procurement Time	9 Months
Construction Time	12 Months
Total Project Length	17 Months

Figure 1 – Interconnection Map



The proposed interconnection project is located approximately 18 miles from the Neosho 345 kV substation on the Neosho – Caney River 345 kv Line.

Results of Short Circuit Analysis

As a part of this Interim Facility Study, a short circuit study was performed to determine the available fault current at the interconnection bus (GEN-2017-009 Interconnection 345 kV) using PSS/E's activity ASCC. The 2019 Summer Peak case from the 2018 Series MDWG Classical, Max Fault Short-Circuit models were used. The GEN-2017-009 wind farm generation facility was taken out of service for this analysis, and all other transmission facilities are in service. As a result, the numbers generated represent the available utility interconnection fault current:

2019 Summer:

3-PH FAULT		1-PH FAULT		THEVENIN IMPEDANCE (PU on 100 MVA and bus base KV)		
AMP	MVA	AMP	MVA	Positive Sequence	Negative Sequence	Zero Sequence
987.8	6637.99	1161.5	4642.21	1.634+j18.306	1.646+j18.297	8.508+j41.352

APPENDIX B FACILITIES STUDY FOR GEN-2017-060

Southwest Power Pool

INTERCONNECTION FACILITIES STUDY REPORT

GEN-2017-060

Facilities Study For
Southwest Power Pool (SPP)

Interconnection of Kings Point Wind

GEN-2017-060

Kings Point Wind 149.4 MW

Executive Summary

In 2017, a request was made by an Interconnection Customer to interconnect a wind energy generating facility to be constructed in Barton, Dade, Jasper and Lawrence Counties in Missouri. The proposed point of interconnection is the existing La Russell substation which is part of Liberty Utilities' transmission network. The requested commercial operation date for the existing facility will be September 1, 2020.

The Southwest Power Pool (SPP) is evaluating the request (GEN-2017-060) to interconnect Kings Point Wind to the EMDE transmission system in a Definitive Interconnection System Impact Study (DISIS-2017-001) and in an Interim Availability Interconnection System Impact Study. The interconnection request is for 149.4 MW of interconnection capacity. The requirements for interconnection consist of adding a new 161 kV line terminal in the existing 161 kV La Russell substation. The total cost to modify the substation to interconnect Kings Point Wind is estimated at $3,200,000.

Introduction

The Southwest Power Pool has requested a Facility Study for the purpose of interconnecting a wind energy generating facility to be constructed in Barton, Dade, Jasper and Lawrence Counties in Missouri. The proposed point of interconnection is at Liberty Utilities' existing 161 kV La Russell substation in Jasper County, MO. The cost to add a new 161 kV line terminal to the existing substation is $3,200,000.

Interconnection Facilities

The primary objective of this study is to identify attachment facilities. The requirements for interconnection consist of adding a new 161 kV line terminal in the existing 161 kV La Russell substation. This will be accomplished by adding a new A-frame for the incoming Kings Point Wind line. A new line disconnect switch, PTs and arrestors will be installed for the new line position. A new 161 kV 200 A breaker and associated disconnect switches will be installed between an existing breaker and the main bus to complete the breaker-and-a-half bay. A new protection panel will be installed at a spare panel position in the control house for the new Kings Point Wind line. All of this work will be performed by Liberty Utilities. The La Russell substation, including the new interconnection facilities, will continue to be maintained by Liberty Utilities. The interconnection customer has obtained all necessary rights of way for construction of the line to the point of interconnection.

The total cost for Liberty Utilities to add a new 161 kV line terminal to the existing substation is $3,200,000. Kings Point Wind is responsible for construction of the 161 kV line up to the point of interconnection. The cost stated above does not include any costs for Kings Point Wind's 161 – 34.5 kV substation.

Fault or Short Circuit Study

For this generator interconnection, no breakers were found to exceed their interrupting capability after the addition of Kings Point Wind's 149.4 MW.

Preliminary One Line Diagram for La Russell Substation following Interconnection of Kings Point Wind

APPENDIX C FACILITIES STUDY FOR GEN-2017-082

INTERCONNECTION FACILITIES STUDY REPORT

GEN-2017-082

Facilities Study For
Southwest Power Pool (SPP)
Interconnection of North Fork Ridge Wind

GEN-2017-082

North Fork Ridge Wind 149.4 MW

Executive Summary

In 2017, a request was made by an Interconnection Customer to interconnect a wind energy generating facility to be constructed in Barton and Jasper Counties in Missouri. The proposed point of interconnection is the existing Asbury Plant substation which is part of Liberty Utilities' transmission network. The requested commercial operation date for the existing facility will be July 1, 2020.

The Southwest Power Pool (SPP) is evaluating the request (GEN-2017-082) to interconnect North Fork Ridge Wind to the EMDE transmission system in a Definitive Interconnection System Impact Study (DISIS-2017-001) and in an Interim Availability Interconnection System Impact Study. The interconnection request is for 149.4 MW of interconnection capacity. In order to interconnect North Fork Ridge Wind, Liberty Utilities will need to add a new 161 kV terminal to the existing substation and relocate the existing Litchfield transmission line to that terminal, allowing interconnection of the new wind farm transmission line at the current Asbury-Litchfield terminal. In addition, an existing 1200 A 161 kV disconnect switch at the point of interconnection will need to be replaced with a 2000 A 161 kV disconnect switch. The total cost to modify the substation to interconnect North Fork Ridge Wind is estimated at $4,200,000.

Introduction

The Southwest Power Pool has requested a Facility Study for the purpose of interconnecting a wind energy generating facility to be constructed in Barton and Jasper Counties in Missouri. The proposed point of interconnection is at Liberty Utilities' existing 161 kV Asbury Plant Substation in Jasper County, MO. The cost to add a new 161 kV terminal to the existing substation and relocate the existing Litchfield transmission line to that terminal, allowing interconnection of the new wind farm transmission line at the current Asbury-Litchfield terminal is $4,200,000.

