Interconnection Facilities Study

GEN-2015-007/IFS-2015-001-01
GEN-2015-023/IFS-2015-001-08

July 2016

Generator Interconnection

SPP Southwest Power Pool

Revision History

Date	Author	Change Description
06/09/2016	SPP	Draft Interconnection Facilities Study Report Revision 0 Issued
7/11/2016	SPP	Final Interconnection Facilities Study Report Revision 0 & GEN-2015-023 Interconnection Customer Comments Issued

Table of Contents

Revision History ii

Table of Contents iii

Interconnection Facilities Study Summary 1

Interconnection Facilities Study Introduction 1

GEN-2015-007 1

IFS-2015-001-01 1

GEN-2015-023 1

IFS-2015-001-08 1

Phase(s) of Interconnection Service 1

Credits/Compensation for Amounts Advanced for Network Upgrade(s) 2

Interconnection Customer Interconnection Facilities 2

GEN-2015-007 2

IFS-2015-001-01 2

GEN-2015-023 2

IFS-2015-001-08 2

Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s) 3

Shared Network Upgrade(s) 4

Affected System Identified Network Upgrade(s) 5

NPPD Facility Study Identified Network Upgrade(s) 5

Other Network Upgrade(s) 5

Conclusion 6

Appendices 8

A : NPPD Transmission Owner Interconnection Facilities Study Report A-0

B : Affected System Impact Study Report B-0

C : GEN-2015-023 Interconnection Customer Comments to Draft Report C-0

Interconnection Facilities Study Summary

Interconnection Facilities Study Introduction

This Interconnection Facilities Study (IFS) for the Generator Interconnection Request(s) (GIRs) listed in **Table 1**.

Table 1: IFS-2015-001 NPPD Interconnection Facilities Request(s)

Request Number	Location	Service Type	Fuel Source	Amount (MW)	Original Customer Proposed In-Service Date
GEN-2015-007 IFS-2015-001-01	Antelope County, Nebraska	ERIS	Wind	160.00	12/1/2016
GEN-2015-023 IFS-2015-001-08	Antelope & Wheeler County, Nebraska	ERIS/NRIS	Wind	300.72	12/31/2019

The Interconnection Requests were studied in the DISIS-2015-001 Impact Study and DISIS-2015-001-1 Impact Restudy as an Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS) requests. The Interconnection Requests were provided updated Cost Allocations in DISIS-2015-001-2 Impact Restudy. Since the posting of the DISIS-2015-001 Impact Study the Interconnection Customers has executed the Interconnection Facilities Study Agreements per Appendix 4 or Appendix 4A and provided deposit securities as required by the Section 8.9 of the Generator Interconnection Produce (GIP) to proceed to the Interconnection Facilities Study. The GIP is covered under Attachment V of the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT). The request for interconnection was placed with SPP by the requesting customer (Interconnection Customer) in accordance with OATT, which covers new generation interconnections on SPP's transmission system.

Nebraska Public Power District (NPPD) performed a detailed Interconnection Facilities Study at the request of SPP for the Interconnection Request. SPP has proposed the full Interconnection Service will be available after the assigned Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s) are completed. Full interconnection service will require Network Upgrade(s) listed in the "Other Network Upgrade(s)" section.

The primary objective of the Interconnection Facilities Study (IFS) is to identify necessary Transmission Owner Interconnection Facilities, network upgrade(s), other direct assigned upgrade(s), and associated upgrade lead times needed for the additional of the requested Interconnection Service into the SPP Transmission System at the specific Point of Interconnection (POI).

Phase(s) of Interconnection Service

It is not expected that Interconnection Service will occur in phases. However, Interconnection Service will not be available until all Interconnection Facilities and Network Upgrade(s) can be placed in service.

Credits/Compensation for Amounts Advanced for Network Upgrade(s)

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

Interconnection Customer Interconnection Facilities

The Generator Interconnection Request(s) listed in **Table 1** were studied in the Interconnection Facilities Study for the proposed Point of Interconnection (POI) listed in **Table 2** for the NPPD transmission system.

Table 2: GI Requests Point of Interconnection

G.I. Request Number	Point of Interconnection (POI)
GEN-2015-007 IFS-2015-001-01	Hoskins 345kV
GEN-2015-023 IFS-2015-001-08	Holt County 345kV

GEN-2015-007/IFS-2015-001-01

The GEN-2015-007/IFS-2015-001-01, (GEN-2015-007) Interconnection Customer's generator facility consists of eighty (80) General Electric (G.E.) 2.0 MW wind generators with +/- 0.90 power factor generator capabilities for a total generating nameplate of 160.00 MW. The 34.5kV collector system for this wind farm is planned to be connect to one (1) 345/34.5/13kV 114/152/190 MVA (ONAN/ONAF/ONAF) Interconnection Customer, GEN-2015-007, owned and maintained transformer at the Interconnection Customer owned substation. A sixteen (16) mile overhead 345kV transmission circuit will connect the Generating Facility from the Interconnection Customer GEN-2015-007, owned substation to the Point of Interconnection (POI) at the existing Nebraska Public Power District (NPPD) owned and maintained 345kV bus at the Hoskins Substation. The Interconnection Customer, GEN-2015-007, will be responsible for all of the transmission facilities connecting the Interconnection Customer owned substation to the Point of Change of Ownership (PCO).

The Interconnection Customer, GEN-2015-007, will be responsible for any equipment located at the Customer substation necessary to maintain a power factor of 0.95 lagging to 0.95 leading at the Point of Change of Ownership (PCO), including approximately 16.7 Mvars[1] of reactors to compensate for injection of reactive power into the transmission system under reduced generating conditions. Also, the Interconnection Customer, GEN-2015-007, will need to coordinate with the Transmission Owner for relay, protection, control, and communication system configurations.

GEN-2015-023/IFS-2015-001-08

The GEN-2015-023/IFS-2015-001-08, (GEN-2015-023) Interconnection Customer's generator facility consists of one hundred-sixty-eight (168) General Electric (G.E.) 1.79 MW wind generators with +/-

[1] This approximate minimum reactor amount is needed for the current configuration of the wind farm as studied in the DISIS-2015-001 Impact Study and DISIS-2015-001-1 Impact Restudy.

0.90 power factor generator capabilities for a total generating nameplate of 300.72 MW. The 34.5kV collector system for this wind farm is planned to be connect to two (2) 345/34.5/13kV 100/133/166 MVA (ONAN/ONAF/ONAF) Interconnection Customer, GEN-2015-023, owned and maintained transformer at the Interconnection Customer owned substation. A fifteen-and-a-half (15.5) mile overhead 345kV transmission circuit will connect the Generating Facility from the Interconnection Customer, GEN-2015-023, owned substation to the Point of Interconnection (POI) at the planned Nebraska Public Power District (NPPD) owned and maintained 345kV bus at the Holt County Substation. The Interconnection Customer, GEN-2015-023, will be responsible for all of the transmission facilities connecting the Interconnection Customer owned substation to the Point of Change of Ownership (PCO).

The Interconnection Customer, GEN-2015-023, will be responsible for any equipment located at the Customer substation necessary to maintain a power factor of 0.95 lagging to 0.95 leading at the Point of Change of Ownership (PCO), including approximately 17.2 Mvars[2] of reactors to compensate for injection of reactive power into the transmission system under reduced generating conditions. Also, the Interconnection Customer, GEN-2015-023, will need to coordinate with the Transmission Owner for relay, protection, control, and communication system configurations.

Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s)

GEN-2015-007/IFS-2015-001-01

To facilitate the GEN-2015-007 interconnection, the interconnecting Transmission Owner, NPPD, will need to expand the existing Hoskins 345kV Substation, construct a new line terminal which includes four (4) 345kV circuit breakers, disconnect switches, structure, and any associated terminal equipment for the acceptance of the Interconnection Customer's Interconnection Facilities. Currently, NPPD estimates an Engineering and Construction (E&C) lead time of approximately twenty-four (24) to thirty-six (36) months after a fully executed Generator Interconnection Agreement (GIA) for the completion of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades.

At this time, Interconnection Customer is responsible for $5,300,000 of NPPD Transmission Owner Interconnection Facilities (TOIF) and Non-Shared Network Upgrade(s). **Table 3** displays the estimated costs for TOIF and Non-Shared Network Upgrade(s).

Table 3: GEN-2015-007/IFS-2015-001-01 TOIF and Non-Shared Network Upgrade(s)

TOIF and Non-Shared Network Upgrades Description	Allocated Cost ($)	Allocated Percent (%)	Total Cost ($)
NPPD Interconnection Substation: Transmission Owner Interconnection Facilities 345kV Substation work for one (1) new line terminal, line switch, dead end structure, line relaying, communications, revenue metering, and line arrestor.	$700,000	100%	$700,000

[2] This approximate minimum reactor amount is needed for the current configuration of the wind farm as studied in the DISIS-2015-001 Impact Study and DISIS-2015-001-1 Impact Restudy.

NPPD Interconnection Substation - Non-Shared Network Upgrades 345kV Substation work for the existing 345kV bus, one (1) new line terminal, four (4) circuit breakers, control panel, line relaying, disconnect switches, and associated equipment.	$4,600,000	100%	$4,600,000
Total	$5,300,000	100%	$5,300,000

GEN-2015-023/IFS-2015-001-08

To facilitate the GEN-2015-023 interconnection, the interconnecting Transmission Owner, NPPD, will need to expand the planned Holt County 345kV Substation, construct a new line terminal which includes four (4) 345kV circuit breakers, disconnect switches, structure, and any associated terminal equipment for the acceptance of the Interconnection Customer's Interconnection Facilities. Currently, NPPD estimates an Engineering and Construction (E&C) lead time of approximately twenty-four (24) to thirty-six (36) months after a fully executed Generator Interconnection Agreement (GIA) for the completion of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades.

At this time, Interconnection Customer is responsible for $6,600,000 of NPPD Transmission Owner Interconnection Facilities (TOIF) and Non-Shared Network Upgrade(s). **Table 4** displays the estimated costs for TOIF and Non-Shared Network Upgrade(s).

Table 4: GEN-2015-023/IFS-2015-001-08 TOIF and Non-Shared Network Upgrade(s)

TOIF and Non-Shared Network Upgrades Description	Allocated Cost ($)	Allocated Percent (%)	Total Cost ($)
NPPD Interconnection Substation: Transmission Owner Interconnection Facilities 345kV Substation work for one (1) new line terminal, line switch, dead end structure, line relaying, communications, revenue metering, and line arrestor.	$700,000	100%	$700,000
NPPD Interconnection Substation - Non-Shared Network Upgrades 345kV Substation work for the planned 345kV bus, one (1) new line terminal, four (4) circuit breakers, control panel, line relaying, disconnect switches, and associated equipment.	$5,900,000	100%	$4,600,000
Total	$6,600,000	100%	$6,600,000

Shared Network Upgrade(s)

The Interconnection Requests GEN-2015-007 and GEN-2015-023 were studied in the DISIS-2015-001 Impact Study and DISIS-2015-001-1 Impact Restudy as an Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS) requests. The Interconnection Request was provided updated Cost Allocations in DISIS-2015-001-2 Impact Restudy. At this time, the Interconnection Customers are allocated $0 for Shared Network Upgrades. If higher queued Interconnection Request(s) withdraw from the queue, suspend or terminate their GIA, restudies will have to be conducted to determine the Interconnection Customers' allocation of Shared Network Upgrades. All studies have been conducted on the basis of higher queued Interconnection Request(s) and the Network Upgrade(s) associated with those higher queued

Interconnection Requests being placed in service. At this time, the Interconnection Customer is allocated the following cost listed in **Table 5** for Shared Network Upgrade.

