GEN-2011-050 Impact Restudy for Generator Modification (Turbine Change)

September 2015
Generator Interconnection

Southwest Power Pool

Revision History

Date	Author	Change Description
9/3/2015	SPP	GEN-2011-050 Impact Restudy for Generator Modification (Turbine Change) issued.

Executive Summary

The GEN-2011-050 Interconnection Customer has requested a modification to its Generator Interconnection Request to change from a sixty-one (61) Vestas V90 1.8MW wind turbine generators (aggregate power of 109.8MW) to fifty-four (54) Vestas V110 2.0MW wind turbine generators (aggregate power of 108.0MW). The point of interconnection (POI) is a new substation on the AEP/Public Service Company of Oklahoma Duncan- Cornville 138kV line.

The study models used were the 2015 summer, the 2015 winter, and the 2025 summer cases and included Interconnection Requests through DISIS-2015-001. The restudy showed that no stability problems were found with the contingencies studied during the summer and the winter peak conditions as a result of changing to the Vestas V110 2.0MW wind turbine generators. 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 and GEN-2011-050 will be required to meet the 0.95 power factor lagging (providing vars) to 0.95 power factor leading (absorbing vars) at the POI. A short circuit analysis was performed and has been included in this report.

A low-wind/no-wind condition analysis was not performed for this modification request since the interconnection is to a 138kV substation. Typically this analysis is performed on interconnection requests where the POI is a 230kV or 345kV substation.

With the assumptions outlined in this report and with all required network upgrades in place, GEN-2011-050 with the Vestas V110 2.0MW wind turbine generators should be able to reliably interconnect to the SPP transmission grid.

It should be noted that this study analyzed the requested modification to change generator technology, manufacturer, and layout. 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 transmission service. If the Customer wishes to obtain deliverability to a specific customer, a separate request for transmission service shall be requested on Southwest Power Pool's OASIS.

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1. Introduction

The GEN-2011-050 Interconnection Customer has requested a modification to its Generator Interconnection Request to change from a sixty-one (61) Vestas V90 1.8MW wind turbine generators (aggregate power of 109.8MW) to fifty-four (54) Vestas V110 2.0MW wind turbine generators (aggregate power of 108.0MW). The point of interconnection (POI) is a new substation on the AEP/Public Service Company of Oklahoma Duncan-Cornville 138kV line. Table 1-1 shows the interconnection request.

Table 1-1: Interconnection Request

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2011-050	108.0	Vestas V110 2.0MW	New Substation on the AEP/PSO Duncan-Cornville 138kV line (Santa Fe Substation)

The prior-queued, equally-queued and lower queued requests shown in Table 1-2 were included in this study and the wind farms were dispatched to 100% of rated capacity.

Table 1-2: Prior and Later Queued Interconnection Requests

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2011-040	110.4	Vestas V100 2.0MW	Tap Ratliff – Pooleville 138 kV (Carter County)
GEN-2012-004	41.4	Vestas V100 2.0MW	Tap Ratliff – Pooleville 138 kV (Carter County)
GEN-2013-007	100.0	Vestas V100 2.0MW	Tap Arbuckle – Jollyville (Prices Fall – Carter Tap) 138 kV
GEN-2014-057	250.0	GE 2.0MW	Tap Lawton Eastside (LES) to Sunnyside 345kV

The study included a stability analysis of the interconnection request. Contingencies that resulted in a prior-queued project tripping off-line, if any, were re-run with the prior-queued project's voltage and frequency tripping relays disabled. Also a low-wind/no-wind analysis was performed on this project since it is a wind farm. The analyses were performed on three seasonal models, the modified versions of the 2015 summer peak, the 2015 winter peak, and the 2025 summer peak cases. The models included Interconnection Requests through DISIS-2015-001.

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 three-phase faults and the single line-to-ground faults listed in Table 3-1 were used in the stability analysis. A power factor analysis at the POI was performed and a short circuit analysis was performed on busses up to five levels away from the POI.

The low-wind/no-wind analysis determines the capacitive effect at the POI caused by the project's collector system and transmission line capacitance. This analysis is typically performed on interconnections to 230kV or 345kV, and therefore, was not performed for this modification request since the POI is 138kV.

Nothing in this study constitutes a request for transmission service or grants the Interconnection Customer any rights to transmission service.