Interconnection Facilities

The primary objective of this study is to identify attachment facilities. The requirements for interconnection consist of adding a new 161 kV terminal in the existing 161 kV Asbury Plant Substation. A new 161 kV breaker and associated disconnect switches will be installed between existing breakers to create a new line position on the ring bus. A new line disconnect switch and PTs will be installed for this new line position. The existing Litchfield line will be relocated to this new line position, and the existing Litchfield CCVT, wave trap, line tuner, steel structure and junction box will also be relocated to the new terminal. The North Fork Ridge line will be installed at the terminal from which the Litchfield line is being relocated. The existing disconnect switch will be replaced with a new 2000 A 161 kV disconnect switch to support the new operating ratings. The existing line surge arresters at that terminal will be replaced with new station class arresters, while the existing steel arrester structures will be reused. The existing 161 kV PTs will be reused. A new protection panel will be installed in the control house for the Litchfield line, and the existing Litchfield line panel will be repurposed for control of the new North Fork Ridge line. All of this work will be performed by Liberty Utilities. The Asbury Plant substation, including the new interconnection facilities, will continue to be maintained by Liberty Utilities. The interconnection customer has obtained all necessary rights of way for construction of the line to the point of interconnection.

The total cost for Liberty Utilities to add a new 161 kV terminal to the existing substation and relocate the existing Litchfield transmission line to that terminal, allowing interconnection of the new wind farm transmission line at the current Litchfield line terminal is $4,200,000. North Fork Ridge Wind is responsible for construction of the 161 kV line up to the point of interconnection. The cost stated above does not include any costs for North Fork Ridge Wind's 161 – 34.5 kV substation.

Fault or Short Circuit Study

All breakers present within the switchyard were installed in 2017, and no breakers were found to exceed their interrupting capability after the addition of Kings Point Wind's 149.4 MW. The existing 1200 A 161 kV disconnect switch at the point of interconnection will be replaced with a 2000 A 161 kV disconnect switch to accommodate the capacity of North Fork Ridge Wind.

Preliminary One Line Diagram for Asbury Plant Substation following Interconnection of North Fork Ridge Wind

CREATE AMAZING.

Burns & McDonnell World Headquarters
9400 Ward Parkway
Kansas City, MO 64114
O 816-333-9400
F 816-333-3690
www.burnsmcd.com

SUBSEQUENT CONSULTANT'S STUDY REPORT

See next page for the subsequent Consultant's Interim Availability Interconnection System Impact Study report.

Technical Final Report for:

Interim Availability Interconnection System Impact Study

Submitted to: Liberty Utilities

Southwest Power Pool

Submitted by: EN Plus Consulting

V.2: August 21, 2020

Revision History

Version	Date	Description
1	8/12/2020	Initial draft.
2	8/21/2020	Editorial update based on SPP comments.

Table of Contents

List of Tables

List of Figures

Executive Summary

Liberty Utilities (LU) retained EN Plus LLC (EN Plus) to perform an Interim Availability System Impact Study (the Study or IAISIS) of an interconnection interim request. The purpose of this study to determine any adverse impacts on the transmission system caused by the interim interconnection request.

The interconnection interim request consists of one wind project (the Project) with interconnection request number GEN-2017-009, and the wind project is allocated to study cluster Group 8 with Southwest Power Pool (SPP). The requested study capacity is 301MW, and the service type is ERIS. The point of interconnection is on a tap between Neosho and Caney River 345kV substations.

For this IAISIS, only stability analysis is included based on the latest prior queue and study assumptions; and the corresponding power flow analysis, short circuit analysis and limited operation amount analysis were conducted in the previous study. The IAISIS assumes that the higher queued projects listed within Table 2-1 of this report might go into service. If additional generation projects with queue priority equal to or higher than the study interim request rights to go into commercial operation, this IAISIS may need to be restudied to ensure that interconnection service remains for the customer's request. All the analyses were performed using PSS/E v. 33.12.

For the interim request, GEN-2017-009 was studied at its maximum requested capacity 301MW. The stability analysis evaluated the system for three load scenarios (2017 winter peak, 2018 summer peak and 2026 summer peak) simulating faults that included three-phase and single-line-to-ground faults.

The dynamic simulation indicated that, except some faults related to Wolf Creek and Waverly substations, the system remained stable. Further investigation identified that an existing TPL Corrective Action Plan (CAP) to implement an OP Guide that reduces the output at Wolf Creek Power Plant can mitigate the unstable conditions. No other transient stability violations were observed for the requested MW capacity for this IAISIS.

Based on the dynamic simulation, this Study has demonstrated that there are no adverse impacts on the transmission system because of the interim interconnection request, and GEN-2017-009 may reliably interconnect on an interim basis for a total nameplate capacity of 301 MW with ERIS.

1 Introduction

Liberty Utilities (Liberty or LU) retained EN Plus LLC. (EN Plus) to perform an Interim Availability System Impact Study (the Study or the IAISIS). The Study evaluated the system impact due to the interconnection of the interim requests within SPP's system.

The Study is to evaluate and identify the adverse system impacts on the SPP system due to the interconnection interim request. This Study included stability analysis, the corresponding power flow analysis, short circuit analysis and limited operation analysis were included in another interim study report[1]. The interim request project in the Study is GEN-2017-009 within SPP cluster Group 08, and the summary of the project is listed in Table 1-1.

Table 1-1: Interconnection Interim Requests

Group #	Queue Number	Capacity	Type	Point of Interconnection
8	GEN-2017-009	301	Wind	Neosho - Caney River 345 kV

For this IAISIS, only stability analysis is included based on the latest study assumptions. The corresponding power flow analysis, short circuit analysis and limited operation amount analysis were conducted in the previous study. All the analyses were performed using PSS/E v. 33.12.

The report documents the study assumption, methodology, results and findings, and the report includes the following sections:

- Introduction
- Project Modelling and Study Assumption
- Stability Analysis
- Conclusion

[1] *Burns & McDonnell Engineering Company, Inc* , Interim Availability Interconnection System Impact Study (Revision 2A, submitted to Liberty Utilities), Oct. 25, 2019

2 Project Modeling and Prior Queue Assumption

2.1 Project Modeling

The Project contains a total of 139 Vestas wind turbine units: 115 units of 2.2MW Vestas V120 and 24 units of 2.0MW Vestas V110), the proposed maximum active power output is 301MW for summer and for winter. The reactive capability of this Project is within the range of -98.93 MVAR to +98.93MVAR.