Table 5: Interconnection Customer Shared Network Upgrades

Shared Network Upgrades Description	Allocated Cost ($)	Allocated Percent (%)	Total Cost ($)
Currently not allocated Shared Network Upgrades for GEN-2015-007 or GEN-2015-023	$0	n/a	$0
Total	$0	n/a	$0

Affected System Identified Network Upgrade(s)

The Mid-Continent Independent System Operator (MISO) performed an Affected System Study for the Interconnection Requests. That study is attached. MISO identified constraints at the Raun 345kV substation owned by Mid-American Energy (MEC). The constraints were estimated at $50,000 to mitigate. These upgrades are assignable to GEN-2015-007 as the Interconnection Request that impacts the constraint. The Interconnection Customer for GEN-2015-007 will be required to enter into a separate agreement with MISO and/or MEC to effect the construction of these upgrades.

Table 6: Affected System Network Upgrades

Shared Network Upgrades Description	GEN-2015-007 Allocation($)	GEN-2015-023 Allocation ($)	Total Cost ($)
Raun 345kV Substation (MEC) – Replace Wave Trap	$50,000	$0	$50,000

NPPD Facility Study Identified Network Upgrade(s)

During the NPPD Facility Study impact review, NPPD identified potential constraints for two elements on the Western Area Power Administration (WAPA) transmission system. The two thermal constraints are Fort Randall – Utica Junction 230kV circuit #1 for the contingency of Kelly (Columbus) – Meadow Grove 230kV circuit #1 and Holt County – Grand Island 345kV circuit #1 for the contingency of Grand Prairie – Fort Thompson 345kV circuit #1 in the 2016 Winter Peak model developed by NPPD. SPP is unable to verify the potential constraints meet the criteria for interconnection upgrades with the GGS-Thedford 345kV line in service. (100% rating of Rate B with all planned Network Upgrades in service and impact factor of 20% OTDF for ERIS and 3% OTDF for NRIS).

Other Network Upgrade(s)

Certain Other Network Upgrades are currently not the cost responsibility of the Interconnection Customer but will be required for full Interconnection Service.

Currently, the following Other Network Upgrades are required for GEN-2015-007:

1) Hoskins – Neligh East (Antelope) 345/115kV Project build assigned in the SPP 2014 Integrated Transmission Plan- Near Term Assessment (2014 ITP NT) per SPP-200253. The current anticipated in-serivce for this project is 6/1/2016.
2) Gentleman – Cherry County (Thedford) – Holt County 345kV Project ("R-Project") and Thedford 345/115/13kV transformer assigned in the SPP 2012 Integrated Transmission Plan – 10 Yea Assessment (2012 ITP10) per SPP-200220. The current anticipated in-service for this project is 10/1/2018
3) Twin Church – Dixon County 230kV circuit #1 increase conductor clearances assigned to DISIS-2010-002 and DISIS-2011-001 Interconnection Customer(s)

Currently, the following Other Network Upgrades are required for GEN-2015-023:

1) Battle Creek – County Line – Neligh East (Antelope) 115kV circuit #1 build assigned to DISIS-2013-002 Interconnection Customer(s)
2) Hoskins – Neligh East (Antelope) 345/115kV Project build assigned in the SPP 2014 Integrated Transmission Plan- Near Term Assessment (2014 ITP NT) per SPP-200253. The current anticipated in-serivce for this project is 6/1/2016.
3) Gentleman – Cherry County (Thedford) – Holt County 345kV Project ("R-Project") and Thedford 345/115/13kV transformer assigned in the SPP 2012 Integrated Transmission Plan – 10 Year Assessment (2012 ITP10) per SPP-200220. The current anticipated in-service for this project is 6/1/2018
4) Twin Church – Dixon County 230kV circuit #1 increase conductor clearances assigned to DISIS-2010-002 and DISIS-2011-001 Interconnection Customer(s)

Depending upon the status of higher or equally queued customers, the Interconnection Request's in-service date is at risk of being delayed or their Interconnection Service is at risk of being reduced until the in-service date of these Other Network Upgrades.

Conclusion

Interconnection Service for GEN-2015-007/IFS-2015-001-01 will be delayed until the Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades are constructed. Full interconnection service will require Network Upgrade(s) listed in the "Other Network Upgrade(s)" section. The Interconnection Customer GEN-2015-007, is responsible for $5,300,000 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer GEN-2015-007 is allocated $0 for Shared Network Upgrades. After all Interconnection Facilities and Non-Shared Network Upgrades have been placed into service, Interconnection Service for 160.00 MW, as requested by the Interconnection Customer GEN-2015-007 can be allowed. At this time the total allocation of costs assigned to Interconnection Customer GEN-2015-007 for interconnection Service are estimated at $5,300,000.

Interconnection Service for GEN-2015-023/IFS-2015-001-08 will be delayed until the Transmission Owner Interconnection Facilities, Non-Shared Network Upgrades, and Holt County Substation are constructed. Full interconnection service will require Network Upgrade(s) listed in the "Other Network Upgrade(s)" section. The Interconnection Customer GEN-2015-023, is responsible for $6,600,000 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer GEN-2015-023 is allocated $0 for Shared Network

Upgrades. After all Interconnection Facilities and Non-Shared Network Upgrades have been placed into service, Interconnection Service for 300.72 MW, as requested by the Interconnection Customer GEN-2015-007 can be allowed. At this time the total allocation of costs assigned to Interconnection Customer GEN-2015-007 for interconnection Service are estimated at $6,600,000.

Appendices

A: NPPD Transmission Owner Interconnection Facilities Study Report

See next page for NPPD Interconnection Facilities Study Report

DISIS-2015-001-1
GENERATION INTERCONNECTION FACILITY STUDY

SPP GEN-2015-007 160.0 MW at Hoskins 345 kV Substation
SPP GEN-2015-023 300.7 MW at Holt County 345 kV Substation

MARCH 2016

PREPARED FOR:
SOUTHWEST POWER POOL

PREPARED BY:
NEBRASKA PUBLIC POWER DISTRICT OPERATIONS
TRANSMISSION ASSET PLANNING
T&D ASSET MANAGEMENT
T&D ENGINEERING

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Table of Contents

EXECUTIVE SUMMARY

1.0 INTRODUCTION 1

2.0 STUDY SCOPE 2

2.1 Overview 2
2.2 Loadflow Analysis 4
2.3 Short Circuit Analysis 5
2.4 Stability Analysis 5
2.5 Detailed Cost Estimates and Project Schedule 6

3.0 MODEL DEVELOPMENT 7

4.0 STUDY CRITERIA 9

5.0 LOADFLOW ANALYSIS 10

5.1 Phase 1 Results (System-wide N-1 Screening) 10
5.2 Phase 2 Results (System-wide Multiple Element Screening) 12
5.3 Phase 3 Results (N-2 Contingency Analysis) 14

6.0 SHORT CIRCUIT ANALYSIS 16

6.1 Model Development 16
6.2 Study Methodology 18
6.3 Results 18

7.0 STABILITY ANALYSIS 19

7.1 Model 19
7.2 Results (P1-P7, Extreme Events) 20
7.3 Stability Analysis Summary 20

8.0 DETAILED COST ESTIMATES AND PROJECT SCHEDULE 23

Executive Summary

The *NPPD DISIS-2015-001-1 Facility Study* was performed to document the reliability impacts of generation projects that are proposed to interconnect to the NPPD transmission system. These projects have developed through the SPP Definitive Interconnection System Impact Study process and have advanced to the facility study stage. SPP has requested that NPPD perform the Facility Study associated with the generation interconnection projects listed below:

Project	MW	Type	Point-of-Interconnection
GEN-2015-007	+160.0	Wind	Hoskins 345 kV Substation
GEN-2015-023	+300.7	Wind	Holt County 345 kV Substation
	+460.7		

SPP entered into a facility study agreement with each of the generation interconnection customers and subsequently requested that NPPD perform the Facility Study for each request. This facility study focused on the impacts of the generation interconnection projects which included a detailed loadflow analysis, short circuit analysis and stability analysis. The Facility Study also includes detailed cost estimates and estimated project schedules for the interconnection and network upgrades identified in the System Impact and Facility Study.

The DISIS-2015-001-1 Facility Study includes a loadflow analysis, short circuit analysis and stability analysis.

The Loadflow Analysis documents the steady-state performance of the network following the generation interconnection projects. The loadflow analysis was split into three phases.

Phase 1 of the loadflow analysis was a system intact and N-1 contingency analysis of the Nebraska transmission system in accordance with NERC Standard TPL-001-4. The Phase 1 screening did not identify any significantly impacted NPPD facilities for system intact conditions. Two facilities in the WAPA system were found to overload for N-1 conditions:

Facility	Contingency	Rating (MVA)	Loading
Ft Randall-Utica Junction 230kV	Kelly-MeadowGrove 230kV	320	107.0%
Holt County-Gr Island 345kV	Gr Prairie-Ft Thompson 345kV	720	101.7%

SPP and WAPA will need to assess and address these issues to determine the required mitigations or network upgrades. The Phase 1 screening did not discover any impacted bus voltages outside of limits for system intact or N-1 conditions.

Phase 2 of the loadflow analysis involved a comprehensive multiple element contingency analysis of the Nebraska transmission system in accordance with NERC Standard TPL-001-4. The Phase 2 screening identified five NPPD facilities that were loaded in excess

of facility ratings for multiple element contingencies. Each of the contingencies and overloaded facilities involve HV (non-EHV) facilities so post-contingency mitigation involving curtailment of firm transmission and/or load shed may be utilized to mitigate these issues. Three facilities in the WAPA system were found to overload for multiple element contingency conditions. SPP and WAPA will need to assess and address these issues as necessary. The Phase 2 screening did not discover any impacted bus voltages outside of limits for multiple element contingency conditions.

Phase 3 of the loadflow analysis evaluated the impacts of worst case independent N-2 double contingency conditions for the local area transmission outlet paths associated with the generation interconnection projects. This phase did identify several independent N-2 contingencies that would require prior outage generation limitations of the proposed generation interconnection projects. These prior outage limitations would be developed through an operational study and/or operational guides if the projects continue to be developed. The limiting prior outages are listed below:

Limiting Prior Outage Facilities

1. Neligh East (Antelope) – Hoskins 345 kV
2. Neligh East (Antelope) 345/115 kV Transformer
3. Neligh East (Antelope) – County Line 115 kV
4. Gavins Point – Bloomfield 115 kV
5. Gavins Point – Hartington 115 kV
6. Gavins Point – Spirit Mound 115 kV
7. Gavins Point – Yankton Junction 115 kV
8. Meadow Grove – Kelly 230 kV
9. Ft. Randall – Sioux City 230 kV
10. Ft. Randall – Utica Junction 230 kV
11. Neligh East (Antelope) – Hoskins 345 kV
12. Ft Thompson – Grand Prairie 345 kV
13. Axtell – Pauline 345 kV
14. Hastings – Pauline 115 kV ckt 1
15. Hastings – Pauline 115 kV ckt 2

The Short Circuit Analysis was performed to evaluate the fault interrupting capability of existing devices in the area and protection coordination issues following the generation interconnection projects and network upgrades. The results of this analysis showed that no existing protective devices were subject to replacement due to the proposed interconnection projects.