2. Facilities

Generating Facility

The point of interconnection (POI) for the GEN-2011-050 interconnection request is a new substation on the AEP/PSO Duncan-Cornville 138kV line (Santa Fe Substation). ***Figure 2-1*** depicts the one-line diagram of the POI and the power flow model representing the request.

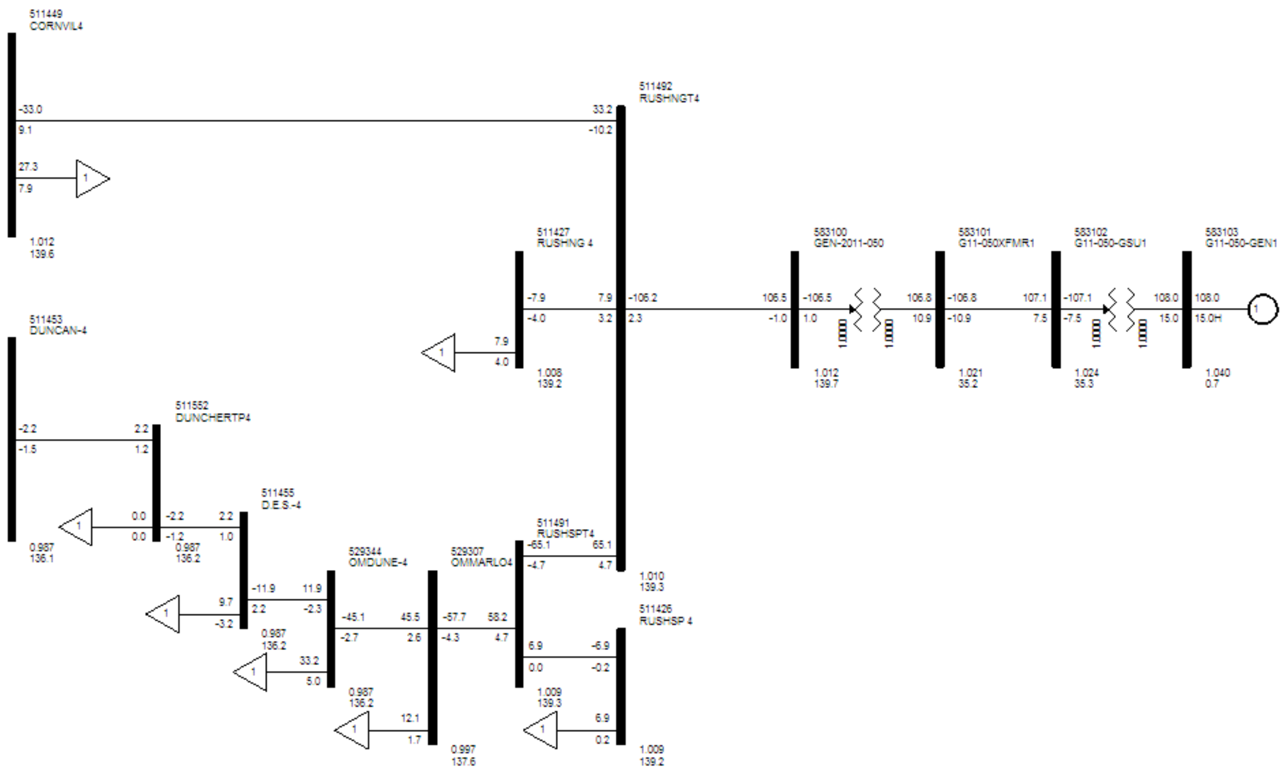

Figure 2-1: Proposed POI and Power Flow Model for GEN-2011-050

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 2014 series of Model Development Working Group (MDWG) dynamic study models including the 2015 summer peak, the 2015 winter 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

Twenty-one (21) contingencies were identified for use in this study and are listed in Table 3-1. These contingencies included three-phase faults and single-phase line faults at locations defined by SPP. Single-phase line faults were simulated by applying fault impedance to the positive sequence network at the fault location to represent the effect of the negative and zero sequence networks on the positive sequence network. The fault impedance was computed to give a positive sequence voltage at the specified fault location of approximately 60% of pre-fault voltage. This method is in agreement with SPP current practice.

