GEN-2014-039 Impact Restudy for Generator Modification (Turbine Change)

March 2017
Generator Interconnection

Southwest Power Pool

Revision History

Date	Author	Change Description
3/23/2017	SPP	GEN-2014-039 Impact Restudy for Generator Modification Report Issued

Executive Summary

The GEN-2014-039 Interconnection Customer has requested a modification to its Generator Interconnection Request to change wind turbine generators for its project. Originally, it consisted of forty-one (41) GE 1.79 MW wind turbines for a total of 73.39 MW. The requested change is for thirty (30) Vestas V110 VCSS 2.0 MW wind turbines and seven (7) Vestas V110 VCSS 1.905 MW wind turbines for a total of 73.335 MW. The point of interconnection (POI) is the Nebraska Public Power District (NPPD) Friend 115kV Substation.

The study models used were the 2016 winter, 2017 summer, and 2025 summer models that included Interconnection Requests through DISIS-2015-002.

Stability analysis has determined with all previously assigned Network Upgrades in service, generators in the monitored areas remained stable and within the pre-contingency, voltage recovery, and post fault voltage recovery criterion of 0.7pu to 1.2pu for the entire modeled disturbances. Additionally, the project wind farm was found to stay connected during the contingencies that were studied and, therefore, will meet the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

Power factor analysis for each generation project was performed on the current study 2016 winter peak, 2017 summer peak, and 2025 summer peak cases with identified system upgrades. As reactive power is required for GEN-2014-039, the final requirement in the GIA will be the pro-forma 95% lagging to 95% leading at the point of interconnection.

A reduced generation analysis was conducted to determine reactor inductive amounts to compensate the capacitive effects on the transmission system during low or reduced wind conditions caused by the interconnecting project's generator lead transmission line and collector systems. The interconnection customer's facility is required to install a reactor that is approximately 4Mvar on the low side of its 115/34.5kV transformer.

Short Circuit analysis was conducted using the current study upgrade 2017 summer peak and 2025 summer peak cases.

With the assumptions outlined in this report and with all the required network upgrades from the DISIS 2015-002 in place, GEN-2014-039 with the Vestas V110 VCSS 2.0 MW and Vestas V110 VCSS 1.905 MW wind turbine generators should be able to interconnect reliably to the SPP transmission grid. The change in wind turbine generator is not a Material Modification.

It should be noted that this study analyzed the requested modification to change generator technology, manufacturer, and layout. Powerflow analysis was not performed. This study analyzed many of the most probable contingencies, but it is not an all-inclusive list and cannot account for every operational situation. It is likely that the customer may be required to reduce its generation output to 0 MW, also known as curtailment, under certain system conditions to allow system operators to maintain the reliability of the transmission network.

Nothing in this study should be construed as a guarantee of delivery or transmission service. If the customer wishes to sell power from the facility, a separate request for transmission service must be requested on Southwest Power Pool's OASIS by the Customer.

Table of Contents

1. Introduction

The GEN-2014-039 Interconnection Customer has requested a modification to its Generator Interconnection Request to change its generators from GE 1.79 MW wind turbines to Vestas V110 VCSS 2.0 MW and Vestas V110 VCSS 1.905 MW wind turbines. Originally, it consisted of forty-one (41) GE 1.79 MW wind turbines for a total 73.39 MW. The requested change is shown in **Table 1-1**.

Table 1-1: Interconnection Request

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2014-039	73.335	30 x Vestas V110 2.0MW = 60.0MW, and 7 x Vestas V110 1.901MW = 13.335MW	Friend 115kV (640174)

The POI is the NPPD Friend 115kV Substation. Other queued generation projects in the model are listed in **Table 1-2**.

Table 1-2: Other Queued Interconnection Requests in the Model

Request	Capacity (MW)	Generator Model	Point of Interconnection
NPPD Distributed (Broken Bow)	7.3	GENCLS	Broken Bow 115kV (640089)
NPPD Distributed (Burwelll)	3	GENCLS	Ord 115kV (640308)
NPPD Distributed (Columbus Hydro Unit)	15	GENSAL	Columbus 115kV (640136)
NPPD Distributed (Columbus Hydro Unit)	15	GENSAL	Columbus 115kV (640136)
NPPD Distributed (Columbus Hydro Unit)	15	GENSAL	Columbus 115kV (640136)
NPPD Distributed (Ord)	10.8	GENCLS	Ord 115kV (640308)
NPPD Distributed (Stuart)	1.8	GENCLS	Ainsworth Wind Tap 115kV (640051)
NPPD Distributed (Jeffrey Hydro Unit)	18	GENSAL	Jeffrey 115kV (640238)
NPPD Distributed (John Hydro Unit 1)	18	GENSAL	John 1 115kV (640240)
NPPD Distributed (John Hydro Unit 2)	18	GENSAL	John 2 115kV (640242)
GEN-2003-021N	75	GE 1.5MW	Ainsworth Wind 115kV (640050)
GEN-2004-023N	75	GENROU	Columbus County 115kV (640119)
GEN-2006-020N	42	Vestas VCUS 1.8MW Vestas VCRS 3.0MW	Bloomfield 115kV (640084)
GEN-2006-037N1	75	GE 1.7MW	Broken Bow 115kV (640089)
GEN-2006-038N005	80	GE 1.6MW	Broken Bow 115kV (640089)
GEN-2006-038N019	80	GE 1.5MW	Petersburg North 115kV (640444)
GEN-2006-044N	40.5	GE 1.5MW	Petersburg North 115kV (640444)
GEN-2007-011N08	81	Vestas VCRS 3.0MW	Bloomfield 115kV (640084)