The Stability Analysis was performed to evaluate the impact of the proposed generation interconnection projects and network upgrades on the existing GGS Stability constrained interface in Nebraska. Based on the results of this analysis, the NPPD transmission system with the current planned future projects meets the stability performance requirements for all Planning Event and Extreme Event conditions that were considered in this study.

Overall, the *NPPD DISIS-2015-001-1 Facility Study* documents the performance of the network following the addition of the generation interconnection projects and network upgrades. The Facility Study has documented the transmission plan required for interconnection to the NPPD transmission system and the details of this plan are listed below. There is no generation interconnection capability available until the projects listed below are completed as required.

DISIS-2015-001-1 Interconnection Plan

Interconnection Facilities

- GEN-2015-007: Expand Hoskins 345 kV Substation to accommodate new GI.

$ 5,300,000

- GEN-2015-023: Expand Holt County 345 kV Substation to accommodate new GI.

$ 6,600,000

Network Upgrades

- Hoskins – Neligh (Antelope) 345/115 kV Transmission expansion project
- Gentleman – Thedford - Holt County (R-Project) and Thedford 345/115 kV Transformer project

Previously-identified Required Transmission Upgrades for prior queued requests

- Dixon County 230 kV substation (for GEN-2010-051)
- Upgrade Twin Church-DixonCounty-Hoskins 230kV line
- Antelope 115 kV substation expansion (for GEN-2013-032)
- Upgrade Antelope-County Line-Battle Creek 115 kV line
- Upgrade Meadow Grove-Prairie Breeze 230 kV Gen-Tie line
- Friend 115 kV substation (for GEN-2014-039)
- Rosemont 115 kV substation (for GEN-2008-123N & GEN-2013-002)

1.0 Introduction

In December 2015, NPPD was notified that several generation interconnection requests in the SPP generation interconnection queue had advanced to the facility study stage. These generation interconnection requests were evaluated by SPP in multiple Definitive Interconnection System Impact Studies (DISIS-2015-001, DISIS-2015-001-1). The generation interconnection requests are listed below:

Project	MW	Type	Point-of-Interconnection
GEN-2015-007	+160.0	Wind	Hoskins 345 kV Substation
GEN-2015-023	+300.7	Wind	Holt County 345 kV Substation
	+460.7		

SPP entered into a facility study agreement with each of the generation interconnection customers and subsequently requested that NPPD perform the Facility Study for each request. In response to the SPP request, NPPD has performed a Facility Study for the generation interconnection requests.

This facility study (NPPD-DISIS-2015-001-1) includes a detailed loadflow, stability and short circuit analysis. The Facility Study also includes detailed cost estimates and estimated project schedules for the interconnection and network upgrades identified in the System Impact Study and Facility Study. The System Impact Study did identify several network upgrades required for interconnection of the new generation projects. Both of these generation interconnection requests are contingent upon the completion of the Hoskins-Neligh 345 kV projects and the GGS-Thedford-Holt 345 kV R-project which were previously approved through the SPP ITP processes. The Hoskins-Neligh 345 kV projects are currently under construction and have a completion date of 6/1/2016. The GGS-Thedford-Holt 345 kV R-project is being developed and slightly behind the original project schedule. The current projected in-service date for the R-project is 10/1/2018.

2.0 Study Scope

2.1 Overview

This Facility Study will evaluate the impact of the requested generation interconnection projects on the NPPD transmission system. This study will evaluate generator interconnection requests in the SPP Generator Interconnection Queue studied in the SPP Definitive Interconnection System Impact Study, SPP DISIS-2015-001-1, and progressed to the facilities study stage. The GI projects on the NPPD transmission system included in the DISIS-2015-001-1 study are as follows:

Project	MW	Type	Point-of-Interconnection
GEN-2015-007	+160.0	Wind	Hoskins 345 kV Substation
GEN-2015-023	+300.7	Wind	Holt County 345 kV Substation
	+460.7		

NPPD will perform a Facility Study of the generation interconnection requests that includes a detailed loadflow and short circuit analysis. The facility study will also include stability analysis to assess the impacts of the proposed generation interconnection requests on existing stability constraints (GGS Stability) and potential stability issues highlighted in the System Impact Study. The Facility Study also includes detailed cost estimates and estimated project schedules for the interconnection and network upgrades identified in the System Impact Study and Facility Study. No new network upgrades were identified in the System Impact Study as required for these generation interconnection projects. Both of these generation interconnection requests are contingent upon the completion of the Hoskins-Neligh 345 kV projects and the GGS-Thedford-Holt 345 kV R-project which were previously approved through the SPP ITP processes.

At the time of this facility study, there were several active generation interconnection requests in the SPP GI queue in the Nebraska area. Due to time constraints, this facility study must proceed assuming the following generation interconnection projects and associated network upgrades remain active projects in the SPP GI process. If any of these GI projects or network upgrades withdraw from the SPP GI queue, then a re-study of this DISIS-2015-001-1 facility study will be required. The previously-queued GI projects and network upgrades in the Nebraska area are as follows:

Generation Interconnection Number	MW	CA	Substation	Status
GEN-2010-051	200	NPPD	Dixon County 230kV	IA FULLY EXECUTED/ON SUSPENSION
GEN-2011-027	120	NPPD	Dixon County 230kV	IA FULLY EXECUTED/ON SUSPENSION
GEN-2013-032	204	NPPD	Antelope 115kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2014-013	73.5	NPPD	Meadow Grove 230kV	IA FULLY EXECUTED/COMMERCIAL
GEN-2014-031	35.8	NPPD	Meadow Grove 230kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2014-032	10.2	NPPD	Meadow Grove 230kV	IA PENDING
GEN-2014-039	73.4	NPPD	Friend 115kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2015-007	160	NPPD	Hoskins 345 kV	FACILITY STUDY STAGE
GEN-2015-023	300.7	NPPD	Holt County 345kV	FACILITY STUDY STAGE
GEN-2008-123N	89.7	NPPD	Rosemont 115kV	IA FULLY EXECUTED/CUSTOMER CONTRACT BREACH
GEN-2013-002	25.5	NPPD	Rosemont 115kV	IA FULLY EXECUTED/CUSTOMER CONTRACT BREACH

Previously allocated interconnection facilities & network upgrades

- Dixon County 230 kV substation (for GEN-2010-051)
- Upgrade Twin Church-DixonCounty-Hoskins 230kV line
- Antelope 115 kV substation expansion (for GEN-2013-032)
- Upgrade Antelope-County Line-Battle Creek 115 kV line
- Upgrade Meadow Grove-Prairie Breeze 230 kV Gen-Tie line
- Friend 115 kV substation (for GEN-2014-039)
- Rosemont 115 kV substation (for GEN-2008-123N & GEN-2013-002)

This facility study will assess the new system state with the generation interconnection requests. The facility study will also identify any additional transmission issues that would require mitigation to meet mandatory NERC reliability standards following the addition of the generation interconnection projects and network upgrades. The Facility Study will include the following study phases:

1. Loadflow Analysis
2. Stability Analysis
3. Short Circuit Analysis

The loadflow analysis will be an assessment of the transmission system following the addition of the generation interconnection projects and network upgrades. The loadflow analysis will evaluate the transmission system for compliance with NERC Reliability Standards and identify any thermal and voltage issues that would require mitigation. The stability analysis will evaluate the impacts of the generation interconnection projects on the transmission system and existing stability constraints (GGS Stability). The short circuit analysis will evaluate the impacts of the generation interconnection projects and network upgrades on existing fault currents in the area and determine if the capability of existing fault interrupting devices are adequate.

The intent of the facility study is to perform a detailed assessment of the proposed generation interconnection facility and associated transmission and validate adherence to system reliability criteria. This study will be performed in accordance with NERC Reliability Standards and the criteria set forth under those standards. This facility study will document the required transmission facility interconnection plan for the proposed uprate and will be performed in accordance with the methodologies described in NPPD's Facility Connection Requirements Document.

2.2 Loadflow Analysis

NPPD Transmission Planning will perform a loadflow analysis to screen the steady state performance of the network following the addition of the generation interconnection project and network upgrades. The powerflow models used for the loadflow analysis will be 2015 Series SPP MDWG models. These models will represent expected near-term system conditions with the generation interconnection projects and will represent worst-case seasonal conditions. The powerflow models utilized for the analysis will be:

2016 Winter Peak Case (16W)

The powerflow models will be updated with planned transmission facility additions in the area of the generation interconnection requests. Specifically, the base models will be updated to include the GGS-Thedford-Holt 345 kV project as it was found to be a required network upgrade to accommodate the generation interconnection projects. Also, the models will be re-dispatched to stress west-to-east transfer limitations in western Nebraska and the GGS Stability Interface.

The loadflow analysis will be split into three phases:

Phase 1 : System-wide Single Contingency N-1 Analysis

Phase 2 : System-wide Multiple Element Contingency N-2 Analysis

Phase 3 : Local Area Full N-2 Contingency Analysis

PHASE 1: This Phase is considered a comprehensive single contingency analysis of the entire Nebraska subregion. Every single element rated from 115 kV – 345 kV in the NPPD, OPPD, and LES areas plus ties will be outaged and monitored through activity ACCC. The results of the contingency screening will be assessed and documented. Phase 1 will also further investigate all critical contingencies identified from the ACCC contingency screening. Phase 1 will be utilized to document the performance characteristics of the system in accordance with NERC Reliability Standards.

PHASE 2: This Phase is considered a comprehensive multiple element contingency analysis of the entire Nebraska region. Multiple element contingencies rated from 115 kV – 345 kV will be outaged and monitored through activity ACCC. The multiple element contingencies consist of stuck breaker contingencies and double circuit tower contingencies identified by Nebraska transmission owners and utilized during MRO and SPP screening processes. The results of the contingency screening will be assessed and documented. Phase 2 will also further investigate all critical contingencies identified from the ACCC contingency screening comparison. Phase 2 will be utilized to document the performance characteristics of the system in accordance with NERC Reliability Standards.

PHASE 3: This Phase will evaluate the impacts of worst case independent N-2 double contingency conditions for the local area transmission outlet paths associated with the generation interconnection projects. The purpose of this Phase will be to evaluate sufficient generator outlet transmission capacity for the generation interconnection requests and evaluate potential prior outage limitations.

2.3 Short Circuit Analysis

The purpose of the Short Circuit Analysis will be to evaluate the impacts of the proposed generation interconnection projects on the existing substation equipment fault duty ratings in the area. The substations to be evaluated are those electrically close to the interconnection points of the generation interconnection projects.