Except for transformer faults, the typical sequence of events for a three-phase and a 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)

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
1	FLT01-3PH	3 phase fault on the RUSHNGT (511492) to Cornville (511449) 138kV line, near RUSHNGT. a. Apply fault at the RUSHNGT 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT02-1PH	*Single phase fault same as previous sequence*
3	FLT03-3PH	3 phase fault on the RUSHNGT (511492) to RUSHPT (511491) 138kV line, near RUSHNGT. a. Apply fault at the RUSHNGT 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT04-1PH	*Single phase fault same as previous sequence*
5	FLT05-3PH	3 phase fault on the Cornville (511449) to Norge (511843) 138kV line, near Cornville. a. Apply fault at the Cornville 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT06-1PH	*Single phase fault same as previous sequence*
7	FLT07-3PH	3 phase fault on the Cornville (511449) to Tuttle (511501) 138kV line, near Cornville. a. Apply fault at the Cornville 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
8	FLT08-1PH	*Single phase fault same as previous sequence*
9	FLT09-3PH	3 phase fault on the Cornville (511449) to N29CHIK (511502) 138kV line, near Cornville. a. Apply fault at the Cornville 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT10-1PH	*Single phase fault same as previous sequence*
11	FLT11-3PH	3 phase fault on the Cornville (511449) to Blanchard (511508) 138kV line, near Cornville. a. Apply fault at the Cornville 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT12-1PH	*Single phase fault same as previous sequence*
13	FLT13-3PH	3 phase fault on the Cornville (511449) to Cornville Tap (520867) 138kV line, near Cornville. a. Apply fault at the Cornville 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
14	FLT14-1PH	*Single phase fault same as previous sequence*
15	FLT15-3PH	3 phase fault on the RUSHPT (511491) to OMMARLO (529307) 138kV line, near RUSHPT. a. Apply fault at the RUSHPT 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT16-1PH	*Single phase fault same as previous sequence*
17	FLT17-3PH	3 phase fault on the Duncan (511453) to OMDuncan (529304) 138kV line, near RUSHPT. a. Apply fault at the RUSHPT 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
18	FLT18-1PH	*Single phase fault same as previous sequence*
19	FLT19-3PH	3 phase fault on the Duncan (511453) to DUNCHERTP (511552) 138kV line, near RUSHPT. a. Apply fault at the RUSHPT 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT20-1PH	*Single phase fault same as previous sequence*
21	FLT21-3PH	3 phase fault on the Cornville (511449) 138kV/(511450) 69kV/(511418) 13.8kV transformer, near Cornville 138kV. a. Apply fault at the Cornville 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
22	FLT22-3PH	3 phase fault on the Duncan (511453) 138kV/(511452) 69kV/(511410) 13.8kV transformer, near Duncan 138kV. a. Apply fault at the Duncan 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Results

The stability analysis was performed and the results are summarized in Table 3-2. Based on the stability results and with all network upgrades in service, GEN-2011-050 did not cause any stability problems and remained stable for all faults studied. No generators tripped or went unstable, and voltages recovered to acceptable levels.

Complete sets of plots for the stability analysis are available on request.

Table 3-2: Stability Analysis Results

Contingency Number and Name		2015SP	2015WP	2025SP
1	FLT01-3PH	Stable	Stable	Stable
2	FLT02-1PH	Stable	Stable	Stable
3	FLT03-3PH	Stable	Stable	Stable
4	FLT04-1PH	Stable	Stable	Stable
5	FLT05-3PH	Stable	Stable	Stable
6	FLT06-1PH	Stable	Stable	Stable
7	FLT07-3PH	Stable	Stable	Stable
8	FLT08-1PH	Stable	Stable	Stable
9	FLT09-3PH	Stable	Stable	Stable
10	FLT10-1PH	Stable	Stable	Stable
11	FLT11-3PH	Stable	Stable	Stable
12	FLT12-1PH	Stable	Stable	Stable
13	FLT13-3PH	Stable	Stable	Stable
14	FLT14-1PH	Stable	Stable	Stable
15	FLT15-3PH	Stable	Stable	Stable
16	FLT16-1PH	Stable	Stable	Stable
17	FLT17-3PH	Stable	Stable	Stable
18	FLT18-1PH	Stable	Stable	Stable
19	FLT19-3PH	Stable	Stable	Stable
20	FLT20-1PH	Stable	Stable	Stable
21	FLT21-3PH	Stable	Stable	Stable
22	FLT22-3PH	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.