Table 1-2: Other Queued Interconnection Requests in the Model

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2007-017IS	166	Vestas V110 VCSS 2.0MW	Grand Prairie 345kV (652532)
GEN-2007-018IS	234	Vestas V110 VCSS 2.0MW	Grand Prairie 345kV (652532)
GEN-2008-086N02	201	GE 1.79MW	Meadow Grove 230kV (640540)
GEN-2008-119O	60	GE 1.5MW	S1399 161kV (646399)
GEN-2008-123N	89.7	GE 1.715MW	Tap Pauline to Hildreth (Rosemont) 115kV (560134)
GEN-2009-040	73.8	Vestas V110 VCSS 2.0MW	Tap Smittyville to Knob Hill (Marshall) 115kV (533303)
GEN-2010-041 (addition to GEN-2008-119O)	10.5	GE 1.5MW	S1399 161kV (646399)
GEN-2010-051	200	GE 1.7MW	Tap Twin Church to Hoskins 230kV (560347)
GEN-2011-018	73.6	GE 1.79MW	Steele City 115kV (640426)
GEN-2011-027 (addition to GEN-2010-051)	120	GE 1.85MW	Tap Twin Church to Hoskins 230kV (560347)
GEN-2011-056 (uprate to Jeffrey Hydro Unit)	3.6	GENSAL	Jeffrey 115kV (640238)
GEN-2011-056A (uprate to John Hydro Unit 1)	3.6	GENSAL	John 1 115kV (640240)
GEN-2011-056B (uprate to John Hydro Unit 2)	4.5	GENSAL	John 2 115kV (640242)
GEN-2012-021 (uprate to Lincoln Electric)	4.8	GENSAE	Terry Bundy Generating Station 115kV (650275)
GEN-2013-002	50.6	Siemens 2.3MW VS	Tap Sheldon to Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV (560746)
GEN-2013-008 (uprate to GEN-2011-018)	1.2	GE 1.79MW	Steele City 115kV (640426)
GEN-2013-019 (addition to GEN-2013-002)	73.6	Siemens 2.3MW VS	Tap Sheldon to Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV (560746)
GEN-2013-032	204	GE 1.7MW	Antelope 115kV (640521)
GEN-2014-004 (uprate to GEN-2011-018 & GEN-2013-008)	4	GE 1.79MW	Steele City 115kV (640426)
GEN-2014-013 (addition to GEN-2008-086N02 & GEN-2014-032)	73.5	GE 1.79MW	Meadow Grove 230kV (640540)
GEN-2014-031 (addition to GEN-2008-086N02 & GEN-2014-032 & GEN-2014-013)	35.8	GE 1.79MW	Meadow Grove 230kV (640540)
GEN-2014-032 (uprate to GEN-2008-086N02)	10.2	GE 1.79MW	Meadow Grove 230kV (640540)
GEN-2015-007	160	GE 2.0MW	Hoskins 345KV (640226)
GEN-2015-023	300.7	GE 1.79MW	Holt 345kV (640510)
GEN-2015-053	50	GE 1.79MW	Antelope 115kV (Neligh East) (640521)
GEN-2015-076	158.4	Vestas V117 Gridstreamer 3.3MW	Belden 115KV (640080)

Table 1-2: Other Queued Interconnection Requests in the Model

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2015-087	66	Vestas V100 VCSS 2.0MW	Tap Hebron to Fairbury 115kV (560061)
GEN-2015-088	300	Vestas V100 VCSS 2.0MW	Tap Pauline to Moore 345kV (560062)

A stability analysis was performed for the change in wind turbines. The analysis was performed on three (3) seasonal models including 2016 winter peak (16WP), the 2017 summer peak (17SP), and the 2025 summer peak (25SP) cases. These cases are modified versions of the 2015 model series of Model Development Working Group (MDWG) dynamic study models that included upgrades and Interconnection Requests through DISIS-2015-002.

The stability analysis determines the impacts of the new interconnecting project on the stability and voltage recovery of the nearby systems and the ability of the interconnecting project to meet FERC Order 661A. If problems with stability or voltage recovery are identified, the need for reactive compensation or system upgrades is investigated. The contingencies listed in **Table 3-1** were used in the stability analysis.

The power factor analysis determines the power factor at the point of interconnection (POI) for the wind interconnection projects for pre-contingency and post-contingency conditions. The contingencies used in the power factor analysis are a subset of the stability analysis contingencies shown in **Table 3-1**.

A reduced (low wind/no wind) generation analysis was performed to determine reactor inductive amounts to compensate for the capacitive effects on the transmission system caused by the interconnecting project's generator lead transmission line and collector systems during low or reduced wind conditions.

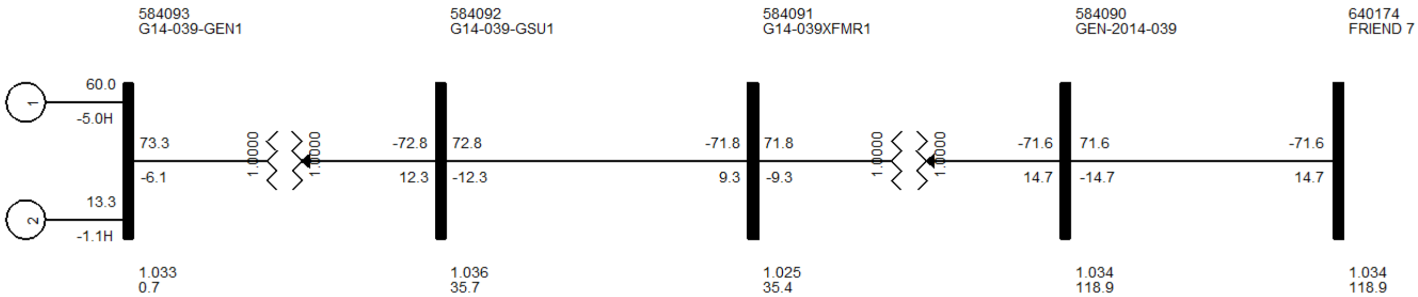
Short Circuit analysis was conducted using the current study upgrade 2017 summer peak and 2025 summer peak cases. The results from the Short circuit analysis are shown in Appendix F.

Nothing in this System Impact Study constitutes a request for transmission service or grants the Interconnection Customer any rights to transmission service. If the customer wishes to sell power from the facility, a separate request for transmission service must be requested on Southwest Power Pool's OASIS by the Customer.

2. Facilities

A one-line PSS/E slider drawing from the 16WP case is shown in **Figure 2-1** for GEN-2014-039. The POI is the NPPD Friend 115kV substation.

Figure 2-1: GEN-2014-039 One-line Diagram



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.

Model Preparation

Transient stability analysis was performed using modified versions of the 2015 series of Model Development Working Group (MDWG) dynamic study models including the 2016 winter peak, 2017 summer peak, and the 2025 summer peak seasonal models. The cases are then loaded with prior queued interconnection requests and network upgrades assigned to those interconnection requests. Finally the prior queued and study generation are dispatched into the SPP footprint. Initial simulations are then carried out for a no-disturbance run of twenty (20) seconds to verify the numerical stability of the model.

Disturbances

Ten (10) contingencies were identified for use in this study and are listed in **Table 3-1**. These contingencies are faults at locations defined by SPP Generation Interconnection Staff. These contingencies include three-phase and single-phase N-1. 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.