The Project also includes two 34.5/345 kV step-up transformers connecting the generators to a 345 kV tap, and the corresponding transformer capacity is 168/168 MVA.

The project is assumed to tap the 345 kV line from Caney River substation and Neosho substation. The equivalent model of the Project is included in the study cases, and the one-line diagram of the PSS/E model is shown in Figure 2-1.

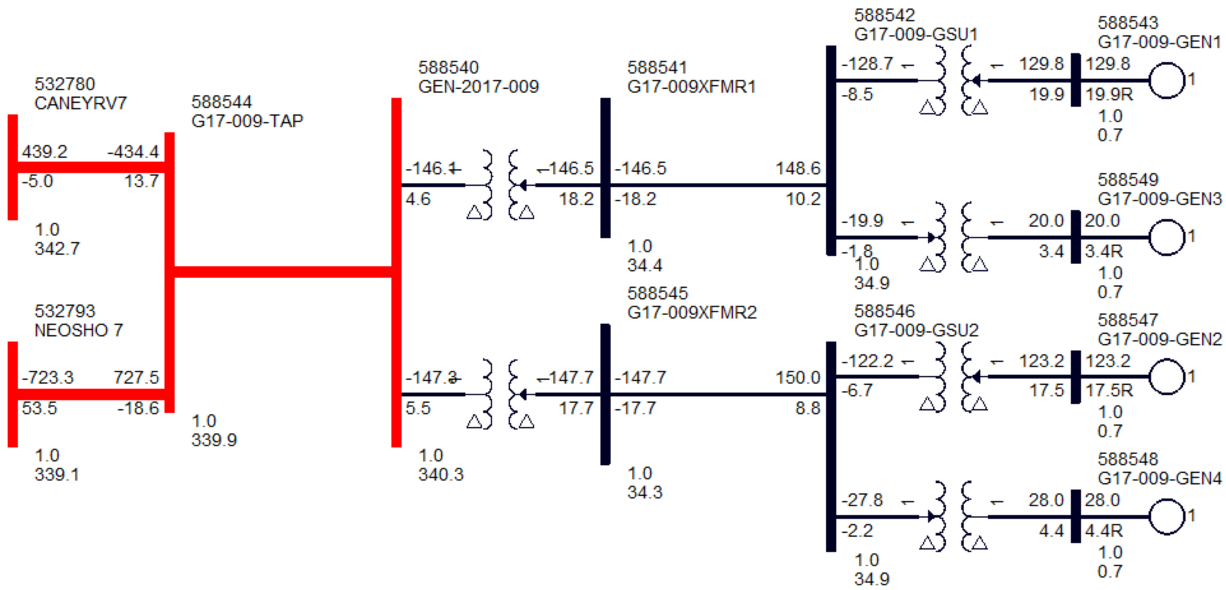


Figure 2-1: Project One-Line Diagram (PSS/E Model)

2.2 Prior Queue Assumption

The IAISIS considers the Base Case as well as all Generating Facilities (and with respect to (b) below, any identified Network Upgrades associated with such higher queued interconnection) that, on the date the IAISIS is commenced:

a) are directly interconnected to the Transmission System;

b) are interconnected to Affected Systems and may have an impact on the Interconnection Request;

c) have a pending higher queued Interconnection Request to interconnect to the Transmission System listed in Table 2-1; or

d) have no Queue Position but have executed an LGIA or requested that an unexecuted LGIA be filed with FERC.

Any changes to these assumptions, for example, one or more of the previously queued requests not included within this study executing an interconnection agreement and commencing commercial operation, may require a re-study of this IAISIS.

This IAISIS study included prior queued generation interconnection requests. Table 2-1 lists the generation interconnection requests that are assumed to have rights to either full or partial interconnection service prior to the requested October 2020 in-service for this IAISIS. Also listed in Table 2-1 are the total MWs requested of interconnection service, the fuel type, the point of interconnection (POI), and the current status of each particular prior queued request. In the event that any of the projects achieve commercial operation with a capacity above the amount studied, the interim interconnection service will reduce to 0MW until a restudy is completed that identifies the available interconnection service.

Table 2-1: Generation Requests Included within IAISIS

Project	MW Modeled	Fuel Source	POI	Status
Asbury Plant	Out-of-service	Coal	Asbury Plant 161 kV	Retired
GEN-2002-004	153	Wind	Latham 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2005-013	199.8	Wind	Caney River 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2007-025	299.2	Wind	Viola 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2008-013	300	Wind	Hunter 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION

Project	MW Modeled	Fuel Source	POI	Status
GEN-2008-098	99.5	Wind	Waverly 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2009-025	59.8	Wind	TAP Deer Creek â€“ Sinclair 69kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2010-003	99.5	Wind	Waverly 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2010-005	299.2	Wind	Viola 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2010-055	4.5	Gas	Wekiwa 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2011-057	150	Wind	Creswell 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2012-032	299	Wind	Rose Hill-(Ranch Road) Sooner (Open Sky) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2012-033	98.06	Wind	Tap and Tie South 4th - Bunch Creek & Enid Tap - Fairmont (GEN-2012-033T) 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2012-041	121.5	CT	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2013-011	30	Coal	Turk 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2013-012	147	Gas	Redbud 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2013-028	559.5	Gas	Tap N Tulsa - GRDA 1 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2013-029	299	Wind	Renfrow 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2014-001	200.6	Wind	Tap Wichita - Emporia Energy Center 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2014-028	35	CC	Riverton 161kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2014-064	248.4	Wind	Otter 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-001	200	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-015	154.56	Wind	Tap Medford Tap â€“ Coyote 138kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-016	200	Wind	Tap Marmaton - Centerville 161kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-024	217.8	Wind	Thistle-Wichita Dbl Ckt (Buffalo Flats) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-025	215.95	Wind	Tap Thistle â€“ Wichita 345kV Dbl CKT	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-034	200	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2015-036	304	Wind	Johnston County 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2015-047	297.8	Wind	Sooner 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-052	300	Wind	Open Sky-Rose Hill 345kV	IA FULLY EXECUTED/ON SUSPENSION
GEN-2015-062	4.5	Wind	Breckinridge 138kV, Bus #514815	IA FULLY EXECUTED/ON SCHEDULE
GEN-2015-063	300	Wind	Woodring-Matthewson 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-066	248.4	Wind	Sooner - Cleveland 345kV	IA FULLY EXECUTED/ON SUSPENSION
GEN-2015-069	300	Wind	Union Ridge 230kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-073	200.1	Wind	Emporia 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2015-082	200	Wind	Beaver County• -Woodward EHV Dbl Ckt (Badger) 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2015-090	218.5	Wind	Thistle-Wichita Dbl Ckt (Buffalo Flats) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION

Project	MW Modeled	Fuel Source	POI	Status
GEN-2015-095	176	Wind	Tap Mooreland - Knob Hill 138kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-003	248	Wind	Badger-Woodward EHV Dbl Ckt 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-009	29	Steam Turbine	Osage 69 kV Sub	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-013	10	CT	LaRussell Energy Center 161kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-014	10	CT	LaRussell Energy Center 161kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-020	150	WIND	Moreland 138kV Substation	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-022	151.8	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA PENDING
GEN-2016-028	100	Wind	Clayton 138 kV Sub	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2016-030	99.9	Solar	Brown 138kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-031	1.5	Wind	Rose Hill (Open Sky)-Sooner (Ranch Road) 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2016-032	200	Wind	Crescent138 kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-047	24	CT	Mustang 69kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2016-051	9.8	Wind	Clinton Junction-Weatherford Southeast 138kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-061	250.7	Wind	Sooner-Woodring 345 kV line	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-063	200	Wind	Hugo-Sunnyside 345 kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-067	73.6	Wind	Mingo 345kV	IA FULLY EXECUTED/COMMERCIAL OPERATION
GEN-2016-068	250	Wind	Woodring 345kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-070	5.3	Wind	Majestic 115 kV Substation	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-071	200.1	Wind	Middleton Tap 138kV Substation	IA PENDING
GEN-2016-073	220	Wind	Thistle-Wichita Dbl Ckt (Buffalo Flats) 345kV	IA PENDING
GEN-2016-092	175	Wind	Fort Thompson-Leland Olds 345kV	FACILITY STUDY STAGE
GEN-2016-100	0	Wind	Spring Creek-Sooner 345kV	FACILITY STUDY STAGE
GEN-2016-101	0	Wind	Spring Creek-Sooner 345kV	FACILITY STUDY STAGE
GEN-2016-119	0	Wind	Spring Creek-Sooner 345kV	FACILITY STUDY STAGE
GEN-2016-128	0	Wind	Woodring 345kV	FACILITY STUDY STAGE
GEN-2016-132	6.1	Wind	Sweetwater 230kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2016-133	187.5	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-134	187.5	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-135	100	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-136	75	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-137	187.5	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-138	187.5	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE

Project	MW Modeled	Fuel Source	POI	Status
GEN-2016-139	100	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-140	75	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-141	350	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-142	350	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-143	175	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-144	175	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-145	175	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-146	175	Wind	Riverside 345kV Substation	FACILITY STUDY STAGE
GEN-2016-153	0	Wind	Viola 345kV	FACILITY STUDY STAGE
GEN-2016-162	0	Wind	Benton 345kV	FACILITY STUDY STAGE
GEN-2016-163	252	Wind	Benton 345kV	FACILITY STUDY STAGE
GEN-2016-166	35	Solar	Prairie Grove 69 kV Substation	WITHDRAWN
GEN-2017-004	0	Wind	Elm Creek - Summit 345 kV	DISIS STAGE
GEN-2017-005	0	Wind	Marmaton - Litchfield 161 kV	DISIS STAGE
GEN-2017-060	250.4	Wind	LaRussell Energy Center 161kV	DISIS STAGE
GEN-2017-082	250.4	Wind	Asbury Plant 161 kV	DISIS STAGE
GEN-2017-069	0	Solar	Norton 115kV	DISIS STAGE
GEN-2017-094	0	Wind	Fort Thompson-Huron 230 kV	DISIS STAGE

The highlight cells under “MW Modeled” are for the updates compared to previous interim study.

3 Stability Analysis

Transient stability analysis is used to determine if the transmission system can maintain angular stability and ensure bus voltages stay within planning criteria bandwidth during and after a disturbance while considering the addition of a generator interconnection request.

3.1 Methodology

Transient stability analysis was performed using modified versions of the 2016 series of Model Development Working Group (MDWG) dynamic study models including the 2017 winter, 2018 summer peak, and 2026 summer peak dynamic cases. The cases were adapted to resemble the power flow study cases with regards to prior queued generation requests and topology. Finally, the prior queued and study generation was dispatched into the SPP footprint. Initial simulations were carried out for a non-disturbance run of twenty (20) seconds to verify the numerical stability of the model.

3.2 Fault Definitions

The study contingencies included three-phase faults and single-phase line-ground faults at locations defined by SPP. Single-phase line faults were simulated by applying fault impedance to the positive sequence network at the fault location to represent the effect of the negative and zero sequence networks on the positive sequence network. The fault impedance was computed to give a positive sequence voltage at the specified fault location of approximately 60% of pre-fault voltage. This method is in agreement with SPP current practice.

With exception to transformers, the typical sequence of events for a three-phase and single-phase fault is as follows:

1. apply fault at a particular location;
2. continue fault for five (5) cycles, clear the fault by tripping the faulted facility;
3. after an additional twenty (20) cycles, re-close the previous facility back into the fault;
4. continue fault for five (5) additional cycles;
5. trip the faulted facility and remove the fault.

Transformer faults are typically only performed for three-phase faults, unless otherwise noted. The sequence of events for a transformer is to 1) apply a three-phase fault for five (5) cycles and 2) clear the fault by tripping the affected transformer facility. Unless otherwise noted there will be no re-closing into a transformer fault.