Contingency 1 in Table 3-2 simulated the LVRT condition. GEN-2011-050 met the LVRT requirements by staying on line and the transmission system remaining stable.

4. Power Factor Analysis

A power factor analysis was performed for this change request. The results are listed in the tables shown in **Appendix B: Power Factor Analysis**. The final power factor requirement for GEN-2011-050 will be the pro-forma 95% lagging to 95% leading at the POI.

5. Reduced Generation Analysis

Interconnection requests for wind generation projects that interconnect to a 345kV or 230kV bus on the SPP system are analyzed for the capacitive charging effects during reduced generation conditions (due to unsuitable wind speeds, curtailment, etc.) at the generation site.

Model Preparation

The project generators and capacitors (if any), and all other wind projects that share the same POI, were turned off in the base case. The resulting reactive power injection into the transmission network comes from the capacitance of the project's transmission lines and collector cables. This reactive power injection is measured at the POI. Shunt reactors were added at the study project substation low voltage bus to bring the Mvar flow into the POI down to approximately zero.

Results

The reduced generation (low-wind/no-wind condition) analysis was not performed for this modification request.

6. Short Circuit Analysis

The short circuit analysis was performed on the 2025 Summer Peak power flow case 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. **Appendix D: Short Circuit Analysis** contains as listing of the short circuit currents.

7. Conclusion

The SPP GEN-2011-050 Impact Restudy evaluated the impact of interconnecting the project shown below in Table 7-1.

Table 7-1: Interconnection Request

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2011-050	108.0	Vestas V110 2.0MW	New Substation on the AEP/PSO Duncan-Cornville 138kV line (Santa Fe Substation)

With all Base Case Network Upgrades in service, previously assigned Network Upgrades in service, and required capacitor banks in service, the GEN-2011-050 project was found to remain on line, and the transmission system was found to remain stable for all conditions studied.

A low-wind/no-wind condition analysis was not performed for this modification request.

A power factor analysis was performed for this study. GEN-2011-050 will be required to meet 0.95 power factor lagging (providing vars) to 0.95 power factor leading (absorbing vars) at the POI.

Low Voltage Ride Through (LVRT) analysis showed the study generators did not trip offline due to low voltage when all Network Upgrades are in service.

All generators in the monitored areas remained stable for all of the modeled disturbances.

Any changes to the assumptions made in this study, for example, one or more of the previously queued requests withdraw, may require a re-study at the expense of the Customer.

Nothing in this System Impact Study constitutes a request for transmission service or confers upon the Interconnection Customer any right to receive transmission service.

APPENDIX A: PLOTS

Available on request

APPENDIX B: POWER FACTOR ANALYSIS

A Power Factor Analysis was performed and the results are shown in Tables B-1 through B-3. Only three phase N-1 contingencies were evaluated. GEN-2011-050 will be required to meet 0.95 power factor lagging (providing vars) to 0.95 power factor leading (absorbing vars) at the POI.

GEN-2011-050 Turbine Restudy POI - RUSHNGT4 138.00 138.0 (511492)		**2015 Summer Voltage = 1.0 pu**			
Cont. No.	**Contingency Name**	**Power at POI**	**VARS at POI**	**Power Factor**	
0	FLT_00_NoFault	108	-19.26	0.98	LEAD
1	FLT_01_RUSHNGT_Cornville_138kV	108	-8.74	1.00	LEAD
3	FLT_03_RUSHNGT_RUSHPT_138kV	108	-28.07	0.97	LEAD
5	FLT_05_Cornville_Norge_138kV	108	-20.04	0.98	LEAD
7	FLT_07_Cornville_Tuttle_138kV	108	-11.95	0.99	LEAD
9	FLT_09_Cornville_N29CHIK_138kV	108	-15.17	0.99	LEAD
11	FLT_11_Cornville_Blanchard_138kV	108	-17.86	0.99	LEAD
13	FLT_13_Cornville_CornvilleTap_138kV	108	-19.37	0.98	LEAD
15	FLT_15_RUSHPT_OMMARLO_138kV	108	-27.37	0.97	LEAD
17	FLT_17_Duncan_OMDuncan_138kV	108	-12.71	0.99	LEAD
19	FLT_19_Duncan_DUNCHERTP_138kV	108	-16.13	0.99	LEAD