Except for transformer faults, the typical sequence of events for a three-phase and single-phase fault is as follows:

1. apply fault at 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 modeled as three-phase faults, unless otherwise noted. The sequence of events for a transformer fault is as follows:

1. apply fault for five (5) cycles
2. clear the fault by tripping the affected transformer facility (unless otherwise noted there will be no re-closing into a transformer fault)

The SPP areas monitored during the stability analysis were:

- 540: Greater Missouri Operations (GMO)
- 541: Kansas City Power & Light (KCPL)
- 640: Nebraska Public Power District (NPPD)
- 645: Omaha Public Power District (OPPD)
- 650: Lincoln Electric System (LES)

- 652: Western Area Power Administration (WAPA)

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
0	FLT_000_NOFAULT	No Fault Conditions
1	FLT_01_FRIEND7_CRETE7_115kV_3PH	3 phase fault on the Friend (640174) to Crete (640153) 115kV line, near Friend. a. Apply fault at the Friend 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT_02_FRIEND7_CRETE7_115kV_1PH	Single phase fault on the Friend (640174) to Crete (640153) 115kV line, near Friend. a. Apply fault at the Friend 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
3	FLT_03_FRIEND7_GENEVA7_115kV_3PH	3 phase fault on the Friend (640174) to Geneva (640178) 115kV line, near Friend. a. Apply fault at the Friend 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT_04_FRIEND7_GENEVA7_115kV_1PH	Single phase fault on the Friend (640174) to Geneva (640178) 115kV line, near Friend. a. Apply fault at the Friend 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
5	FLT_05_CRETE7_SHELDON7_115kV_3PH	3 phase fault on the Crete (640153) to Sheldon (640278) 115kV line, near Crete. a. Apply fault at the Crete 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT_06_CRETE7_SHELDON7_115kV_1PH	Single phase fault on the Crete (640153) to Sheldon (640278) 115kV line, near Crete. a. Apply fault at the Crete 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
7	FLT_07_G13002TAP_SW7BENNET7_115kV_3PH	3 phase fault on the GEN-2013-002 Tap (560746) to SW7 & Bennett (650244) 115kV line, near GEN-2013-002 Tap. a. Apply fault at the GEN-2013-002 Tap 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
8	FLT_08_GENEVA7_CARLJCT7PO_115kV_3PH	**Prior outage** on the Geneva (640178) to McCool (640272) 115kV line: 3 phase fault on the Geneva (640178) to Carlisle Junction (640105) 115kV line, near Geneva 115kV. a. Prior Outage Geneva to McCool 115kV. b. Apply fault at the Geneva 115kV bus. c. Clear fault after 5 cycles by tripping the faulted line. d. Wait 20 cycles, and then re-close the line in (b) back into the fault. e. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

9	FLT_09_MCCOOL7_YORKSW7PO_115kV_3PH	**Prior outage** on the McCool (640272) to Moore (640277) 115kV line: 3 phase fault on the McCool (640272) to York SW (640413) 115kV line, near McCool 115kV. a. Prior Outage McCool to Moore 115kV. b. Apply fault at the McCool 115kV bus. c. Clear fault after 5 cycles by tripping the faulted line. d. Wait 20 cycles, and then re-close the line in (b) back into the fault. e. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT_10_G13002TAP_SW7BENNET7PO_115kV_3PH	**Prior outage** on the Sheldon (640278) to Folsom & Pheasant Hill (650242) 115kV line: 3 phase fault on the GEN-2013-002 Tap (560746) to to SW7 & Bennett (650244) 115kV line, near GEN-2013-002 Tap 115kV. a. Prior Outage Sheldon to Folsom & Pheasant Hill 115kV. b. Apply fault at the GEN-2013-002 Tap 115kV bus. c. Clear fault after 5 cycles by tripping the faulted line. d. Wait 20 cycles, and then re-close the line in (b) back into the fault. e. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Results

The stability analysis was performed and the results are summarized in **Error! Reference source not found.**. The stability plots will be available upon customer request.

Contingency Number and Name		2016WP	2017SP	2025SP
0	FLT_000_NOFAULT	STABLE	STABLE	STABLE
1	FLT_01_FRIEND7_CRETE7_115kV_3PH	STABLE	STABLE	STABLE
2	FLT_02_FRIEND7_CRETE7_115kV_1PH	STABLE	STABLE	STABLE
3	FLT_03_FRIEND7_GENEVA7_115kV_3PH	STABLE	STABLE	STABLE
4	FLT_04_FRIEND7_GENEVA7_115kV_1PH	STABLE	STABLE	STABLE
5	FLT_05_CRETE7_SHELDON7_115kV_3PH	STABLE	STABLE	STABLE
6	FLT_06_CRETE7_SHELDON7_115kV_1PH	STABLE	STABLE	STABLE
7	FLT_07_G13002TAP_SW7BENNET7_115kV_3PH	STABLE	STABLE	STABLE
8	FLT_08_GENEVA7_CARLJCT7PO_115kV_3PH	STABLE	STABLE	STABLE
9	FLT_09_MCCOOL7_YORKSW7PO_115kV_3PH	STABLE	STABLE	STABLE
10	FLT_10_G13002TAP_SW7BENNET7PO_115kV_3PH	STABLE	STABLE	STABLE

FERC LVRT Compliance

FERC Order 661A places specific requirements on wind farms through its Low Voltage Ride Through (LVRT) provisions. For Interconnection Agreements signed after December 31, 2006, wind farms shall stay on line for faults at the POI that draw the voltage down at the POI to 0.0 pu. The faults listed below in **Table 3-2** were tested to meet Order 661A LVRT provisions. GEN-2014-039 was found to be in compliance with FERC Order 661A.

Table 3-2 LVRT Contingencies

Contingency Number and Name	Description
FLT_01_FRIEND7_CRETE7_115kV_3PH	3 phase fault on the Friend (640174) to Crete (640153) 115kV line, near Friend.

	a. Apply fault at the Friend 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT_03_FRIEND7_GENEVA7_115kV_3PH	3 phase fault on the Friend (640174) to Geneva (640178) 115kV line, near Friend. a. Apply fault at the Friend 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

4. Power Factor Analysis

The power factor analysis was performed for each project included in this study and is designed to demonstrate the reactive power requirements at the point of interconnection (POI) using the current study upgrade cases. For all projects that require reactive power, the final requirement in the GIA will be the pro-forma 95% lagging to 95% leading at the POI.

Model Preparation

For each project included in this study, as well as previous queued projects modeled at the same POI, the projects were turned off for the power factor analysis. The projects were replaced by an equivalent generator located at the POI producing the total MW of the project at that POI and 0.0 Mvar capability.

A Mvar generator without limits was modeled at the interconnection project POI to hold a voltage schedule at the POI consistent with the greater of the voltage schedule in the base case or unity (1.0 pu) voltage.

Disturbances

Each N-1 contingency evaluated in the Stability Analysis found in **Table 3-1** was also included in the determination of the power factor requirements.

Results

The power factor ranges are summarized in **Table 4-1** and the resultant ranges are shown **Table D-1**. The analysis showed that reactive power is required for the study project, the final requirement in the Generation Interconnection Agreement (GIA) for each project will be the pro-forma 95% lagging to 95% leading at the POI.

For analyzing power factor results a positive Q (Mvar) output indicates that the equivalent generator is supplying reactive power to the system, implying a lagging power factor. A negative Q (Mvar) output indicts that the equivalent generator is absorbing reactive power from the system, implying a leading power factor.

Table 4-1*: Summary of Power Factor Analysis at the POI*

Request	Capacity (MW)	Point of Interconnection (POI)	Fuel	Generator	Lagging (providing Mvars)	Leading (absorbing Mvars)
GEN-2014-039	73.335	Friend 115kV (640174)	Wind	30 x Vestas V110 2.0MW = 60.0MW, and 7 x Vestas V110 1.901MW = 13.335MW	0.95	0.95

NOTE: As reactive power is required for the project, the final requirement in the GIA will be the pro-forma 95% lagging to 95% leading at the point of interconnection.