The Short Circuit Analysis will include short circuit calculations, an evaluation of the adequacy of existing circuit breaker interrupting ratings and an evaluation of the adequacy of the fault withstand capability of other substation equipment located at the monitored substations. The Short Circuit Analysis will be performed by NPPD Engineering Protection & Control personnel.

2.4 Stability Analysis

The purpose of the Stability Analysis will be to evaluate the impacts of the proposed generation interconnection projects on an existing stability constraint on the NPPD transmission system (GGS Stability). The analysis will evaluate worst-case disturbances impacting stability limitations in western Nebraska. The analysis will also evaluate disturbances and prior outage combinations near the proposed generation interconnection projects to evaluate stability issues highlighted in the System Impact Study.

2.5 Detailed Cost Estimates & Project Schedule

NPPD Engineering, Asset Management, and Project Management departments will review any additional transmission upgrades identified in the SPP DISIS-2015-001-1 facility study. Detailed cost estimates and project schedules will be developed by these groups to implement the proposed transmission upgrades using standard NPPD construction and procurement practices. If any additional transmission upgrades are identified in this facility study, a detailed cost estimate and project schedule for these additional upgrades will be developed and provided as required.

3.0 Model Development

Overview

This study was conducted using Rev 32.2.1 of Power Technology Inc.'s (PTI's) Power System Simulator (PSS/E) software package and the following SPP 2015 Series MDWG powerflow models:

2016 Winter 100% Peak Load Case

The powerflow models were updated to include the generation interconnection projects and network upgrades as well as the latest transmission upgrades documented in the latest regional transmission plans. Specifically, the base models were updated to include the GGS-Thedford-Holt 345 kV project as it was found to be a required network upgrade to accommodate the generation interconnection projects. Also, the models were re-dispatched to stress west-to-east transfer limitations in western Nebraska and the GGS Stability Interface. A base model was established with GGS Eastflow at the 1850 MW transfer level with the projected system topology for 2016 (without the R-Project). The prior-queued wind generation, R-Project, and DISIS-2015-001 wind projects were then added to this model to establish the baseline for this stability analysis.

The following prior-queued generation interconnection projects were included in the base powerflow models:

Generation Interconnection Number	MW	CA	Substation	Status
GEN-2010-051	200	NPPD	Dixon County 230kV	IA FULLY EXECUTED/ON SUSPENSION
GEN-2011-027	120	NPPD	Dixon County 230kV	IA FULLY EXECUTED/ON SUSPENSION
GEN-2013-032	204	NPPD	Antelope 115kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2014-013	73.5	NPPD	Meadow Grove 230kV	IA FULLY EXECUTED/COMMERCIAL
GEN-2014-031	35.8	NPPD	Meadow Grove 230kV	IA FULLY EXECUTED/ON SCHEDULE
GEN-2014-032	10.2	NPPD	Meadow Grove 230kV	IA PENDING
GEN-2014-039	73.4	NPPD	Friend 115kV	IA FULLY EXECUTED/ON SCHEDULE

The proposed future generation interconnection projects were dispatched off-system. The new generation interconnection projects listed below were then added to the models and dispatched at 100%. The total output from the new generation interconnection projects was dispatched off-system.

Generation Interconnection Number	MW	CA	Substation	Status
GEN-2015-007	160	NPPD	Hoskins 345 kV	FACILITY STUDY STAGE
GEN-2015-023	300.7	NPPD	Holt County 345kV	FACILITY STUDY STAGE

Wind Generation Models

Each of the new wind generation interconnection projects were modeled with a +/- 0.95 power factor range with voltage control capability at the designated point-of-interconnection. Some of the new projects may have a larger reactive power range available, but the reactive capability of each generation interconnection project was limited to +/- 0.95 power factor to match the power factor requirements identified in the system impact study. The dynamics models for the new wind projects were standard PSS/E Type 3 WTG models.

4.0 Study Criteria

The following criteria were used for the Steady-State Analysis:

Facility Loading Criteria

Overloads of equipment are defined as greater than 100% of the normal continuous rating (Rate A).

Voltage Criteria

Normal steady-state voltage levels are defined as 0.95 to 1.05 pu. Emergency steady-state voltage levels are defined as 0.90 – 1.10 pu and may be utilized for less than 30 minutes.

The following criteria were used for the Stability Analysis:

Transient Voltage Criteria

Bus voltage excursions outside the band of 0.70 to 1.2 PU any time after the fault is cleared is considered unacceptable.

Damping Criteria

All significant machine rotor angle oscillations must be positively damped and meet the criteria below. The criteria does not apply to bus voltages. The Damping Factor will be calculated from the "Successive Positive Peak Ratio" (SPPR) of the peak-to-peak amplitude of the rotor oscillation. SPPR and the associated Damping Factor will be calculated as:

SPPR = Successive swing amplitude / Previous swing amplitude
Damping Factor = (1 - SPPR) * 100 (in %)

The Damping Criteria are as follows (with increased damping required for higher probability events):

For Disturbances with faults: SPPR (maximum) = 0.95
Damping Factor (minimum) = 5%

For Line Trips: SPPR (maximum) = 0.90
Damping Factor (minimum) = 10%

5.0 Loadflow Analysis

5.1 Phase 1 Results (System-wide N-1 Screening)

PSS/E activity ACCC was used as a screening tool on each of the base cases to identify those contingencies which deserve closer study. ACCC analyzed the system by sequentially taking each transmission element greater than 100kV in the NPPD, OPPD, and LES areas out of service. Transmission facilities in the NPPD, OPPD, and LES areas were then monitored for violations of loading or bus voltage criteria. Contingencies which resulted in facility loadings or bus voltages outside of acceptable limits will be discussed in the summary of each case. The Phase 1 ACCC analysis is performed to assess the performance of the transmission system following the addition of the generation interconnection projects and proposed new network upgrades according to NERC standards.

Phase 1 analysis further addressed contingencies flagged in the screened ACCC run with additional AC powerflow analysis as required. In the NPPD area, there are loadflow solution issues associated with voltage regulation bandwidths. Consequently, most of the capacitors and reactors are modeled as fixed mode switched shunts, which must be manually switched to achieve optimal voltage profiles.

Powerflow activities VCHK and RATE were used to identify voltage and loading issues in the NPPD, OPPD, and LES areas for the full AC solution contingency runs. Activity VCHK produced a listing of those buses whose voltage magnitude was greater than 1.05 PU, followed by a listing of buses whose voltage was less than 0.95 PU. Activity RATE reported any branch whose current loading, including line charging and line connected shunt components, exceeded the specified percentage of RATE A.

<u>Phase 1 – 2016 Winter Peak</u>

System Intact Results:

There were no impacted transmission facility overloads or bus voltages outside of limits under system intact or base case conditions.

N-1 Contingency Results:

There were three transmission facility overloads that were discovered under N-1 conditions. Two of the overloads are on WAPA transmission facilities that would need further review to determine the required mitigation or network upgrades.

Facility	Contingency	Rating (MVA)	Loading
Ft Randall-Utica Junction 230kV	Kelly-MeadowGrove 230kV	320	107.0%[B]
Holt County-Gr Island 345kV	Gr Prairie-Ft Thompson 345kV	720	101.7%[B]
GGS-Ogallala 230kV	GGS-Keystone 345kV	320	100.8%[A]

A - Loading mitigated through implementation of Sidney DC RAS
B – WAPA-owned Facility

There were no impacted bus voltages discovered outside of limits under N-1 conditions.

Phase 1 Results Summary

The Phase 1 screening did not identify any significantly impacted NPPD facilities for system intact conditions. Two facilities in the WAPA system were found to overload for N-1 conditions. SPP and WAPA will need to assess and address these issues to determine the required mitigations or network upgrades. The Phase 1 screening did not discover any impacted bus voltages outside of limits for system intact or N-1 conditions.

5.2 Phase 2 Results (System-wide Multiple Element Screening)

PSS/E activity ACCC was used as a screening tool on each of the base cases to identify those multiple element contingencies which deserve closer study. ACCC analyzed the system by sequentially taking select multiple element contingencies in the Nebraska area out-of-service. Transmission facilities in the NPPD, OPPD, and LES areas were then monitored for violations of loading or bus voltage criteria. The Phase 2 ACCC analysis is performed to assess the performance of the transmission system following the addition of the generation interconnection projects and proposed new network upgrades according to NERC standards.

Phase 2 – 2016 Winter Peak

There were nine transmission facility overloads that were discovered under multiple element contingency conditions. Three of the overloads are on WAPA transmission facilities that would need further review to determine the appropriate mitigation.

Facility	Contingency	Rating (MVA)	Loading
Ft Randall-Utica Junction 230kV	P22:230:NPPD:COLMBUS4:NORTH	320.0	107.7%[B]
Holt County-Gr Island 345kV	P42:345:NPPD:BKR-SW-3308	720.0	101.9%[B]
GI 345/230 KU1B	P42:115:NPPD:BKR-GRI-1396	250.0	102.2%[B]
GGS 345/230 T1	P42:345:NPPD:BKR-GGS-3316	336.0	155.9%
GGS 345/230 T2	P42:345:NPPD:BKR-GGS-3304	336.0	105.5%
BrokenBow-LoupCity 115kV	P42:230:NPPD:BKR-CC-2204	120.0	104.2%
Cozad-Gothenburg 115kV	P42:230:NPPD:BKR-CC-2208	78.0	101.2%
Hastings-Pauline 115kV	P71:345:NPPD:TWR-PA-PH	121.0	108.5%
GGS-Ogallala 230kV	P71:345:NPPD:TWR-GK-PS	320.0	128.5%[A]