Table B-1: Power Factor Analysis – 2015 Summer

GEN-2011-050 Turbine Restudy POI - RUSHNGT4 138.00 138.306610107 (511492)		2015 Winter Voltage = 1.00222182274 pu			
Cont. No.	**Contingency Name**	**Power at POI**	**VARS at POI**	**Power Factor**	
0	FLT_00_NoFault	108	-28.06	0.97	LEAD
1	FLT_01_RUSHNGT_Cornville_138kV	108	-9.63	1.00	LEAD
3	FLT_03_RUSHNGT_RUSHPT_138kV	108	-33.64	0.95	LEAD
5	FLT_05_Cornville_Norge_138kV	108	-28.21	0.97	LEAD
7	FLT_07_Cornville_Tuttle_138kV	108	-20.54	0.98	LEAD
9	FLT_09_Cornville_N29CHIK_138kV	108	-25.71	0.97	LEAD
11	FLT_11_Cornville_Blanchard_138kV	108	-25.85	0.97	LEAD
13	FLT_13_Cornville_CornvilleTap_138kV	108	-27.38	0.97	LEAD
15	FLT_15_RUSHPT_OMMARLO_138kV	108	-33.27	0.96	LEAD
17	FLT_17_Duncan_OMDuncan_138kV	108	-24.56	0.98	LEAD
19	FLT_19_Duncan_DUNCHERTP_138kV	108	-25.20	0.97	LEAD

Table B-2: Power Factor Analysis – 2015 Winter

GEN-2011-050 Turbine Restudy POI - RUSHNGT4 138.00 138.0 (511492)		2025 Summer Voltage = 1.0 pu			
Cont. No.	**Contingency Name**	**Power at POI**	**VARS at POI**	**Power Factor**	
0	FLT_00_NoFault	108	-7.91	1.00	LEAD
1	FLT_01_RUSHNGT_Cornville_138kV	108	2.69	1.00	LAG
3	FLT_03_RUSHNGT_RUSHPT_138kV	108	-18.60	0.99	LEAD
5	FLT_05_Cornville_Norge_138kV	108	-8.14	1.00	LEAD
7	FLT_07_Cornville_Tuttle_138kV	108	-0.30	1.00	LEAD
9	FLT_09_Cornville_N29CHIK_138kV	108	-2.63	1.00	LEAD
11	FLT_11_Cornville_Blanchard_138kV	108	-7.78	1.00	LEAD
13	FLT_13_Cornville_CornvilleTap_138kV	108	-8.70	1.00	LEAD
14	FLT_14_Cornville_CornvilleTap_138kV	108	-8.70	1.00	LEAD
16	FLT_16_RUSHPT_OMMARLO_138kV	108	-17.75	0.99	LEAD
17	FLT_17_Duncan_OMDuncan_138kV	108	2.37	1.00	LAG
19	FLT_19_Duncan_DUNCHERTP_138kV	108	-3.17	1.00	LEAD

Table B-3: Power Factor Analysis – 2025 Summer

APPENDIX C: REDUCED GENERATION ANALYSIS

This analysis was not performed for this modification request.

APPENDIX D: SHORT CIRCUIT ANALYSIS

Table D-1: Short Circuit Currents at GEN-2011-050 POI (Rushing National Gas Tap 138kV) and five levels away

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                              PSS(R)E-32.2.2 ASCC SHORT CIRCUIT CURRENTS
WED, SEP 02 2015  15:00
2014 MDWG PASS 8   WITH 2013 MMWG
MDWG 2025S WITH MMWG 2024S