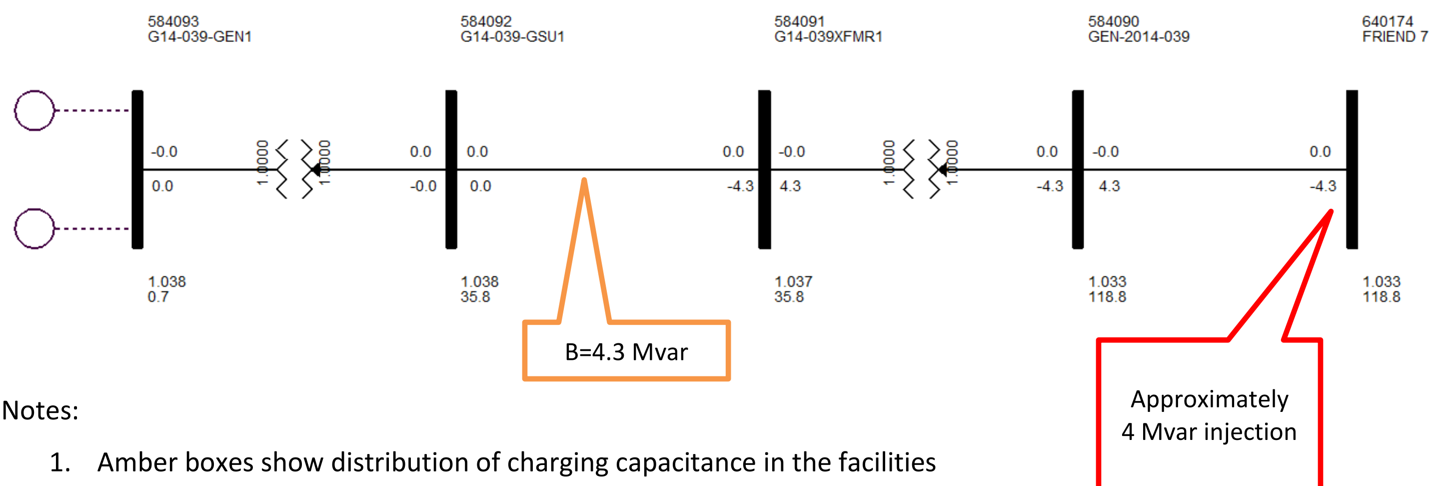
5. Reduced Wind Generation Analysis

A low wind analysis was performed for GEN-2014-039. SPP performed this low wind analysis to determine the capacitive charging current injected at the POI.

The project generators and capacitors (if any) were turned off in the base case. **Error! Reference source not found.** shows the resulting reactive power injection (approximately 4Mvar) at the POI that is due to the capacitance of the project's transmission lines and collector cables. Also, the figure shows how the capacitance is distributed throughout the project. In this impact restudy GEN-2014-039 is responsible for a 4Mvar reactor needed to offset the capacitive effects of the collector system (4.3Mvar) and of the transmission lead (0Mvar) that connects into the transmission system under no/reduced generating conditions. The 4Mvar reactor will be required and would normally be installed on the low side of the 115/34.5kV transformer. The Interconnection Customer may use wind turbine manufacturing options for providing reactive power under no/reduced generation conditions.

A shunt reactor was added at the GEN-2014-039 project substation 34.5 kV bus to bring the Mvar flow into the POI down to approximately zero as shown in **Figure E-1**. A reactor of approximately 4Mvar will negate the capacitive effect of the project at the POI. This is shown for information only and not as a requirement.

Figure 5-1*:* GEN-2014-039 with generators turned off



Notes:

1. Amber boxes show distribution of charging capacitance in the facilities
2. Red box shows the net effect of all the charging capacitances at the POI

6. Short Circuit Analysis

The short circuit analysis was performed on the 2017 & 2025 Summer Peak 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.

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

Results

The results of the short circuit analysis are shown in **Appendix F, Table F-1 *GEN-2014-039 Short Circuit Analysis Results (2017SP)*** and **Table F-2 *GEN-2014-039 Short Circuit Analysis Results (2025SP)***.

7. Conclusion

The GEN-2014-039 Interconnection Customer has requested a modification to its Generator Interconnection Request to change its generators from GE 1.79 MW wind turbines to Vestas V110 VCSS 2.0 MW and Vestas V110 VCSS 1.905 MW wind turbines. Originally, it consisted of forty-one (41) GE 1.79 MW wind turbines for a total of 73.39 MW. The requested change is thirty (30) Vestas V110 VCSS 2.0 MW wind turbines and seven (7) Vestas V110 VCSS 1.905 MW wind turbines for a total of 73.335 MW. The point of interconnection (POI) is the Nebraska Public Power District (NPPD) Friend 115kV Substation.

Stability analysis has determined that with all previously assigned Network Upgrades in service, generators in the monitored areas remained stable and within the pre-contingency, voltage recovery, and post fault voltage recovery criterion of 0.7pu to 1.2pu for the entire modeled disturbances. Additionally, the project wind farm was found to stay connected during the contingencies that were studied and, therefore, will meet the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

A power factor analysis was performed for the wind turbine modification request. As reactive power is required for GEN-2014-039, the final requirement in the GIA will be the pro-forma 95% lagging to 95% leading at the POI.

A reduced generation analysis was conducted to determine reactor size necessary to compensate the capacitive effects on the transmission system during low or reduced wind conditions caused by the interconnecting project's generator lead transmission line and collector systems. The interconnection customer's facility is required to install a reactor that is approximately 4Mvar on the low side of its 115/34.5kV transformer.

Short Circuit analysis was conducted using the current study upgrade 2017 summer peak and 2025 summer peak cases.

With the assumptions outlined in this report and with all the required network upgrades from the DISIS 2015-002 in place, GEN-2014-039 with the Vestas V110 VCSS 2.0 MW and Vestas V110 VCSS 1.905 MW wind turbine generators should be able to interconnect reliably to the SPP transmission grid. The change in wind turbine generator is not a Material Modification.

It should be noted that this study analyzed the requested modification to change generator technology, manufacturer, and layout. Power flow analysis was not performed. This study analyzed many of the most probable contingencies, but it is not an all-inclusive list and cannot account for every operational situation. It is likely that the customer may be required to reduce its generation output to 0 MW, also known as curtailment, under certain system conditions to allow system operators to maintain the reliability of the transmission network.

Nothing in this study should be construed as a guarantee of delivery or transmission service. If the customer wishes to sell power from the facility, a separate request for transmission service must be requested on Southwest Power Pool's OASIS by the Customer.