Based on the configuration of interconnection of the study projects, total of forty-three (43) contingencies for Group 08 near the POI of GEN-2017-009 were identified for this study. These faults are listed in Table 3-1.

Table 3-1: Contingency Fault Description

Fault #	Fault Name	Contingency (Fault) Description
01	**009FLT01-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to NEOSHO 5 (532937) 345/161 kV Transformer , CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345/161 kV Transformer (532793-532937, CKT 1)
02	**009FLT02-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to NEOSHO 4 (533021) 345/138 kV Transformer , CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345/138 kV Transformer (532793-533021, CKT 1)
03_R	**009FLT03_R-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to 7BLACKBERRY (300739) 345 kV Line, CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-300739, 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
04_R	**009FLT04_R-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to LACYGNE7 (542981) 345 kV Line, CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-542981, 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
05_R	**009FLT05_R-3PH**	**3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to DELWARE7 (510380) 345 kV Line, CKT 1**
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-510380, 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
06_R	**009FLT06_R-3PH**	**3 Phase Fault on G17-009-TAP (588544) 345 kV Bus to NEOSHO 7 (532793) 345 kV Line, CKT 1**
		a. Apply Fault at the G17-009-TAP (588544) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (588544-532793, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault

Fault #	Fault Name	Contingency (Fault) Description
		d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
07_R	**009FLT07_R-3PH**	**3 Phase Fault on G17-009-TAP (588544) 345 kV Bus to CANEYRV7 (532780) 345 kV Line, CKT 1**
		a. Apply Fault at the G17-009-TAP (588544) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (588544-532780, 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
08_R	**009FLT08_R-3PH**	**3 Phase Fault on CANEYRV7 (532780) 345 kV Bus to LATHAMS7 (532800) 345 kV Line, CKT 1**
		a. Apply Fault at the CANEYRV7 (532780) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532780-532800, 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
10_R	**009FLT10_R-3PH**	**3 Phase Fault on LATHAMS7 (532800) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1**
		a. Apply Fault at the LATHAMS7 (532800) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532800-532794, 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
11_R	**009FLT11_R-3PH**	**3 Phase Fault on Wolf Creek (532797) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1**
		a. Apply Fault at the Wolf Creek (532797) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532797-532794, 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
12_R	**009FLT12_R-3PH**	**3 Phase Fault on Wolf Creek (532797) 345 kV Bus to Benton (532791) 345 kV Line, CKT 1**
		a. Apply Fault at the Wolf Creek (532797) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532797-532791, 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
13	**009FLT13-3PH**	**3 Phase Fault on Wolf Creek (532797) 345 kV Bus to Waverly (532799) 345 kV Line, CKT 1**
		a. Apply Fault at the Wolf Creek (532797) 345 kV Bus
		b. Clear Fault after 3.6 Cycles and Trip the Faulted 345 kV Line (532797-532799, CKT 1)
13_CAP	**009FLT13-3PH_CAP**	**3 Phase Fault on Wolf Creek (532797) 345 kV Bus to Waverly (532799) 345 kV Line, CKT 1**
		with Wolf Creek generation output of net 700MW
		a. Apply Fault at the Wolf Creek (532797) 345 kV Bus
		b. Clear Fault after 3.6 Cycles and Trip the Faulted 345 kV Line (532797-532799, CKT 1)
14	**009FLT14-3PH**	**3 Phase Fault on Waverly (532799) 345 kV Bus to LACYGNE7 (542981) 345 kV Line, CKT 1**
		a. Apply Fault at the Waverly (532799) 345 kV Bus
		b. After 3.6 cycles, open Waverly to LaCygne 345 kV Line, CKT 1 at Waverly end
		c. Clear Fault after an additional 0.65 Cycles and Trip the Faulted 345 kV Line (532799-542981, CKT 1) by opening the LaCygne end

Fault #	Fault Name	Contingency (Fault) Description
14_CAP	**009FLT14-3PH_CAP**	**3 Phase Fault on Waverly (532799) 345 kV Bus to LACYGNE7 (542981) 345 kV Line, CKT 1**
		with Wolf Creek generation output of net 700MW
		a. Apply Fault at the Waverly (532799) 345 kV Bus
		b. After 3.6 cycles, open Waverly to LaCygne 345 kV Line, CKT 1 at Waverly end
		c. Clear Fault after an additional 0.65 Cycles and Trip the Faulted 345 kV Line (532799-542981, CKT 1) by opening the LaCygne end
15_R	**009FLT15_R-3PH**	**3 Phase Fault on Benton (532791) 345 kV Bus to Wichita (532796) 345 kV Line, CKT 1**
		a. Apply Fault at the Benton (532791) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532791-532796, 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
16_R	**009FLT16_R-3PH**	**3 Phase Fault on ROSEHIL7 (532794) 345 kV Bus to Benton (532791) 345 kV Line, CKT 1**
		a. Apply Fault at the ROSEHIL7 (532794) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532794-532791, 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
17	**009FLT17-3PH**	**3 Phase Fault on ROSEHIL7 (532794) 345 kV Bus to ROSEHIL4 (533062) 345/138 kV Transformer, CKT 1**
		a. Apply Fault at the ROSEHIL7 (532794) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345/138 kV Transformer (532794-533062, CKT 1)
18_R	**009FLT18_R-3PH**	**3 Phase Fault on Ranch Road (515576) 345 kV Bus to Sooner (514803) 345 kV Line, CKT 1**
		a. Apply Fault at the Ranch Road (515576) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (515576-514803, 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
19_R	**009FLT19_R-3PH**	**3 Phase Fault on LACYGNE7 (542981) 345 kV Bus to West Gardner (542965) 345 kV Line, CKT 1**
		a. Apply Fault at the LACYGNE7 (542981) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (542981-542965, 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
20_R	**009FLT20_R-3PH**	**3 Phase Fault on LACYGNE7 (542981) 345 kV Bus to Stilwell (542968) 345 kV Line, CKT 1**
		a. Apply Fault at the LACYGNE7 (542981) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (542981-542968, 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
21_R	**009FLT21_R-3PH**	**3 Phase Fault on DELWARE7 (510380) 345 kV Bus to Northeastern (510406) 345 kV Line, CKT 1**
		a. Apply Fault at the DELWARE7 (510380) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (510380-510406, CKT 1)
		c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault

Fault #	Fault Name	Contingency (Fault) Description
		d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault
22_R	**009FLT22_R-3PH**	**3 Phase Fault on Northeastern (510406) 345 kV Bus to Tulsa North (509852) 345 kV Line, CKT 1**
		a. Apply Fault at the Northeastern (510406) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (510406-509852, 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
23_R	**009FLT23_R-3PH**	**3 Phase Fault on Northeastern (510406) 345 kV Bus to Oneta (509807) 345 kV Line, CKT 1**
		a. Apply Fault at the Northeastern (510406) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (510406-509807, 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
24_R	**009FLT24_R-3PH**	**3 Phase Fault on 7BLACKBERRY (300739) 345 kV Bus to Sportsman (300740) 345 kV Line, CKT 1**
		a. Apply Fault at the 7BLACKBERRY (300739) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (300739-300740, 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
25_R	**009FLT25_R-3PH**	**3 Phase Fault on 7BLACKBERRY (300739) 345 kV Bus to 7JASPER (300949) 345 kV Line, CKT 1**
		a. Apply Fault at the 7BLACKBERRY (300739) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (300739-300949, 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
26_R	**009FLT26_R-3PH**	**3 Phase Fault on 7MORGAN (300045) 345 kV Bus to BROOKLINE 7 (549984) 345 kV Line, CKT 1**
		a. Apply Fault at the 7MORGAN (300045) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (300045-549984, 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
27_R	**009FLT27_R-3PH**	**3 Phase Fault on 7MORGAN (300045) 345 kV Bus to Huben (300042) 345 kV Line, CKT 1**
		a. Apply Fault at the 7MORGAN (300045) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (300045-300042, 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
28_P4	**009FLT28_P4-1PH**	**SLG Fault with breaker failure cleared by opening LATHAMS7 (532800) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT**
		SLG Fault with breaker failure on ROSEHIL7 (532794) 345 kV Bus to ROSEHIL4 (533062) 345/161 kV Transformer , CKT 1
		a. Apply Fault at the ROSEHIL7 (532794) 345 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 345/161 kV Transformer (532794-533062, CKT 1) and345 kV Line (532800-532794, CKT)

Fault #	Fault Name	Contingency (Fault) Description
29_P4	009FLT29_P4-1PH	**SLG Fault with breaker failure cleared by opening Wolf Creek (532797) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1**
		SLG Fault with breaker failure on ROSEHIL7 (532794) 345 kV Bus to ROSEHIL4 (533062) 345/161 kV Transformer , CKT 1
		a. Apply Fault at the ROSEHIL7 (532794) 345 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 345/161 kV Transformer (532794-533062, CKT 1) and 345 kV Line (532797-532794, CKT 1)
30_P4	009FLT30_P4-1PH	**SLG Fault with breaker failure cleared by opening ROSEHIL7 (532794) 345 kV Bus to Benton (532791) 345 kV Line, CKT 1**
		SLG Fault with breaker failure on ROSEHIL7 (532794) 345 kV Bus to ROSEHIL4 (533062) 345/161 kV Transformer , CKT 1
		a. Apply Fault at the ROSEHIL7 (532794) 345 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 345/161 kV Transformer (532794-533062, CKT 1) and 345 kV Line (532794-532791, CKT 1)
31_P4	009FLT31_P4-1PH	**SLG Fault with breaker failure cleared by opening Sooner (514803) 345 kV Bus to Woodring (514715) 345 kV Line, CKT 1**
		SLG Fault with breaker failure on Sooner (514803) 345 kV Bus to Ranch Road (515576) 345/161 kV Transformer , CKT 1
		a. Apply Fault at the Sooner (514803) 345 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 345/161 kV Transformer (514803-515576, CKT 1) and 345 kV Line (514803-514715, CKT 1)
32_P4	009FLT32_P4-1PH	**SLG Fault with breaker failure cleared by opening G17-009-TAP (588544) 345 kV Bus to NEOSHO 7 (532793) 345 kV Line, CKT 1**
		SLG Fault with breaker failure on NEOSHO 7 (532793) 345 kV Bus to DELWARE7 (510380) 345 kV Line, CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 345 kV Line (532793-510380, CKT 1) and 345 kV Line (588544-532793, CKT 1)
33_P4	009FLT33_P4-1PH	**SLG Fault with breaker failure cleared by opening NEOSHO 7 (532793) 345 kV Bus to 7BLACKBERRY (300739) 345 kV Line, CKT 1**
		SLG Fault with breaker failure on NEOSHO 7 (532793) 345 kV Bus to NEOSHO 5 (532937) 345/161 kV Transformer , CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 345/161 kV Transformer (532793-532937, CKT 1) and 345 kV Line (532793-300739, CKT 1)
34_P4	009FLT34_P4-1PH	**SLG Fault with breaker failure cleared by opening NEOSHO 7 (532793) 345 kV Bus to LACYGNE7 (542981) 345 kV Line, CKT 1**
		SLG Fault with breaker failure on NEOSHO 7 (532793) 345 kV Bus to NEOSHO 4 (533021) 345/138 kV Transformer , CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 16 Cycles and Trip the Faulted 345/138 kV Transformer (532793-533021, CKT 1) and 345 kV Line (532793-542981, CKT 1)
35_P6	009FLT35_P6-3PH	**Prior outage of LATHAMS7 (532800) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to NEOSHO 5 (532937) 345/161 kV Transformer, CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345/161 kV Transformer (532793-532937, CKT 1)