A - Loading mitigated through implementation of Sidney DC RAS
B – WAPA-owned Facility

```
P22:230:NPPD:COLMBUS4:NORTH     : OPEN LINE FROM BUS 640133 [COLMBUS4    230.00] TO BUS 640343 [SHELCRK4    230.00] CKT 1
                                  OPEN LINE FROM BUS 640133 [COLMBUS4    230.00] TO BUS 640540 [MEADOWGROVE4230.00] CKT 1
                                  OPEN LINE FROM BUS 640133 [COLMBUS4 230.00] TO BUS 640134 [KELLY  7  115.00] TO BUS 640135 [COLMBS19    13.200]
                                  OPEN LINE FROM BUS 640133 [COLMBUS4    230.00] TO BUS 640126 [E.COL. 4    230.00] CKT 1
                                  OPEN LINE FROM BUS 640133 [COLMBUS4    230.00] TO BUS 640131 [COLMB.W4    230.00] CKT 1
P42:345:NPPD:BKR-SW-3308        : TRIP LINE FROM BUS 640374 [SWEET W3    345.00] TO BUS 652571 [GR ISLD3    345.00] CKT 1
                                  TRIP LINE FROM BUS 640183 [GENTLMN3    345.00] TO BUS 640374 [SWEET W3    345.00] CKT 1
P42:115:NPPD:BKR-GRI-1396       : TRIP LINE FROM BUS 652571 [GR ISLD3    345.00] TO BUS 640271 [MCCOOL 3    345.00] CKT 1
                                  TRIP LINE FROM BUS 652571 [GR ISLD3 345.00] TO BUS 640200 [GR ISLD4    230.00] TO BUS 652314 [GR ISL19    13.800]
P42:345:NPPD:BKR-GGS-3316       : TRIP LINE FROM BUS 640183 [GENTLMN3 345.00] TO BUS 640252 [KEYSTON3    345.00] CKT 1
                                  TRIP LINE FROM BUS 640183 [GENTLMN3 345.00] TO BUS 640184 [GENTLMN4    230.00] TO BUS 643066 [GENTLEMANT2913.800]
P42:345:NPPD:BKR-GGS-3304       : TRIP LINE FROM BUS 640183 [GENTLMN3 345.00] TO BUS 640011 [GENTLM2G    24.000] CKT 1
                                  TRIP LINE FROM BUS 640183 [GENTLMN3 345.00] TO BUS 640184 [GENTLMN4    230.00] TO BUS 640185 [G.GENT19    13.800]
P42:230:NPPD:BKR-CC-2204        : TRIP LINE FROM BUS 640093 [C.CREEK4 230.00] TO BUS 640330 [RIVERDL4    230.00] CKT 1
                                  TRIP LINE FROM BUS 640093 [C.CREEK4 230.00] TO BUS 640102 [CANADAY4    230.00] CKT 1
                                  TRIP LINE FROM BUS 640102 [CANADAY4 230.00] TO BUS 640103 [CANADAY7    115.00] TO BUS 643029 [CANADAY T4 913.800]
P42:230:NPPD:BKR-CC-2208        : TRIP LINE FROM BUS 640093 [C.CREEK4 230.00] TO BUS 640286 [N.PLATT4    230.00] CKT 1
                                  TRIP LINE FROM BUS 640093 [C.CREEK4 230.00] TO BUS 640094 [C.CREEK7    115.00] TO BUS 643026 [CRKDCREEKT1913.800]
P71:345:NPPD:TWR-PA-PH          : TRIP LINE FROM BUS 640312 [PAULINE3    345.00] TO BUS 640065 [AXTELL 3    345.00] CKT 1
                                  TRIP LINE FROM BUS 640313 [PAULINE7    115.00] TO BUS 640215 [HASTING7    115.00] CKT 1
P71:345:NPPD:TWR-GK-PS          : TRIP LINE FROM BUS 659808 [PAXTON 7    115.00] TO BUS 640370 [SUTHLND7    115.00] CKT 1
                                  TRIP LINE FROM BUS 640183 [GENTLMN3    345.00] TO BUS 640252 [KEYSTON3    345.00] CKT 1
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There were no impacted bus voltages discovered outside of limits under multiple element conditions.

Phase 2 Results Summary

The Phase 2 screening identified five facilities that were loaded in excess of facility ratings for multiple element contingencies. Each of the contingencies and overloaded facilities involve HV (non-EHV) facilities so post-contingency mitigation involving curtailment of firm transmission and/or load shed may be utilized to mitigate these issues. Three facilities in the WAPA system were found to overload for multiple element contingency conditions. SPP and WAPA will need to assess and address these issues as necessary. The Phase 2 screening did not discover any impacted bus voltages outside of limits for multiple element contingency conditions.

5.3 Phase 3 Results (N-2 Contingency Analysis)

This phase of the analysis evaluated a select set of independent N-2 contingencies in the local area of the generation interconnection projects. PSS/E activity ACCC was used as a screening tool on the 2016 Winter Peak model with the generation interconnection projects to identify those contingencies which deserve closer study. ACCC analyzed the system by sequentially taking out all independent N-2 contingencies in the local area and monitoring facilities in the NPPD, OPPD, and LES areas for violations of loading or bus voltage criteria. A total of 2178 independent N-2 contingencies were included in this contingency analysis.

Phase 3 – 2016 Winter Peak – Maximum Generation (Independent N-2)

There were a number of overloaded transmission facilities discovered in the monitored study areas in the independent N-2 ACCC analysis of the 2016 Winter Peak Maximum Generation case with the generation interconnection addition. Prior outage generation restrictions would be required to ensure the transmission system is able to be operated reliably when certain transmission lines are taken out-of-service. The generation interconnection project curtailments will be subject to "first on, last off" curtailment priorities and operating guides will need to be developed to ensure the transmission system is operated in accordance with mandatory reliability standards. Based on a review of the N-2 contingencies that were flagged in the ACCC analysis, the following list was prepared of transmission facilities that would need detailed prior outage review or operating guides established if all the projects are developed. These transmission facilities were found to be part of an N-2 contingency pairing that resulted in a facility overload on the NPPD transmission system.

Limiting Prior Outage Facilities

1. Neligh East (Antelope) – Hoskins 345 kV
2. Neligh East (Antelope) 345/115 kV Transformer
3. Neligh East (Antelope) – County Line 115 kV
4. Gavins Point – Bloomfield 115 kV
5. Gavins Point – Hartington 115 kV
6. Gavins Point – Spirit Mound 115 kV
7. Gavins Point – Yankton Junction 115 kV
8. Meadow Grove – Kelly 230 kV
9. Ft. Randall – Sioux City 230 kV
10. Ft. Randall – Utica Junction 230 kV
11. Neligh East (Antelope) – Hoskins 345 kV
12. Ft Thompson – Grand Prairie 345 kV
13. Axtell – Pauline 345 kV
14. Hastings – Pauline 115 kV ckt 1
15. Hastings – Pauline 115 kV ckt 2

Phase 3 Results Summary

There were several independent N-2 contingencies that resulted in overloads and would require prior-outage generation limitations to mitigate the identified issues if all the proposed projects are developed.

6.0 Short Circuit Study

6.1 Model Development

Computer Programs

The Aspen OneLiner software program was utilized to perform short circuit simulations and studies on the transmission system. Where elements were added to the short-circuit model, best estimates for impedance parameters were used based on available data and typical modeling practices. Short-circuit calculation options used were as follows:

- Flat voltage profile with V(pu) = 1.0
- Generator Impedance = Subtransient
- Ignore loads, transmission line G+jB, and shunts with positive sequence values

OneLiner was used to calculate three-phase (3PH) and single-line-to-ground (SLG) system-intact bus fault currents for all system buses associated with interrupting devices being evaluated in this study. For devices that the full bus fault current approached or exceeded the device's interrupting rating, more detailed fault calculations were done, calculating the maximum phase current through the breaker for close-in faults, close-in faults with the remote end open, and bus faults with all other branches to the bus open. The maximum phase current of these faults was recorded. For comparison with the breaker interrupting ratings, maximum phase current was multiplied by a factor of 1.05 to account for the possibility of the system operating at up to the maximum normal operating voltage of 1.05 per-unit.

Base System Model Additions ("Base Case")