Appendix A – 2016 Winter Peak Stability Plots

(Available on request)

Appendix B – 2017 Summer Peak Stability Plots

(Available on request)

Appendix C – 2025 Summer Peak Stability Plots

(Available on request)

Appendix D – Power Factor Analysis Results

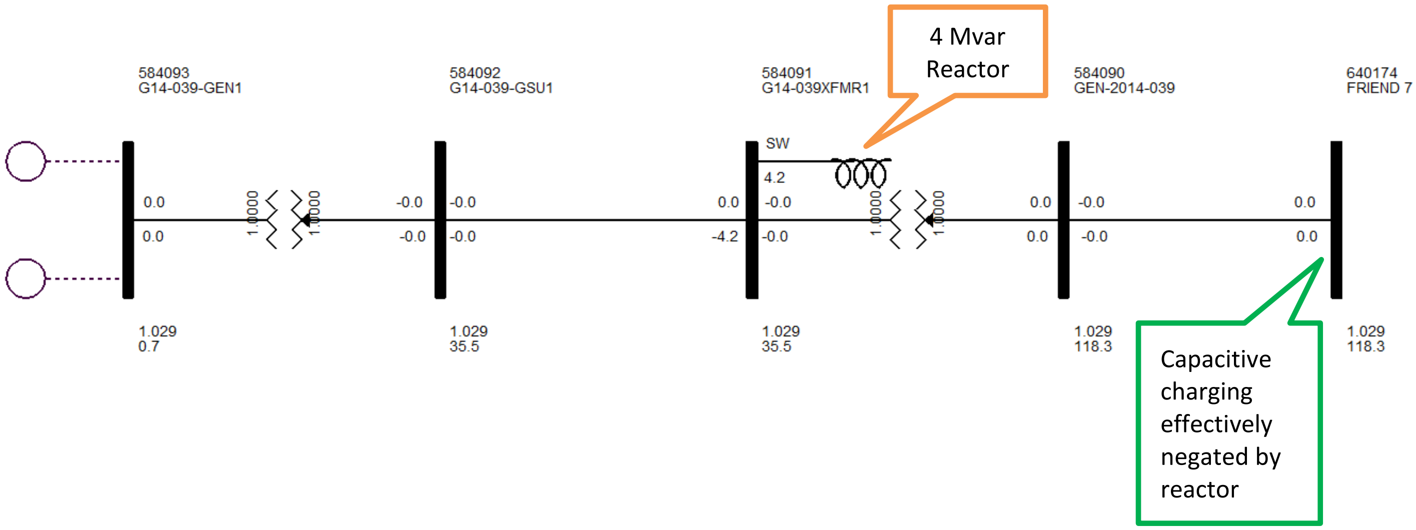
Table D-1: GEN-2014-039 Power Factor Analysis Results

Leading power factor is absorbing vars; Lagging power factor is providing vars										
	GEN-2014-039 POI: Friend 115 kV (640174) Power at POI (MW): 73.335	2016 Winter Peak POI Voltage = 1.0291 pu			2017 Summer Peak POI Voltage = 1.0221 pu			2025 Summer Peak POI Voltage = 1.0265 pu		
	Contingency Name	**Mvars at POI**	**Power Factor**		**Mvars at POI**	**Power Factor**		**Mvars at POI**	**Power Factor**	
0	FLT_00_NoFault	-21.047	0.9612	LEAD	-21.8101	0.95851	LEAD	-21.8346	0.95842	LEAD
1	FLT_01_FRIEND7_CRETE7_115kV	-27.7591	0.93524	LEAD	-22.2636	0.95688	LEAD	-22.763	0.95505	LEAD
2	FLT_02_FRIEND7_CRETE7_115kV	-27.7591	0.93524	LEAD	-22.2636	0.95688	LEAD	-22.763	0.95505	LEAD
3	FLT_03_FRIEND7_GENEVA7_115kV	-10.0934	0.99066	LEAD	-15.5153	0.97834	LEAD	-15.1312	0.97937	LEAD
4	FLT_04_FRIEND7_GENEVA7_115kV	-10.0934	0.99066	LEAD	-15.5153	0.97834	LEAD	-15.1312	0.97937	LEAD
5	FLT_05_CRETE7_SHELDON7_115kV	-6.47128	0.99613	LEAD	-9.13098	0.99234	LEAD	-8.39276	0.99352	LEAD
6	FLT_06_CRETE7_SHELDON7_115kV	-6.47128	0.99613	LEAD	-9.13098	0.99234	LEAD	-8.39276	0.99352	LEAD
7	FLT_07_G13002TAP_SW7BENNET7_115kV	-21.8286	0.95844	LEAD	-21.5505	0.95943	LEAD	-21.4286	0.95986	LEAD
8	FLT_08_GENEVA7_CARLJCT7PO_115kV	-20.4553	0.96323	LEAD	-22.4038	0.95637	LEAD	-19.6149	0.96604	LEAD
9	FLT_09_MCCOOL7_YORKSW7PO_115kV	-19.9767	0.96484	LEAD	-21.8917	0.95822	LEAD	-22.611	0.95561	LEAD
10	FLT_10_G13002TAP_SW7BENNET7PO_115kV	-21.8286	0.95844	LEAD	-21.5505	0.95943	LEAD	-21.4286	0.95986	LEAD

Appendix E – Reduced Wind Generation Analysis Results

Below figure is from the 2016WP model with identified upgrades in-service. The other two cases (2017SP and 2025SP) were almost identical since the Interconnection Request facilities design is the same in all cases.

Figure E-1*:* GEN-2014-039 with generators turned off and shunt reactor added to the 34.5kV side of the customer substation



Appendix F – Short Circuit Analysis Results

Table F-1: GEN-2014-039 Short Circuit Analysis Results (2017SP)

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                              PSS®E-32.2.0 ASCC SHORT CIRCUIT CURRENTS         MON, MAR 20 2017  11:44
2015 MDWG FINAL WITH 2013 MMWG, UPDATED WITH 2014 SERC & MRO
MDWG 17S WITH MMWG 15S, MRO 16W TOPO/16S PROF, SERC 16S

OPTIONS USED:
    - FLAT CONDITIONS
    - BUS VOLTAGES SET TO 1 PU AT 0 PHASE ANGLE
    - GENERATOR P=0, Q=0
    - TRANSFOMRER 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