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+)
511492 [RUSHNGT4    138.00] AMP     7538.2   -77.55
511427 [RUSHNG 4    138.00] AMP     5166.2   -78.11
511449 [CORNVIL4    138.00] AMP    16371.1   -77.53
511491 [RUSHSPT4    138.00] AMP     7285.6   -77.29
583100 [GEN-2011-050138.00] AMP     6325.5   -78.83
511418 [CORNV2-1    13.800] AMP     8435.5   -88.31
511426 [RUSHSP 4    138.00] AMP     6336.0   -76.92
511450 [CORNVIL2    69.000] AMP     6518.9   -84.36
511483 [NORGE--4    138.00] AMP    11344.5   -75.28
511501 [TUTTLE4     138.00] AMP    10525.3   -80.89
511502 [N29CHIK4    138.00] AMP    10370.8   -79.60
511508 [BLANCHD4    138.00] AMP     5835.2   -68.20
511516 [ALEX BR4    138.00] AMP     4761.9   -81.62
511560 [GRADY  4    138.00] AMP     4069.6   -79.41
520867 [CORN TP4    138.00] AMP    14003.0   -76.96
529307 [OMMARLO4    138.00] AMP     5890.6   -72.26
583101 [G11-050XFMR134.500] AMP    15820.8   -84.58
511421 [VERDEN 4    138.00] AMP     9849.3   -80.58
511425 [TUTCONT4    138.00] AMP    10627.0   -80.92
511451 [CYRIL--2    69.000] AMP     4639.6   -75.02
511477 [S.W.S.-4    138.00] AMP    33601.4   -84.61
511515 [TEXAS  4    138.00] AMP     3518.5   -82.05
515055 [MAUD   4    138.00] AMP    21514.4   -79.30
520814 [ANADARK4    138.00] AMP    32372.4   -84.56
520888 [PAYNE       138.00] AMP     9084.7   -76.75
529344 [OMDUNE-4    138.00] AMP     5740.4   -70.27
583102 [G11-050-GSU134.500] AMP    15721.8   -84.55
583900 [GEN-2014-020138.00] AMP    10525.3   -80.89
510948 [EARLSBORO  4138.00] AMP     7618.0   -71.59
511413 [SWS#1--1    13.800] AMP     6315.6   -87.23
511423 [FLE TAP4    138.00] AMP     8516.3   -81.04
511424 [T-CONCO4    138.00] AMP     6897.0   -74.79
511445 [CARNEG-4    138.00] AMP     5756.0   -75.57
511455 [D.E.S.-4    138.00] AMP     5807.3   -70.18
511476 [S.W.S.-2    69.000] AMP     4216.7   -87.57
511486 [ELGINJT4    138.00] AMP     9897.8   -81.05
511487 [ELGINJT2    69.000] AMP     8463.6   -81.51
511514 [PHILPS 4    138.00] AMP     3351.4   -82.11
511846 [SWS1-1      14.400] AMP    58593.1   -88.58
511847 [SWS2-1      14.400] AMP    58593.1   -88.58
511848 [SWS3-1      24.000] AMP    88697.7   -87.76
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511849	[SWS NG4 13.800]	AMP	61549.2	-89.42
511850	[SWS NG5 13.800]	AMP	61597.0	-89.40
514898	[CIMARON4 138.00]	AMP	40879.5	-85.08
515044	[SEMINOL4 138.00]	AMP	57593.1	-86.91
515054	[MAUD 2 69.000]	AMP	11963.5	-79.16
515075	[FRSTHIL4 138.00]	AMP	13962.1	-76.94
515736	[MAUD 1 13.200]	AMP	20150.4	-86.58
515802	[GRACMNT4 138.00]	AMP	28017.7	-84.80
520810	[ANADARK2 69.000]	AMP	23323.6	-84.86
520811	[ANADRK4 13.800]	AMP	54377.8	-88.95
520812	[ANADRK5 13.800]	AMP	54439.9	-88.92
520813	[ANADRK6 13.800]	AMP	54375.7	-88.91
520828	[BLANCHD4 138.00]	AMP	21320.0	-84.08
520868	[CRINER 138.00]	AMP	8503.9	-77.45
520923	[GEORGIA4 138.00]	AMP	18176.9	-84.25
521023	[PAOLI 4 138.00]	AMP	6995.1	-76.09
521031	[POCASET4 138.00]	AMP	7613.3	-80.80
521089	[WASHITA4 138.00]	AMP	27635.8	-84.30