The base system model used by the transmission system protection department as of January 6, 2016 was used as the starting point for the short-circuit model used for this study. The base system model included all projects that were in-service at the time the model was copied. All Nebraska-area generation in the short-circuit model was enabled in order to provide maximum short-circuit current. For the study base case, planned system upgrades in the area of the studied projects and prior-queued large generator interconnections expected to be in-service prior to the projects being studied were added to the base case model. The following table lists the prior-queued large generator interconnections that were added to the base model for this study.

Prior Queued Large Generator Interconnections

Queue Designation	Proposed POI	Capacity (MW)
GEN-2008-123N GEN-2013-014	Rosemont 115 kV (New substation)	115.2
GEN-2010-051	Wakefield 230 kV (New substation)	200
GEN-2011-027	Wakefield 230 kV (New substation)	120
GEN-2014-013	Prairie Breeze 230 kV	73.5
GEN-2013-008	Steele City 115 kV (Add to existing 34.5 kV collector bus)	1.2
GEN-2013-032	Antelope 115 kV (Expand new substation)	204
GEN-2014-004	Steele Flats 115 KV (Add to existing 34.5 kV collector bus)	4
GEN-2013-002	New substation tapping L1197 Sheldon – SW 7th & Bennett	50.6
GEN-2013-019	New substation tapping L1197Sheldon – SW 7th & Bennett	73.6
GEN-2014-031	Prairie Breeze 230 kV (Add to existing 230 kV bus)	35.8
GEN-2014-032	Prairie Breeze 230 kV (Add to existing 34.5 kV collector bus)	10.2
GEN-2014-039	Friend 115 kV Substation	73.4

Along with the prior-queued large generator interconnections, system upgrades previously identified to accommodate the prior-queued projects were added to the study model. The upgrades previously identified included the following additions:

- Antelope – Tilden – Battle Creek 115 kV line upgrade

In addition to the prior-queued large generator interconnections, planned system upgrades in the area of the studied projects were added to the base model. For this study, the upgrades associated with the Antelope 115 kV – 345 kV substation were included in the model, including the four re-routed 115 kV lines into the new Antelope Substation, the one new 345 kV line from Hoskins to Antelope, and a new 345 kV – 115 kV auto transformer at the new Antelope Substation. The planned 345 kV line from GGS – Thedford – Holt County was included with a 345 – 115 kV tie transformer at Thedford 115 kV. The planned 115 kV line from Ord to Broken Bow Wind/Muddy Creek substation was included.

Model Additions for Projects Being Studied ("Study Case")

The base-case study model was modified to include the new generation interconnections being considered in this study as well as the system upgrades identified to accommodate this additional generation. The following table lists the large generator interconnections that were added to the study-case model for this study.

Large Generator Interconnections Added to Study Case

Queue Designation	Proposed POI	Capacity (MW)
GEN-2015-007	Hoskins 345 kV Substation	160
GEN-2015-023	Holt County 345 kV Substation	300.7

No network upgrades associated with the generator interconnections being studied were included with this study.

6.2 Study Methodology

Circuit breaker, circuit switcher, and fuse ratings were identified by querying NPPD's SAP equipment database and extracting equipment data including short-circuit ratings. Breaker ratings given on an asymmetrical (total current) basis were converted to symmetrical current ratings using an assumed maximum system operating voltage of 1.05 per unit.

The calculated short-circuit current at the equipment bus was extracted from the short-circuit results from Aspen OneLiner and compared against the interrupting device interrupting rating. It is recommended that all equipment be replaced if it is found to be at or above 95% of its interrupting rating and seeing an increase of 1% or more in its interrupting duty as a result of the studied projects.

6.3 Results

No devices were found to be above 95% of their interrupting rating or short-circuit capability with an increase of 1% due to the addition of the projects considered in this study.

7.0 Stability Analysis

7.1 Model

The stability case was created from the 2016 Winter Peak power flow base case from the 2015 Series SPP MDWG dynamics package. The power flow base case was re-dispatched western Nebraska resources to maximum output with the various western NE/SD DC ties flowing at maximum capacity from west to east. The net generation and DC tie dispatch levels are listed below:

GGS #1	=	678.0 MW
GGS #2	=	700.0 MW
Laramie River Station #1	=	570.0 MW
Sidney DC West-to-East	=	200.0 MW
Stegall DC West-to-East	=	110.0 MW
Rapid City DC West-to-East	=	200.0 MW
Kingsley Hydro #1	=	50.0 MW

Additional wind generation to the north and south of NPPD was dispatched to provide a worst-case system bias of west to east across the NPPD system and establish a GGS Eastflow transfer level of 1850 MW. Next, additional prior queued wind generation resources in eastern Nebraska were added to the base model as well as the R-project (GGS-Thedford-Holt County 345 kV). Finally, the new DISIS-2015-001 generation interconnection projects at Hoskins and Holt County were added to the base model. The following lists the Nebraska area wind generation dispatched in the base model.

GI #	MW	Substation or Line
GEN-2003-021N	59.4	Ainsworth Wind Tap 115kV
GEN-2006-020N	42.0	Bloomfield 115kV
GEN-2006-037N1	75.0	Broken Bow 115kV
GEN-2006-038N005	80.0	Broken Bow 115kV
GEN-2006-038N019	80.0	Petersburg North 115kV
GEN-2006-044N	40.5	North Petersburg 115kV
GEN-2007-011N08	81.0	Bloomfield 115kV
GEN-2008-086N02	201.0	Meadow Grove 230kV
GEN-2010-051	200.0	Tap Twin Church - Hoskins 230kV
GEN-2011-018	73.6	Steele City 115kV
GEN-2011-027	120.0	Tap Twin Church - Hoskins 230kV
GEN-2013-008	1.2	Steele City 115kV
GEN-2013-032	204.0	Neligh 115kV
GEN-2014-013	73.5	Meadow Grove (GEN-2008-086N2 Sub) 230kV
GEN-2014-031	35.8	Meadow Grove 230kV
GEN-2015-007	160.0	Hoskins 345 kV
GEN-2015-023	300.7	Holt County 345kV substation
	1367.0	prior-queued DISIS-2015-001
	460.7	included in DISIS-2015-001
	1827.7	Total Wind

7.2 Results (P1-P7 and Extreme Events)

To assess the impact of the generation interconnection projects, a number of Planning Event and Extreme Event faults were evaluated on the base model. Localized faults near the interconnection locations were considered as well as worst-case faults for the GGS Stability Interface. The stability simulations performed are listed in the table titled, *Disturbance Code Description and Summary Results*. The list of contingencies was developed in accordance with the methodologies described previously in this report. Summary of findings for the disturbances applied in this study can be found in the table. All the NPPD area contingencies listed in the table were performed on the base model. The complete study results are available upon request subject to CEII restrictions. Worst-case critical disturbances that are expected to produce more severe system impacts on the NPPD transmission system were simulated in the stability analysis included in this assessment. Disturbances applicable to NERC Standard TPL-001-4 demonstrated a stable system response with acceptable transient voltage swings for all Planning Events (P1-P7) and Extreme Events that were evaluated. A total of 53 separate disturbance runs were performed for this stability analysis.

7.3 Stability Analysis Summary

Based on the results of this analysis, the NPPD transmission system meets the stability performance requirements for all Planning Event and Extreme Event conditions that were considered in this study.

FAULT CODE	NERC CATEGORY	FAULT DESCRIPTION	2016 WIPK	
			STABILITY RESULTS	VOLTAGE RESULTS
2008	P1.2	3PH FAULT ON GENTLMN4-N.PLATT4	STABLE	NO TVV
2014	P1.2	3PH FAULT ON HOSKINS4-TWIN CH4	STABLE	NO TVV
2016	P1.2	3PH FAULT ON TWIN CH4-SIOUXCY4	STABLE	NO TVV
2018	P1.2	3PH FAULT ON MEADOWGROVE4-PR BRZ 4	STABLE	NO TVV
2019	P1.2	3PH FAULT ON MEADOWGROVE4-FTRANDL4	STABLE	NO TVV
3001	P1.2	3PH FAULT ON POSTROCK7-AXTELL 3	STABLE	NO TVV
3002	P1.2	3PH FAULT ON MINGO 7-REDWILO3	STABLE	NO TVV
3004	P1.2	3PH FAULT ON RAUN 3-HOSKINS3	STABLE	NO TVV
3005	P1.2	3PH FAULT ON AXTELL 3-PAULINE3	STABLE	NO TVV
3006	P1.2	3PH FAULT ON AXTELL 3-SWEET W3	STABLE	NO TVV
3007	P1.2	3PH FAULT ON COLMB.E3-SHELCRK3	STABLE	NO TVV
3008	P1.2	3PH FAULT ON COLMB.E3-NW68HOLDRG3	STABLE	NO TVV