                                   THREE PHASE FAULT
X---------- BUS ----------X           /I+/    AN(I+)
640174 [FRIEND 7    115.00] AMP     5953.8   -74.20
584090 [GEN-2014-039115.00] AMP     5953.8   -74.20
640153 [CRETE__7    115.00] AMP     8228.2   -74.61
640175 [FRIEND 9    34.500] AMP     3319.9   -84.47
640178 [GENEVA 7    115.00] AMP     9602.3   -78.81
643060 [FRIEND T1  913.800] AMP     4192.1   -88.68
584091 [G14-039XFMR134.500] AMP    10417.2   -82.10
640105 [CARLJCT7    115.00] AMP     5373.9   -77.69
640154 [CRETE  G    34.500] AMP    11513.4   -83.29
640179 [GENEVA 8    69.000] AMP     4121.6   -85.88
640272 [MCCOOL 7    115.00] AMP    13789.7   -84.03
640278 [SHELDON7    115.00] AMP    31175.0   -85.33
640372 [SUTTON 7    115.00] AMP     6246.1   -80.88
643048 [CRETE T1   913.800] AMP     8575.3   -86.16
643049 [CRETE T2   913.800] AMP     8602.4   -86.14
643062 [GENEVA T2  913.800] AMP     4012.1   -88.43
560746 [G13-002-TAP 115.00] AMP    27856.0   -85.07
584092 [G14-039-GSU134.500] AMP     9383.2   -79.47
640019 [SHELDN1G    13.800] AMP    85019.1   -88.75
640020 [SHELDN2G    13.800] AMP    92192.4   -88.94
640021 [HALLAM3G    13.800] AMP    16776.5   -87.83
640088 [BPS SUB7    115.00] AMP    15691.8   -81.99
640106 [CARLJCT9    34.500] AMP     3181.0   -85.65
640111 [CLATONA7    115.00] AMP    10128.7   -77.14
640171 [FIRTH  7    115.00] AMP     6056.3   -74.28
640218 [HEBRN N7    115.00] AMP     5511.9   -75.28
640271 [MCCOOL 3    345.00] AMP    10005.6   -84.54
640273 [MCCOOL     869.000] AMP     5437.0   -87.17
640274 [MCCOOL19    13.800] AMP    17358.8   -88.41
640277 [MOORE  3    345.00] AMP    20674.5   -85.35
640279 [SHELDON9    34.500] AMP     5173.5   -84.62
640280 [MOORE  9    13.800] AMP    31585.2   -87.69
640373 [SUTTON 8    69.000] AMP     3745.6   -85.37
640413 [YORK SW7    115.00] AMP     7940.5   -80.36
640415 [CARLJCT8    69.000] AMP     3546.5   -83.84
641087 [EGYCNTR7    115.00] AMP    17686.2   -83.45
643030 [CARLTNJCTT1913.800] AMP     4409.5   -88.80
643031 [CARLTNJCTT2913.800] AMP     3829.9   -87.44
643104 [SHELDON T4 913.800] AMP     2865.4   -89.95
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643149	[SUTTON T1 913.800]	AMP	3873.2	-87.79
643171	[MCCOOL T1 913.800]	AMP	3977.4	-87.98
650242	[FOLSM&PHIL7 115.00]	AMP	26078.8	-84.47
560061	[G15-087-TAP 115.00]	AMP	5368.4	-74.83
560062	[G15-088-TAP 345.00]	AMP	10557.7	-85.07
583520	[GEN-2013-002115.00]	AMP	27856.0	-85.07
583700	[GEN-2013-019115.00]	AMP	21664.6	-84.52
640012	[HEBRON G 13.800]	AMP	12959.8	-84.43
640022	[BPS GT1G 13.800]	AMP	59924.5	-87.78
640023	[BPS GT2G 13.800]	AMP	59875.7	-87.79
640024	[BPS ST3G 13.800]	AMP	61364.3	-88.37
640076	[BEATRCE7 115.00]	AMP	12915.9	-80.34
640112	[CLATONA9 34.500]	AMP	3645.4	-85.96
640139	[COOPER 3 345.00]	AMP	24991.4	-86.04
640172	[FIRTH 9 34.500]	AMP	3365.4	-84.91
640215	[HASTING7 115.00]	AMP	18850.2	-82.78
640220	[HEBRON 7 115.00]	AMP	5248.7	-74.61
640362	[STERLNG7 115.00]	AMP	4249.8	-74.17
640411	[YORK 7 115.00]	AMP	7443.7	-78.37
640414	[YORK SW9 34.500]	AMP	6284.9	-86.04
640447	[YORK.SW T2 869.000]	AMP	2404.8	-85.22
641086	[EGY CTRG 13.800]	AMP	36300.2	-88.29
641088	[HASTCTY7 115.00]	AMP	18850.2	-82.78
641089	[EGYCTR2G 18.000]	AMP	85113.7	-87.91
641090	[S. 281 7 115.00]	AMP	10982.7	-82.00
643035	[CLATONIA T1913.800]	AMP	3551.4	-89.46
643057	[FIRTH T1 913.800]	AMP	3558.1	-88.91
643168	[YORK.SW T1 913.800]	AMP	6633.4	-87.17
643176	[YORK.SW T2 913.800]	AMP	3596.1	-88.57
650114	[NW68HOLDRG3 345.00]	AMP	16161.1	-85.10
650189	[103&ROKEBY3 345.00]	AMP	19332.6	-85.22
650238	[20PIONEERS7 115.00]	AMP	26126.4	-83.92
650244	[SW7&BENNET7 115.00]	AMP	21010.5	-84.32
650290	[ROKEBY 7 115.00]	AMP	24377.2	-84.58
650342	[FOLSM&PHIL9 12.470]	AMP	7347.2	-88.27
650542	[421TERTIARY 7.2000]	AMP	9491.1	-89.87
652571	[GR ISLD3 345.00]	AMP	11488.3	-84.96
300039	[7FAIRPT 345.00]	AMP	11916.3	-84.53
541199	[ST JOE 3 345.00]	AMP	18750.7	-85.08
583521	[G13-002XFMR134.500]	AMP	7256.8	-87.65
583701	[G13-019XFMR134.500]	AMP	10504.2	-87.37
585230	[GEN-2015-087115.00]	AMP	4932.8	-75.39
585240	[GEN-2015-088345.00]	AMP	10173.5	-84.85
635017	[ATCHSNT3 345.00]	AMP	15001.4	-85.13
640009	[COOPER1G 22.000]	AMP	265003.2	-88.18
640063	[AURORA_7 115.00]	AMP	6887.0	-79.50
640074	[BEAT. S7 115.00]	AMP	5186.4	-76.49
640077	[BEATRCE9 34.500]	AMP	9575.1	-85.88
640125	[COLMB.E3 345.00]	AMP	9509.0	-84.79
640140	[COOPER 5 161.00]	AMP	17048.5	-87.07
640142	[COOPER T2 913.800]	AMP	44369.6	-87.68
640169	[FAIRBRY7 115.00]	AMP	5488.8	-74.23
640200	[GR ISLD4 230.00]	AMP	15793.6	-84.84
640208	[HARBINE7 115.00]	AMP	6971.6	-76.05
640214	[HASTING4 230.00]	AMP	7156.1	-84.59
640216	[HASTING9 34.500]	AMP	8974.2	-86.31
640221	[HEBRON 9 34.500]	AMP	3260.2	-84.81
640312	[PAULINE3 345.00]	AMP	7731.3	-84.32
640313	[PAULINE7 115.00]	AMP	15968.8	-81.82
640361	[STEINER7 115.00]	AMP	4369.6	-72.90
640368	[SUPEROR7 115.00]	AMP	3346.2	-69.76
640374	[SWEET W3 345.00]	AMP	9690.9	-85.31
640375	[TAMORA 7 115.00]	AMP	5828.7	-75.47
640412	[YORK 9 34.500]	AMP	6269.6	-85.40