521101	[GENCO1 4 13.800]	AMP	32300.1	-88.25
521102	[GENCO2 4 13.800]	AMP	32363.0	-88.21
521110	[ORME1 13.800]	AMP	50384.0	-88.84
521111	[ORME2 13.800]	AMP	50384.0	-88.84
521112	[ORME3 13.800]	AMP	50384.0	-88.84
521129	[BLUCAN5 4 138.00]	AMP	5737.9	-77.83
521181	[ADRKTERT 13.800]	AMP	21927.5	-86.64
583901	[G14-020XFMR134.500]	AMP	16408.0	-85.11
510877	[FIXCT4 138.00]	AMP	7248.7	-71.48
511412	[ELGJT1-1 13.800]	AMP	10198.5	-88.26
511422	[FLETCHR4 138.00]	AMP	7795.0	-80.44
511443	[BING-TP2 69.000]	AMP	2666.4	-76.03
511463	[HOB-JCT4 138.00]	AMP	6241.4	-76.96
511467	[L.E.S.-4 138.00]	AMP	23417.0	-84.30
511473	[PO.HILL2 69.000]	AMP	5791.8	-77.31
511513	[LWATER 4 138.00]	AMP	2877.8	-82.28
511552	[DUNCHERTP4 138.00]	AMP	6008.9	-70.05
514819	[EL-RENO4 138.00]	AMP	15075.1	-80.16
514820	[JENSENT4 138.00]	AMP	14924.0	-79.64
514863	[HAYMAKR4 138.00]	AMP	25294.3	-82.50
514894	[CZECHAL4 138.00]	AMP	25969.1	-82.85
514895	[SARA 4 138.00]	AMP	18413.1	-84.13
514901	[CIMARON7 345.00]	AMP	30042.5	-85.94
515040	[SEMINL1G 20.900]	AMP	206555.8	-88.81
515045	[SEMINOL7 345.00]	AMP	28113.9	-86.70
515053	[PEARSNT2 69.000]	AMP	4479.9	-69.44
515073	[ERLSBOR2 69.000]	AMP	8403.6	-69.63
515074	[FRSTHIL2 69.000]	AMP	11146.4	-78.78
515100	[PAOLI- 4 138.00]	AMP	10162.1	-79.48
515178	[PARKLN 4 138.00]	AMP	16922.1	-81.36
515286	[STRLGTP4 138.00]	AMP	13769.8	-76.87
515423	[SEMINL4G 20.900]	AMP	206555.8	-88.81
515496	[KNAWATP2 69.000]	AMP	4498.0	-65.26
515499	[SEMINL5G 20.900]	AMP	206555.8	-88.81
515503	[LTRIVRT2 69.000]	AMP	4802.4	-74.46
515531	[VANOSTP4 138.00]	AMP	13709.9	-78.35
515714	[CIMARO11 13.800]	AMP	37457.6	-88.58
515715	[CIMARO21 13.800]	AMP	52152.8	-87.61
515725	[FRSTHIL1 13.800]	AMP	13423.5	-87.08
515756	[SEMINO11 14.400]	AMP	38529.8	-88.71
515757	[SEMINO21 14.400]	AMP	23645.7	-87.86
515800	[GRACMNT7 345.00]	AMP	14473.3	-85.21
515801	[GRCMNT11 13.800]	AMP	44875.7	-87.76
520395	[SLICKHILLS 138.00]	AMP	12536.8	-85.05
520401	[BLUCAN5-LVB134.500]	AMP	10243.1	-84.93
520807	[ANADRK1 13.800]	AMP	9601.3	-89.58
520808	[ANADRK2 13.800]	AMP	9601.3	-89.58
520809	[ANADRK3 13.800]	AMP	43918.6	-89.52
520822	[BASELIN4 138.00]	AMP	4550.6	-75.70

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520838 [CADDO  2    69.000] AMP    14948.0   -78.30
520854 [CIVIT  4    138.00] AMP     5054.3   -75.59
520859 [COGAR  2    69.000] AMP     4177.5   -70.84
520861 [COLE        138.00] AMP    10743.1   -79.56
520870 [CYRIL  2    69.000] AMP     6650.9   -81.28
520912 [FLETCH-4    138.00] AMP     7408.1   -82.48
521017 [ONEY   4    138.00] AMP    10646.9   -82.76
521022 [PAOLI  2    69.000] AMP     6213.2   -80.15
521024 [PARADSE4    138.00] AMP     5469.4   -77.62
521072 [TUTTLE 4    138.00] AMP     6521.7   -80.37
521088 [WASHITA2    69.000] AMP     9774.3   -79.37
521104 [OU SW 4     138.00] AMP    14051.1   -81.64
521174 [PAOLTERT    13.800] AMP    10171.6   -87.93
521179 [WASHTERT    13.800] AMP    10179.3   -87.58
583902 [G14-020-GSU134.500] AMP    15967.4   -84.25
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