3010	P1.2	3PH FAULT ON GENTLMN3-KEYSTON3	STABLE	NO TVV
3011	P1.2	3PH FAULT ON GENTLMN3-REDWILO3	STABLE	NO TVV
3012	P1.2	3PH FAULT ON GENTLMN3-SWEET W3	STABLE	NO TVV
3013	P1.2	3PH FAULT ON GENTLMN3-SWEET W3	STABLE	NO TVV
3014	P1.2	3PH FAULT ON HOSKINS3-SHELCRK3	STABLE	NO TVV
3015	P1.2	3PH FAULT ON HOSKINS3-ANTELOPE 3	STABLE	NO TVV
3018	P1.2	3PH FAULT ON MCCOOL 3-GR ISLD3	STABLE	NO TVV
3019	P1.2	3PH FAULT ON MOORE 3-PAULINE3	STABLE	NO TVV
3020	P1.2	3PH FAULT ON SWEET W3-GR ISLD3	STABLE	NO TVV
3021	P1.2	3PH FAULT ON HOLT.CO3-THEDFRD3	STABLE	NO TVV
3022	P1.2	3PH FAULT ON HOLT.CO3-GRPRAR1-LNX3	STABLE	NO TVV
3023	P1.2	3PH FAULT ON HOLT.CO3-GR ISLD3	STABLE	NO TVV
3024	P1.2	3PH FAULT ON GENTLMN3-THEDFRD3	STABLE	NO TVV
3025	P1.2	3PH FAULT ON GRPRAR2-LNX3-FTTHOM2-LNX33	STABLE	NO TVV
2020	P1.2	3PH FAULT ON HOSKINS4-G10-51T	STABLE	NO TVV
2021	P1.2	3PH FAULT ON G10-51T-TWIN CH4	STABLE	NO TVV
4009	P1.3	3PH FAULT ON HOSKINS T1	STABLE	NO TVV
4023	P1.3	3PH FAULT ON HOSKN T4	STABLE	NO TVV
4029	P1.3	3PH FAULT ON ANTELOPE T1	STABLE	NO TVV
4033	P1.3	3PH FAULT ON GGS T2	STABLE	NO TVV
4034	P1.3	3PH FAULT ON GI KU3A	STABLE	NO TVV
4035	P1.3	3PH FAULT ON HOSKINS T2	STABLE	NO TVV
4036	P1.3	3PH FAULT ON SHELLCREEKT1	STABLE	NO TVV

FAULT CODE	NERC CATEGORY	FAULT DESCRIPTION	2016 WIPK	
			STABILITY RESULTS	VOLTAGE RESULTS
7154	P4.2	SLG Fault on GENTLMN3-SWEET W3; Delayed Clear; GENTLMN3-THEDFRD3	STABLE	NO TVV
7005	P4.2	SLG Fault on GENTLMN3-SWEET W3; Delayed Clear; GENTLMN3-REDWILO3	STABLE	NO TVV
7008	P4.2	SLG Fault on GENTLMN3-KEYSTON3; Delayed Clear; GGS T2	STABLE	NO TVV
7017	P4.2	SLG Fault on GENTLMN4-N.PLATT4; Delayed Clear; N.PLATT4-GENTLMN4	STABLE	NO TVV
7020	P4.2	SLG Fault on GENTLMN4-OGALALA4; Delayed Clear; GGS T2	STABLE	NO TVV
7071	P4.2	SLG Fault on HOSKINS3-SHELCRK3; DELAYED Clear; HOSKINS T4	STABLE	NO TVV
7072	P4.2	SLG Fault on HOSKINS3-SHELCRK3; DELAYED Clear; HOSKINS T2	STABLE	NO TVV
7073	P4.2	SLG Fault on HOSKINS3-RAUN 3; DELAYED Clear; HOSKINS T2	STABLE	NO TVV
7074	P4.2	SLG Fault on HOSKINS3-RAUN 3; DELAYED Clear; HOSKINS T4	STABLE	NO TVV
7164	P4.2	SLG Fault on HOLT.CO3-GRPRAR1-LNX3; DELAYED Clear; HOLT.CO3-GR ISLD-LNX3	STABLE	NO TVV
7165	P4.2	SLG Fault on HOLT.CO3-GR ISLD-LNX3; DELAYED Clear; HOLT.CO3-THEDFRD3	STABLE	NO TVV
7012	P7.1	SLG Fault on GENTLMN3-SWEET W3 and GENTLMN3-REDWILO3 Double Circuit	STABLE	NO TVV
7024	P7.1	SLG Fault on GENTLMN4-N.PLATT4 and GENTLMN4-N.PLATT4 Double Circuit	STABLE	NO TVV
7077	P7.1	SLG Fault on HOSKINS3-SHELCRK3 and MADISON7-NORFOLK7 Double Circuit	STABLE	NO TVV
7078	P7.1	SLG Fault on HOSKINS3-SHELCRK3 and HOSKINS7-NORFOLK7 Double Circuit	STABLE	NO TVV
7156	Extreme Event	SLG Fault on GENTLMN3-SWEET W3 and GENTLMN3-SWEET W3 Cross Point	STABLE	NO TVV
7160	Extreme Event	SLG Fault on GRPRAR2-LNX3-FTTHOM2-LNX33 and MEADOWGROVE4-FTRANDL4 Cross Point	STABLE	NO TVV
7161	Extreme Event	SLG Fault on HOSKINS3-RAUN 3 and HOSKINS4-TWIN CH4 Cross Point	STABLE	NO TVV

8.0 Detailed Cost Estimates & Project Schedule

NPPD's Engineering, Asset Management, and Project Management groups have reviewed the list of interconnection facility upgrades that are required for DISIS-2015-001-1 projects. Detailed cost estimates have been prepared for the facility upgrades that were identified in the system impact study for the requests. The prepared cost estimates are budgetary level estimates (+75%/-25%) and assume implementation of standard NPPD construction and procurement practices. The cost estimates for the interconnection facilities and network upgrades are below:

- GEN-2015-007: Expand Hoskins 345 kV Substation to accommodate new GI.

$ 5,300,000

- GEN-2015-023: Expand Holt County 345 kV Substation to accommodate new GI.

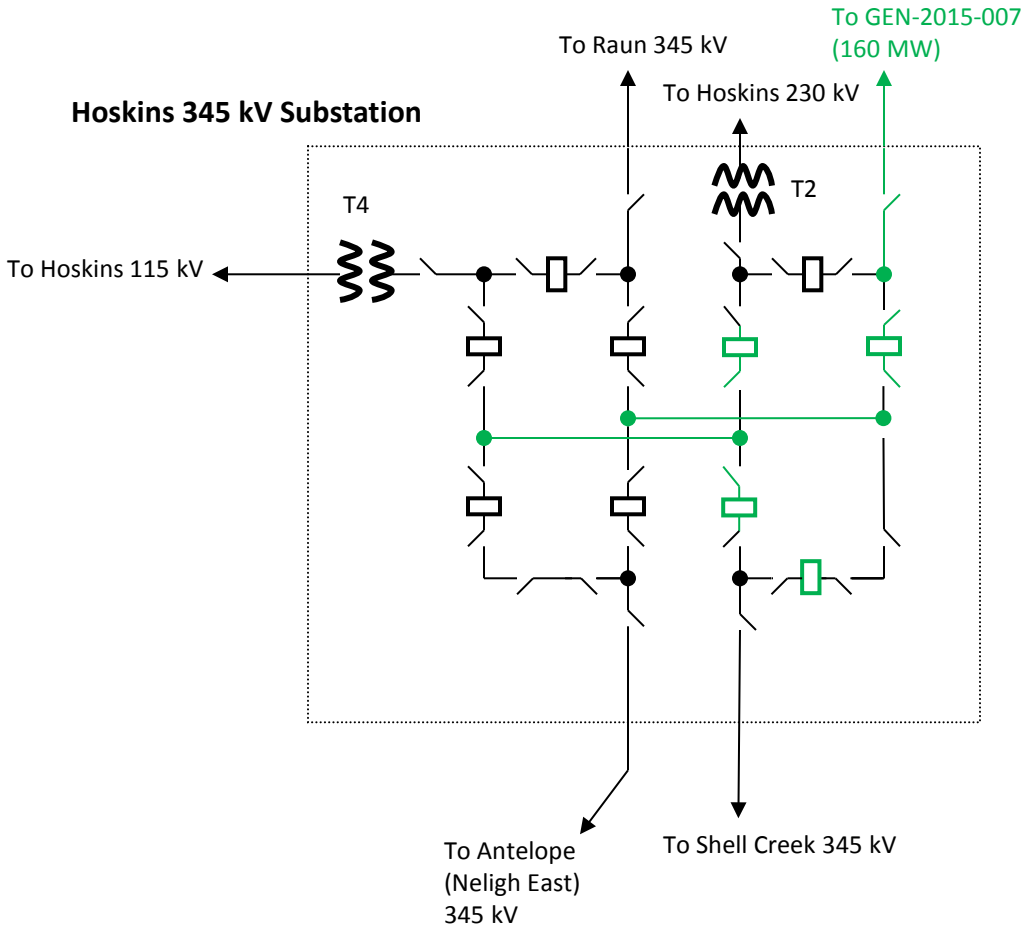
$ 6,600,000

The results of DISIS-2015-001-1 documented that these two requests are contingent on the completion of the following previously allocated required network upgrades:

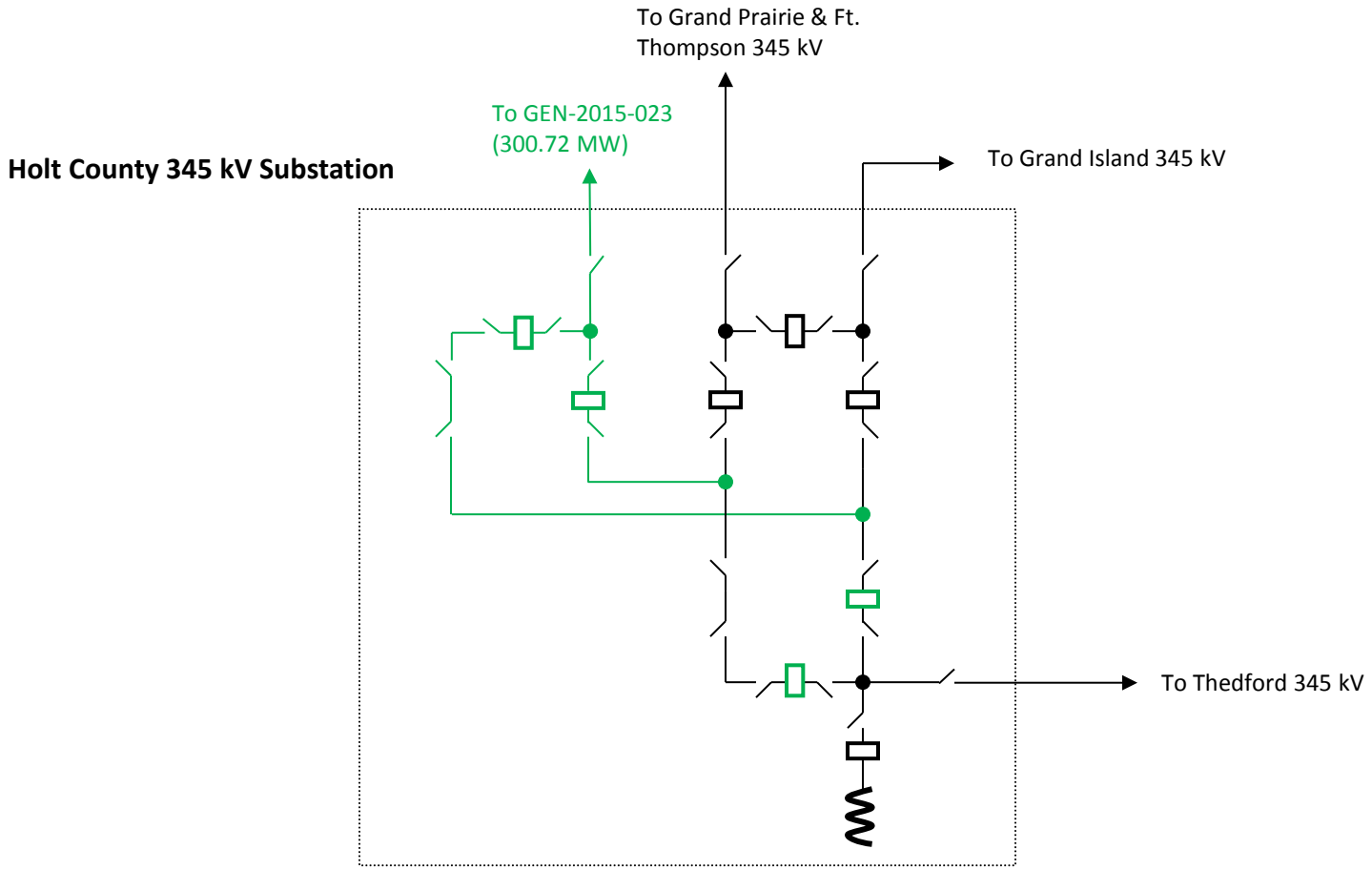
- Hoskins – Neligh (Antelope) 345/115 kV Transmission expansion project
- Gentleman – Thedford - Holt County (R-Project) and Thedford 345/115 kV Transformer project

The substation one-line diagrams highlighting the required facility upgrades for each generator interconnection are on the following pages. NPPD will work with the generation interconnection projects to develop project schedules for the interconnection facilities and network upgrade projects listed above during the development of the generation interconnection agreement. Typical implementation schedules for new transmission lines (≥ 115 kV) are roughly 4 years or longer to accommodate the public routing process and construction schedules. Substation additions require less land acquisition and typically can be implemented in less time or approximately 2-3 years. Project schedule details will be further discussed in the development of the generator interconnection agreement (GIA) and the milestones associated with the generation interconnection projects.

It should also be noted that the interconnection plan for the DISIS-2015-001-1 generation projects are dependent on the transmission upgrades/additions that are required as part of the previous SPP DISIS GI Studies and SPP ITP Studies. If there are any modifications to these previous studies and related upgrades, then the interconnection plan for the DISIS-2015-001-1 projects could be affected. There is no interconnection capacity for the DISIS-2015-001-1 projects without the previously identified upgrades.



- DISIS-2015-001 Interconnection Facilities for GEN-2015-007


Holt County 345 kV Substation
To Grand Prairie & Ft. Thompson 345 kV
To GEN-2015-023 (300.72 MW)
To Grand Island 345 kV
To Thedford 345 kV

B: Affected System Impact Study Report

See next page for MISO Affected System Impact Study Report

MISO SPP DISIS-2015-001

Affected System Impact Study

May 2, 2016

MISO
720 City Center Drive
Carmel
Indiana - 46032
http://www.misoenergy.org

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY 4

2. STUDY METHODOLOGY & ASSUMPTIONS 4

2.1. STUDY CRITERIA 4

2.2. CONTINGENCY CRITERIA 5

2.3. MONITORED ELEMENTS 5

2.4. MODEL DEVELOPMENT 6

2.5. STUDY ASSUMPTIONS 6

3. STEADY STATE ANALYSIS 7

3.1. NEAR TERM (2017) ANALYSIS 7

3.2. OUT YEAR(2024) ANALYSIS 7

4. CONCLUSION 8

5. APPENDIX A 8

TABLE OF TABLES

Table 1-1 List of SPP Group Generation Interconnection Projects 4

Table 1-2 Constrained Facility and Mitigation Costs 4

Table 3-1 Near-Term Constraint 7

Table 3-2 Out-Year Constraint 7

Table 5-1 SPP High Queued Projects 8

1. Executive Summary

This report documents the Affected System Impacts of three projects in the SPP generator interconnection queue on the Midcontinent Independent System Operator ("MISO") transmission system. The projects are listed in Table 1-1.

Table 1-1 List of SPP Group Generation Interconnection Projects

GI_Number	Capacity	Type	Service	POI_Bus
GEN-2015-005	200.1	Wind	ER	Tap Nebraska City - Sibley 345kV
GEN-2015-007	160	Wind	ER	Hoskins 345kV
GEN-2015-023	300.7	Wind	ER/NR	Holt County 345kV

The total cost of network upgrades is listed in Table 1-2 as shown below. The costs for Network Upgrades are planning level estimates and subject to be revised in the facility studies.

Table 1-2 Constrained Facility and Mitigation Costs

Project	Facility Owner	Constraint	Mitigation Required	Cost Estimate
G007	MEC	635200 RAUN 3 345 - 645451 S3451 3 345 1	Replace the wave trap at Raun and adjust relay settings. This will increase MidAmerican's rating of its section of the Raun-Ft. Calhoun line to above 1107 MVA for a new MidAmerican rating of 1195 MVA	$50,000

2. Study Methodology & Assumptions

2.1. Study Criteria

All interconnection requirements are based on the applicable MISO Interconnection Planning Criteria and in accordance with the NERC Reliability Standards. Steady state violations of applicable planning criteria were attributed to the SPP group generation requests by the usage of MISO injection criteria, and applicable local planning criteria.

2.2. Contingency Criteria

A comprehensive list of contingencies was considered for steady-state analysis:

- NERC Category A with system intact (no contingencies)