Fault #	Fault Name	Contingency (Fault) Description
36_P6	**009FLT36_P6-3PH**	**Prior outage of LATHAMS7 (532800) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to NEOSHO 4 (533021) 345/138 kV Transformer, CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345/138 kV Transformer (532793-533021, CKT 1)
37_P6_R	**009FLT37_P6_R-3PH**	**Prior outage of LATHAMS7 (532800) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to 7BLACKBERRY (300739) 345 kV Line, CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-300739, 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
38_P6_R	**009FLT38_P6_R-3PH**	**Prior outage of LATHAMS7 (532800) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to LACYGNE7 (542981) 345 kV Line, CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-542981, 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
39_P6_R	**009FLT39_P6_R-3PH**	**Prior outage of LATHAMS7 (532800) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on NEOSHO 7 (532793) 345 kV Bus to DELWARE7 (510380) 345 kV Line, CKT 1
		a. Apply Fault at the NEOSHO 7 (532793) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532793-510380, 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
40_P6_R	**009FLT40_P6_R-3PH**	**Prior outage of G17-009-TAP (588544) 345 kV Bus to NEOSHO 7 (532793) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on Wolf Creek (532797) 345 kV Bus to ROSEHIL7 (532794) 345 kV Line, CKT 1
		a. Apply Fault at the Wolf Creek (532797) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532797-532794, 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
41_P6_R	**009FLT41_P6_R-3PH**	**Prior outage of G17-009-TAP (588544) 345 kV Bus to NEOSHO 7 (532793) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution**
		3 Phase Fault on ROSEHIL7 (532794) 345 kV Bus to Benton (532791) 345 kV Line, CKT 1
		a. Apply Fault at the ROSEHIL7 (532794) 345 kV Bus
		b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (532794-532791, 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

<table>
<tr><th>Fault #</th><th>Fault Name</th><th>Contingency (Fault) Description</th></tr>
<tr><td rowspan="4">42_P6</td><td rowspan="4">009FLT42_P6-3PH</td><td>Prior outage of G17-009-TAP (588544) 345 kV Bus to NEOSHO 7 (532793) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution</td></tr>
<tr><td>3 Phase Fault on ROSEHIL7 (532794) 345 kV Bus to ROSEHIL4 (533062) 345/138 kV Transformer, CKT 1</td></tr>
<tr><td>a. Apply Fault at the ROSEHIL7 (532794) 345 kV Bus</td></tr>
<tr><td>b. Clear Fault after 5 Cycles and Trip the Faulted 345/138 kV Transformer (532794-533062, CKT 1)</td></tr>
<tr><td rowspan="6">43_P6_R</td><td rowspan="6">009FLT43_P6_R-3PH</td><td>Prior outage of G17-009-TAP (588544) 345 kV Bus to NEOSHO 7 (532793) 345 kV Line, CKT 1 followed by FDNS solution, convert generators and TYSL solution</td></tr>
<tr><td>3 Phase Fault on Ranch Road (515576) 345 kV Bus to Sooner (514803) 345 kV Line, CKT 1</td></tr>
<tr><td>a. Apply Fault at the Ranch Road (515576) 345 kV Bus</td></tr>
<tr><td>b. Clear Fault after 5 Cycles and Trip the Faulted 345 kV Line (515576-514803, CKT 1)</td></tr>
<tr><td>c. Wait 20 Cycles, and then reclose the line in (b) back into the Fault</td></tr>
<tr><td>d. Leave Fault on for 5 Cycles, then Trip the Line in (b) and Clear the Fault</td></tr>
</table>

3.3 Results

Table 3-2 summarizes results 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 A.

Table 3-2: Stability Analysis Results

Fault Number	Fault Name	17W	18S	26S
1	009FLT01-3PH	Stable	Stable	Stable
2	009FLT02-3PH	Stable	Stable	Stable
03_R	009FLT03_R-3PH	Stable	Stable	Stable
04_R	009FLT04_R-3PH	Stable	Stable	Stable
05_R	009FLT05_R-3PH	Stable	Stable	Stable
06_R	009FLT06_R-3PH	Stable	Stable	Stable
07_R	009FLT07_R-3PH	Stable	Stable	Stable
08_R	009FLT08_R-3PH	Stable	Stable	Stable
10_R	009FLT10_R-3PH	Stable	Stable	Stable
11_R	009FLT11_R-3PH	Stable	Stable	Stable
12_R	009FLT12_R-3PH	Stable	Stable	Stable
13	009FLT13-3PH	Unstable	Stable	Stable
13_CAP	009FLT13-3PH_CAP	Stable	-	-
14	009FLT14-3PH	Unstable	Unstable	Unstable
14_CAP	009FLT14-3PH_CAP	Stable	Stable	Stable

Fault Number	Fault Name	17W	18S	26S
15_R	009FLT15_R-3PH	Stable	Stable	Stable
16_R	009FLT16_R-3PH	Stable	Stable	Stable
17	009FLT17-3PH	Stable	Stable	Stable
18_R	009FLT18_R-3PH	Stable	Stable	Stable
19_R	009FLT19_R-3PH	Stable	Stable	Stable
20_R	009FLT20_R-3PH	Stable	Stable	Stable
21_R	009FLT21_R-3PH	Stable	Stable	Stable
22_R	009FLT22_R-3PH	Stable	Stable	Stable
23_R	009FLT23_R-3PH	Stable	Stable	Stable
24_R	009FLT24_R-3PH	Stable	Stable	Stable
25_R	009FLT25_R-3PH	Stable	Stable	Stable
26_R	009FLT26_R-3PH	Stable	Stable	Stable
27_R	009FLT27_R-3PH	Stable	Stable	Stable
28_P4	009FLT28_P4-1PH	Stable	Stable	Stable
29_P4	009FLT29_P4-1PH	Stable	Stable	Stable
30_P4	009FLT30_P4-1PH	Stable	Stable	Stable
31_P4	009FLT31_P4-1PH	Stable	Stable	Stable
32_P4	009FLT32_P4-1PH	Stable	Stable	Stable
33_P4	009FLT33_P4-1PH	Stable	Stable	Stable
34_P4	009FLT34_P4-1PH	Stable	Stable	Stable
35_P6	009FLT35_P6-3PH	Stable	Stable	Stable
36_P6	009FLT36_P6-3PH	Stable	Stable	Stable
37_P6_R	009FLT37_P6_R-3PH	Stable	Stable	Stable
38_P6_R	009FLT38_P6_R-3PH	Stable	Stable	Stable
39_P6_R	009FLT39_P6_R-3PH	Stable	Stable	Stable
40_P6_R	009FLT40_P6_R-3PH	Stable	Stable	Stable
41_P6_R	009FLT41_P6_R-3PH	Stable	Stable	Stable
42_P6	009FLT42_P6-3PH	Stable	Stable	Stable
43_P6_R	009FLT43_P6_R-3PH	Stable	Stable	Stable