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640443 [YORK   8    69.000] AMP     2540.8   -83.74
641083 [D.HENRY7    115.00] AMP    11037.1   -81.84
641085 [E7THST 7    115.00] AMP    17794.3   -82.54
641096 [S. 281 9    13.800] AMP     9769.4   -87.05
643013 [BEATRICE T1913.800] AMP     8053.3   -89.13
643014 [BEATRICE T2913.800] AMP     5862.0   -89.70
643071 [GR ISLD T6 913.800] AMP    37015.5   -88.18
643075 [HASTINGS T3913.800] AMP    23470.2   -86.81
643076 [HASTINGS T1913.800] AMP     2401.4   -87.44
643077 [HASTINGS T2913.800] AMP     7282.6   -85.90
643078 [HEBRON T1  913.800] AMP     3471.5   -88.79
643144 [STERLING T1913.800] AMP     5230.8   -85.11
643166 [YORK T1    913.800] AMP     6595.2   -87.14
643167 [YORK T2    913.800] AMP     3017.0   -89.44
643172 [COOPER T5  913.800] AMP    25521.5   -88.32
645458 [S3458  3    345.00] AMP    27681.6   -86.56
647974 [S974   8    69.000] AMP     5348.8   -77.26
650091 [ROKEBY   1G 13.800] AMP    15993.2   -87.82
650092 [ROKEBY   2G 13.800] AMP    50432.6   -89.03
650093 [ROKEBY   3G 13.800] AMP    25970.4   -88.06
650185 [WAGENER   3 345.00] AMP    19351.9   -85.26
650214 [NW68HOLDRG7 115.00] AMP    24757.2   -84.67
650218 [3&VANDORN 7 115.00] AMP    21058.9   -82.81
650229 [27&PLR    7 115.00] AMP    19518.5   -84.36
650230 [2&N       7 115.00] AMP    25241.7   -83.86
650250 [40&ROKEBY 7 115.00] AMP    19981.8   -84.35
650258 [40&GERTIE 7 115.00] AMP    22268.4   -82.98
650270 [70&CALVERT7 115.00] AMP    25849.7   -84.03
650314 [NW68HOL1  9 13.800] AMP    26015.4   -89.45
650338 [20&PI    A9 13.200] AMP     8193.6   -89.78
650438 [20&PI    B9 13.200] AMP    10646.3   -87.39
650538 [381TERTIARY 7.2000] AMP    10470.9   -89.85
650638 [382TERTIARY 7.6200] AMP    10349.2   -89.84
652314 [GR ISL19    13.800] AMP    25206.2   -87.63
652316 [GR ISL29    13.800] AMP    25320.6   -87.63
652871 [GR ISLD-LNX3345.00] AMP    11488.3   -84.96
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Table F-2: GEN-2014-039 Short Circuit Analysis Results (2025SP)

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                              PSS®E-32.2.0 ASCC SHORT CIRCUIT CURRENTS          MON, MAR 20 2017  11:45
2015 MDWG FINAL WITH 2013 MMWG, UPDATED WITH 2014 SERC & MRO
MDWG 2025S WITH MMWG 2024S, MRO & SERC 2025 SUMMER

OPTIONS USED:
    - FLAT CONDITIONS
    - BUS VOLTAGES SET TO 1 PU AT 0 PHASE ANGLE
    - GENERATOR P=0, Q=0
    - TRANSFOMRER 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