- NERC Category B contingencies
  - Single element outages, at buses with a nominal voltage of 69 kV and above in the following areas: CWLD (area 333), AMMO (area 356), AMIL (area357), WEC (area 295), WEC MI (area 296), XCEL (area 600), MP (area 608),SMMPA (area 613), GRE (area 615), OTP (area 620), ITCM (area 627),MPW (area 633), MEC (area 635), MDU (area 661), MHEB (area 667), DPC(area 680), ALTE (area 694), WPS (area 696), MGE (area 697), UPPC (area 698), CE(area 222), NPPD (area 640), OPPD (area 645), LES (area 650),WAPA (area 652), AECI (area 330), MIPU(area 540), KCPL (area 541),KACY (area 542), INDN (area 545).
  - Multiple-element outages initiated by a fault with normal clearing such as multi-terminal lines, in the Dakotas, Illinois, Iowa, Manitoba, Minnesota, Missouri, and Wisconsin.
- NERC Category C
  - Selected NERC Category C events in the study region of the Dakotas, Illinois, Iowa, Manitoba, Minnesota, Missouri, and Wisconsin.

2.3. Monitored Elements

Table 2-1 Monitored Area

Area #	Voltage	Area ID	Area Name
295	69kV and above	WEC	Wisconsin Electric Power Company (ATC)
296	69kV and above	MIUP	Michigan Upper Peninsula (ATC)
333	69kV and above	CWLD	Columbia, MO Water and Light
356	100kV and above	AMMO	Ameren Missouri
357	100kV and above	AMIL	Ameren Illinois
600	69kV and above	XEL	Xcel Energy North
608	69kV and above	MP	Minnesota Power & Light
613	69kV and above	SMMPA	Southern Minnesota Municipal Power Association
615	69kV and above	GRE	Great River Energy

620	69kV and above	OTP	Otter Tail Power Company
627	69kV and above	ALTW	Alliant Energy West
633	69kV and above	MPW	Muscatine Power & Water
635	69kV and above	MEC	MidAmerican Energy
661	69kV and above	MDU	Montana-Dakota Utilities Co.
680	69kV and above	DPC	Dairyland Power Cooperative
694	69kV and above	ALTE	Alliant Energy East (ATC)
696	69kV and above	WPS	Wisconsin Public Service Corporation (ATC)
697	69kV and above	MGE	Madison Gas and Electric Company (ATC)
698	69kV and above	UPPC	Upper Peninsula Power Company (ATC)

2.4. Model Development

The following MTEP base case load profiles were used for the study:

- 2017 Shoulder
- 2017 Summer Peak
- 2024 Shoulder
- 2024 Summer Peak

The study cases were built by adding and dispatching the appropriate queue projects to the base cases. The detail of each SPP interconnection request is listed in Table 1-1. The study projects were dispatched per MISO criteria to the entire SPP footprint, where generators were scaled in proportion to the available reserve.

2.5. Study Assumptions

This affected system impact study was conducted with all the participating generators operating together as a group. Analysis was not performed on individual generating units or subsets of the generating units unless specifically noted otherwise. Higher queued SPP projects were modeled as outlined in Appendix A of the report. The results obtained in this analysis may change if any of the data or assumptions made during the development of the study models is revised.

3. Steady State Analysis

3.1. Near Term (2017) Analysis

The following constraints were identified in the near term analysis for the off peak scenario. No violations were identified in the summer peak scenario. The following table lists the constraints identified.

Table 3-1 Near-Term Constraint

Scenario	Constraint	Contflow MVA	Rating MVA	Loading%	Contingency	G005 DF	G007 DF	G023 DF
2017SH	635200 RAUN 3 345 645451 S3451 3 345 1	1106.7	956	115.8	640226 HOSKINS3 345 640342 SHELCRK3 345 1	-4.0%	24.0%	-2.8%
2017SH	635200 RAUN 3 345 645451 S3451 3 345 1	961.5	956	100.6	** BASE CASE **	-3.7%	14.0%	-1.0%

3.2. Out Year(2024) Analysis

The following constraints were identified in the out year analysis for the off peak scenario. No violations were identified in the summer peak scenario. The following table lists the constraints identified.

Table 3-2 Out-Year Constraint

Scenario	Constraint	Contflow MVA	Rating MVA	Loading%	Contingency	G005 DF	G007 DF	G023 DF
2024SH	635200 RAUN 3 345 645451 S3451 3 345 1	1103.8	956	115.5	640226 HOSKINS3 345 640342 SHELCRK3 345 1	-3.9%	23.6%	-2.9%
2024SH	635200 RAUN 3 345 645451 S3451 3 345 1	964.6	956	100.9	** BASE CASE **	-3.7%	13.8%	-1.0%

4. Conclusion

The Affected system study identified Steady State thermal violations associated with the interconnection of the three SPP projects. These included injection constraints in the off peak scenario under both the Near-term (2017) and the Out-year (2024) analysis for SPP project number G007.

5. Appendix A

Table 5-1 SPP High Queued Projects

SPP Queue	Capacity MW	Area	Proposed Point of Interconnection	Fuel Type	SP output	SH output
GEN-2003-021N	75	NPPD	Ainsworth Wind Tap 115kV	Wind	20%	100%
GEN-2004-023N	75	NPPD	Columbus Co 115kV	Coal	100%	100%
GEN-2006-020N	42	NPPD	Bloomfield 115kV	Wind	20%	100%
GEN-2006-037N1	75	NPPD	Broken Bow 115kV	Wind	20%	100%
GEN-2006-038N005	80	NPPD	Broken Bow 115kV	Wind	20%	100%
GEN-2006-038N019	80	NPPD	Petersburg North 115kV	Wind	20%	100%
GEN-2006-044N	40.5	NPPD	North Petersburg 115kV	Wind	20%	100%
GEN-2007-011N08	81	NPPD	Bloomfield 115kV	Wind	20%	100%
GEN-2008-086N02	201	NPPD	Meadow Grove 230kV	Wind	20%	100%
GEN-2008-119O	60	OPPD	S1399 161kV	Wind	20%	100%
GEN-2008-123N	89.7	NPPD	Tap Pauline - Hildreth (Rosemont) 115kV	Wind	20%	100%
GEN-2008-129	80	GMO	Pleasant Hill 161kV	CT	100%	0%
GEN-2009-040	73.8	WERE	Marshall 115kV	Wind	20%	100%
GEN-2010-036	4.6	WERE	6th Street 115kV	Hydro	100%	100%
GEN-2010-041	10.5	OPPD	S1399 161kV	Wind	20%	100%
GEN-2010-051	200	NPPD	Tap Twin Church - Hoskins 230kV	Wind	20%	100%
GEN-2011-011	50	KCPL	Iatan 345kV	Coal	100%	100%
GEN-2011-018	73.6	NPPD	Steele City 115kV	Wind	20%	100%

SPP Queue	Capacity MW	Area	Proposed Point of Interconnection	Fuel Type	SP output	SH output
GEN-2011-027	120	NPPD	Tap Hoskins - Twin Church 230kV	Wind	20%	100%
GEN-2011-056	3.6	NPPD	Jeffrey 115kV	Hydro	100%	100%
GEN-2011-056A	3.6	NPPD	John 1 115kV	Hydro	100%	100%
GEN-2011-056B	4.5	NPPD	John 2 115kV	Hydro	100%	100%
GEN-2012-021	4.8	LES	Terry Bundy Generating Station 115kV	Gas	100%	100%
GEN-2013-002	50.6	LES	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2	Wind	20%	100%
GEN-2013-008	1.2	NPPD	Steele City 115kV	Wind	20%	100%
GEN-2013-014	25.5	NPPD	Tap Guide Rock - Pauline (Rosemont) 115kV	Wind	20%	100%
GEN-2013-019	73.6	LES	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2	Wind	20%	100%
GEN-2013-032	204	NPPD	Antelope 115kV	Wind	20%	100%
GEN-2014-004	4	NPPD	Steele City 115kV (GEN-2011-018 POI)	Wind	20%	100%
GEN-2014-013	73.5	NPPD	Meadow Grove (GEN-2008-086N2 Sub) 230kV	Wind	20%	100%
GEN-2014-021	300	GMO	Tap Nebraska City - MullinCreek 345kV	Wind	20%	100%
GEN-2014-031	35.8	NPPD	Meadow Grove 230kV	Wind	20%	100%
GEN-2014-032	10.2	NPPD	Meadow Grove 230kV	Wind	20%	100%
GEN-2014-039	73.4	NPPD	Friend 115kV	Wind	20%	100%

C: GEN-2015-023 Interconnection Customer Comments to Draft Report

See next page Interconnection Customer comments to the draft Interconnection Facilities Studies report.

Transmission Owner Review Comments will be provided to the associated Interconnection Customer.

July 5th 2016

GI Studies
Southwest Power Pool
201 Worthen Drive
Little Rock, AR 72223

RE: Draft Facilities Studies GEN-2015-023/IFS-2015-001-08 Comments

To Whom It May Concern:

Omitted Text would like to propose the configuration shown in Figure 1 as an alternative to the NPPD proposed expansion of the Holt Substation in the Draft Facilities Studies for the interconnection of our GEN-2015-023 Project. NPPD's proposed expansion is shown on Figure 2

Omitted Text considers that the alternative provides the same function as NPPD's proposal. NPPD proposal creates two partially occupied breaker-and-a-half bays which result in the need for an additional 345kV circuit breaker and much more 345kV Bus Work than required for the interconnection of GEN-2015-023/IFS-2015-001-08.

We respectfully request that the proposal be evaluated as an alternative.

Thank you,

Omitted Text

Figure 1 – Omitted Text – Breaker and a Half with 4 Positions

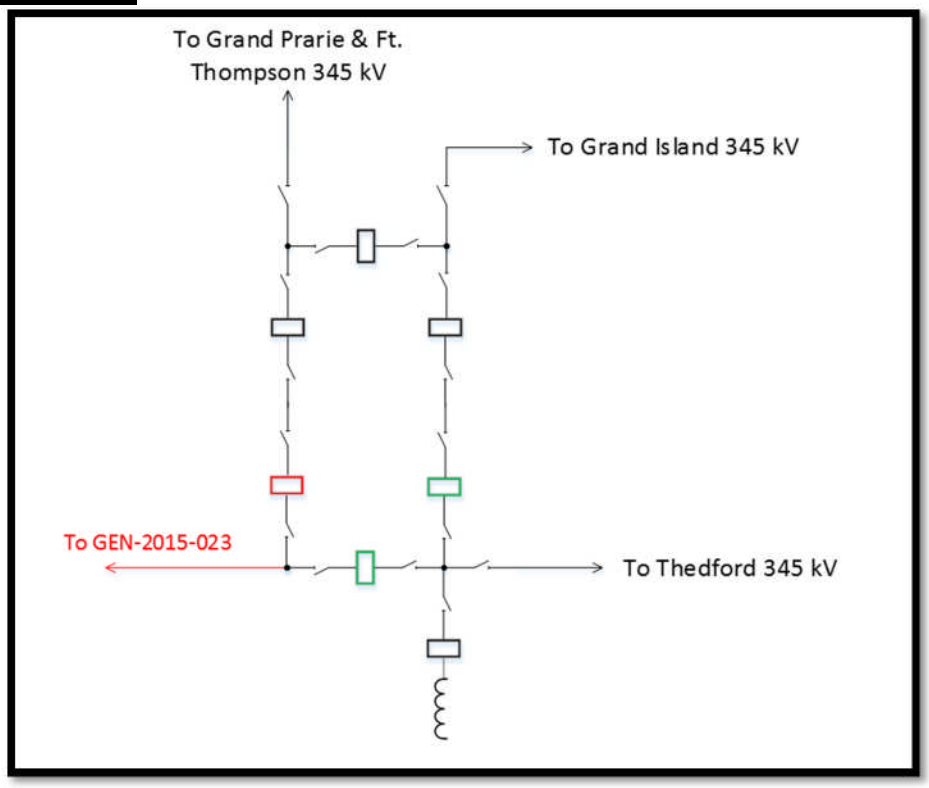


Figure 2 – NPPD Proposal on Draft Facilities Studies. Breaker and a Half with 6 Positions (2 partially equipped, not used)