The dynamic simulation indicated that the system remained stable except some faults related to Wolf Creek substation and Waverly substations. The corresponding faults are Fault# 13 on Wolf Creek under 2017 winter case and Fault#14 on Waverly substation (highlighted cells in Table 3-2) under 2017 winter, 2018 summer peak and 2026 summer peak cases. Further investigation identified that an existing TPL Corrective Action Plan (CAP) to implement an OP Guide that reduces the output at Wolf Creek Power Plant can mitigate the unstable conditions. The representative result comparison is included in Figure 3-1. In the plot, the rotor angle responses of Wolf Creek unit showed undamped oscillations with the Project on and without the Project on, and the oscillations are improved with reduced amplitude between the case with the Project and the case without the Project. With the CAP (reducing the Wolf Creek generation output to the System Operating Limit at net 700MW), the Wolf Creek angle oscillation is well damped.

No other transient stability violations were observed for the requested MW capacity for this IAISIS.

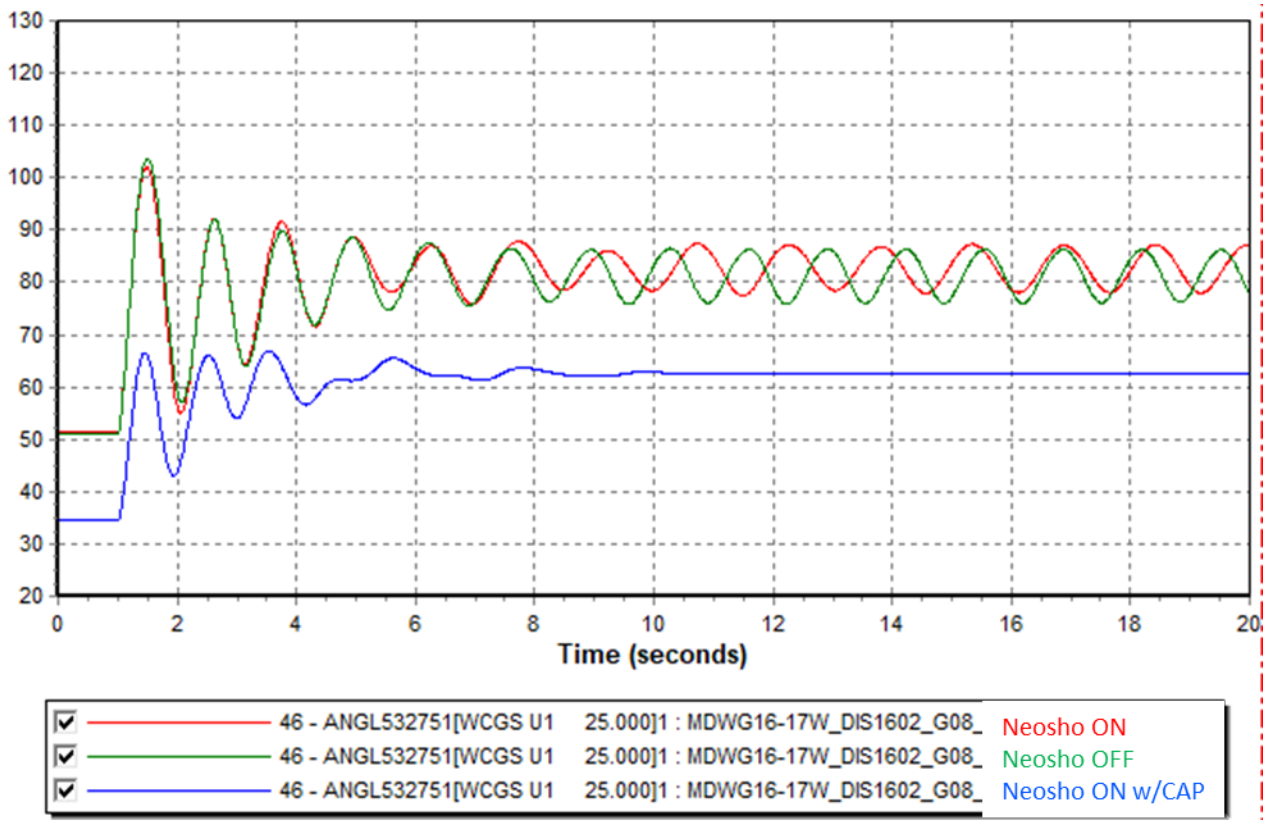


Figure 3-1: Representative Comparison for Fault# 14 and Fault# 14_CAP

Overall, the stability analysis results indicate that there is no adverse impact from the Project under all the study scenarios.

4 Conclusion

For the interim request, GEN-2017-009 was studied at its maximum requested capacity 301MW. The stability analysis evaluated the system for three load scenarios (2017 winter peak, 2018 summer peak and 2026 summer peak) simulating faults that included three-phase and single-line-to-ground faults.

The dynamic simulation indicated that, except some faults related to Wolf Creek and Waverly substations, the system remained stable. Further investigation identified that an existing TPL Corrective Action Plan (CAP) to implement an OP Guide that reduces the output at Wolf Creek Power Plant can mitigate the unstable conditions. No other transient stability violations were observed for the requested MW capacity for this IAISIS.

Based on the dynamic simulation, this Study has demonstrated that there are no adverse impacts on the transmission system because of the interim interconnection request, and GEN-2017-009 may reliably interconnect on an interim basis for a total nameplate capacity of 301 MW with ERIS.

The IAISIS assumes that the higher queued projects listed within Table 2-1 of this report might go into service. If additional generation projects with queue priority equal to or higher than the study interim request rights to go into commercial operation, this IAISIS may need to be restudied to ensure that interconnection service remains for the customer’s request.

Appendix

Appendix A: Stability Simulation Results