                                   THREE PHASE FAULT
X---------- BUS ----------X          /I+/    AN(I+)
640174 [FRIEND 7    115.00] AMP     5949.4   -74.13
584090 [GEN-2014-039115.00] AMP     5949.4   -74.13
640153 [CRETE__7    115.00] AMP     8185.4   -74.33
640175 [FRIEND 9    34.500] AMP     3319.6   -84.46
640178 [GENEVA 7    115.00] AMP     9615.2   -78.79
643060 [FRIEND T1  913.800] AMP     4191.9   -88.67
584091 [G14-039XFMR134.500] AMP    10414.8   -82.07
640105 [CARLJCT7    115.00] AMP     5377.2   -77.68
640154 [CRETE  G    34.500] AMP    11128.6   -83.03
640179 [GENEVA 8    69.000] AMP     4123.0   -85.88
640272 [MCCOOL 7    115.00] AMP    13837.1   -84.03
640278 [SHELDON7    115.00] AMP    32612.2   -85.48
640372 [SUTTON 7    115.00] AMP     6250.4   -80.88
643048 [CRETE T1   913.800] AMP     8475.4   -86.06
643049 [CRETE T2   913.800] AMP     8503.0   -86.04
643062 [GENEVA T2  913.800] AMP     4012.3   -88.43
560746 [G13-002-TAP 115.00] AMP    28989.9   -85.19
584092 [G14-039-GSU134.500] AMP     9381.0   -79.44
640019 [SHELDN1G    13.800] AMP    85322.3   -88.77
640020 [SHELDN2G    13.800] AMP    92541.1   -88.96
640021 [HALLAM3G    13.800] AMP    34030.0   -88.93
640088 [BPS SUB7    115.00] AMP    15782.4   -81.94
640106 [CARLJCT9    34.500] AMP     3181.3   -85.65
640111 [CLATONA7    115.00] AMP    10203.7   -77.08
640171 [FIRTH  7    115.00] AMP     6097.1   -74.22
640218 [HEBRN N7    115.00] AMP     5514.9   -75.27
640271 [MCCOOL 3    345.00] AMP    10096.4   -84.54
640273 [MCCOOL     869.000] AMP     5441.4   -87.18
640274 [MCCOOL19    13.800] AMP    17368.9   -88.42
640277 [MOORE  3    345.00] AMP    20966.3   -85.39
640279 [SHELDON9    34.500] AMP     5184.8   -84.63
640280 [MOORE  9    13.800] AMP    31600.0   -87.69
640373 [SUTTON 8    69.000] AMP     3746.6   -85.37
640413 [YORK SW7    115.00] AMP     7957.1   -80.35
640415 [CARLJCT8    69.000] AMP     3547.3   -83.84
641087 [EGYCNTR7    115.00] AMP    17707.7   -83.44
643030 [CARLTNJCTT1913.800] AMP     4409.8   -88.80
643031 [CARLTNJCTT2913.800] AMP     3830.2   -87.44
643104 [SHELDON T4 913.800] AMP     2866.8   -89.95
643149 [SUTTON T1  913.800] AMP     3873.4   -87.79
643171 [MCCOOL T1  913.800] AMP     3977.9   -87.98
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650242 [FOLSM&PHIL7 115.00] AMP    27672.3   -84.70
560061 [G15-087-TAP 115.00] AMP     5371.2   -74.82
560062 [G15-088-TAP 345.00] AMP    10606.6   -85.08
583520 [GEN-2013-002115.00] AMP    28989.9   -85.19
583700 [GEN-2013-019115.00] AMP    22338.2   -84.59
640012 [HEBRON G    13.800] AMP    12961.9   -84.43
640022 [BPS GT1G    13.800] AMP    59972.3   -87.78
640023 [BPS GT2G    13.800] AMP    59923.3   -87.79
640024 [BPS ST3G    13.800] AMP    61412.7   -88.36
640076 [BEATRCE7    115.00] AMP    12970.8   -80.30
640112 [CLATONA9    34.500] AMP     3648.3   -85.96
640139 [COOPER 3    345.00] AMP    25017.5   -86.02
640172 [FIRTH  9    34.500] AMP     3369.2   -84.91
640215 [HASTING7    115.00] AMP    18877.8   -82.78
640220 [HEBRON 7    115.00] AMP     5251.4   -74.60
640362 [STERLNG7    115.00] AMP     4266.5   -74.13
640411 [YORK   7    115.00] AMP     7459.0   -78.36
640414 [YORK SW9    34.500] AMP     6288.1   -86.04
640447 [YORK.SW T2 869.000] AMP     2405.7   -85.22
641086 [EGY CTRG    13.800] AMP    36305.3   -88.29
641088 [HASTCTY7    115.00] AMP    18877.8   -82.78
641089 [EGYCTR2G    18.000] AMP    85140.7   -87.91
641090 [S. 281 7    115.00] AMP    10991.4   -81.99
643035 [CLATONIA T1913.800] AMP     3552.5   -89.47
643057 [FIRTH T1   913.800] AMP     3559.8   -88.91
643168 [YORK.SW T1 913.800] AMP     6634.8   -87.18
643176 [YORK.SW T2 913.800] AMP     3596.5   -88.57
650114 [NW68HOLDRG3 345.00] AMP    16373.7   -85.14
650189 [103&ROKEBY3 345.00] AMP    19575.8   -85.25
650238 [20PIONEERS7 115.00] AMP    27185.8   -84.05
650244 [SW7&BENNET7 115.00] AMP    21841.8   -84.45
650290 [ROKEBY    7 115.00] AMP    26184.4   -84.88
650342 [FOLSM&PHIL9 12.470] AMP     7360.1   -88.28
650542 [421TERTIARY 7.2000] AMP     9503.4   -89.89
652571 [GR ISLD3    345.00] AMP    11716.1   -84.98
300039 [7FAIRPT     345.00] AMP    11823.6   -84.47
541199 [ST JOE 3    345.00] AMP    18294.8   -84.87
583521 [G13-002XFMR134.500] AMP     7272.6   -87.66
583701 [G13-019XFMR134.500] AMP    10537.8   -87.39
585230 [GEN-2015-087115.00] AMP     4935.1   -75.38
585240 [GEN-2015-088345.00] AMP    10218.4   -84.86
635017 [ATCHSNT3    345.00] AMP    15022.7   -85.12
640009 [COOPER1G    22.000] AMP   265087.3   -88.17
640063 [AURORA_7    115.00] AMP     6898.4   -79.50
640074 [BEAT. S7    115.00] AMP     5195.1   -76.46
640077 [BEATRCE9    34.500] AMP     9584.2   -85.87
640125 [COLMB.E3    345.00] AMP     9552.5   -84.79
640140 [COOPER 5    161.00] AMP    17062.2   -87.07
640142 [COOPER T2  913.800] AMP    44377.9   -87.68
640169 [FAIRBRY7    115.00] AMP     5492.7   -74.21
640200 [GR ISLD4    230.00] AMP    15966.9   -84.88
640208 [HARBINE7    115.00] AMP     6980.2   -76.04
640214 [HASTING4    230.00] AMP     7177.1   -84.59
640216 [HASTING9    34.500] AMP     8976.0   -86.32
640221 [HEBRON 9    34.500] AMP     3260.5   -84.80
640312 [PAULINE3    345.00] AMP     7745.0   -84.32
640313 [PAULINE7    115.00] AMP    15984.9   -81.82
640361 [STEINER7    115.00] AMP     4373.4   -72.90
640368 [SUPEROR7    115.00] AMP     3347.0   -69.75
640374 [SWEET W3    345.00] AMP     9735.5   -85.27
640375 [TAMORA 7    115.00] AMP     5843.0   -75.45
640412 [YORK   9    34.500] AMP     6272.9   -85.40
640443 [YORK   8    69.000] AMP     2541.9   -83.74
641083 [D.HENRY7    115.00] AMP    11046.2   -81.84
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641085 [E7THST 7    115.00] AMP    17819.0   -82.54
641096 [S. 281 9    13.800] AMP     9770.2   -87.05
643013 [BEATRICE T1913.800] AMP     8055.9   -89.13
643014 [BEATRICE T2913.800] AMP     5863.4   -89.70
643071 [GR ISLD T6 913.800] AMP    37065.1   -88.20
643075 [HASTINGS T3913.800] AMP    23475.1   -86.81
643076 [HASTINGS T1913.800] AMP     2401.5   -87.44
643077 [HASTINGS T2913.800] AMP     7283.1   -85.90
643078 [HEBRON T1  913.800] AMP     3471.6   -88.79
643144 [STERLING T1913.800] AMP     5232.9   -85.11
643166 [YORK T1    913.800] AMP     6596.7   -87.14
643167 [YORK T2    913.800] AMP     3017.3   -89.44
643172 [COOPER T5  913.800] AMP    25524.4   -88.32
645458 [S3458  3    345.00] AMP    27853.4   -86.55
647974 [S974   8    69.000] AMP     5359.2   -77.25
650091 [ROKEBY   1G 13.800] AMP    16080.1   -87.86
650092 [ROKEBY   2G 13.800] AMP    50685.9   -89.07
650093 [ROKEBY   3G 13.800] AMP    50922.8   -89.01
650185 [WAGENER   3 345.00] AMP    19641.6   -85.29
650214 [NW68HOLDRG7 115.00] AMP    25409.2   -84.73
650218 [3&VANDORN 7 115.00] AMP    21664.8   -82.85
650229 [27&PLR    7 115.00] AMP    20465.1   -84.54
650230 [2&N       7 115.00] AMP    26012.5   -83.91
650250 [40&ROKEBY 7 115.00] AMP    20789.5   -84.48
650258 [40&GERTIE 7 115.00] AMP    22953.0   -83.02
650270 [70&CALVERT7 115.00] AMP    26659.0   -84.08
650314 [NW68HOL1  9 13.800] AMP    26106.8   -89.47
650338 [20&PI    A9 13.200] AMP     8205.0   -89.79
650438 [20&PI    B9 13.200] AMP    10665.6   -87.40
650538 [381TERTIARY 7.2000] AMP    10481.1   -89.86
650638 [382TERTIARY 7.6200] AMP    10359.7   -89.85
652314 [GR ISL19    13.800] AMP    25230.3   -87.64
652316 [GR ISL29    13.800] AMP    25344.8   -87.63
652871 [GR ISLD-LNX3345.00] AMP    11716.1   -84.98
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