GEN-2010-005 Impact Restudy for Generator Modification (Turbine Change)

March 2017
Generator Interconnection

SPP *Southwest Power Pool*

Revision History

Date	Author	Change Description
3/6/2017	SPP	GEN-2010-005 Impact Restudy for Generator Modification Report Issued

Executive Summary

The GEN-2010-005 Interconnection Customer has requested a modification to its Generator Interconnection Request to change wind turbine generators for its Phase II construction of the project. Originally, Phase I and Phase II consisted of one-hundred eighty-seven (187) GE 1.6MW wind turbines for a total 299.2 MW. The requested change is one hundred seven (107) GE 1.6MW wind turbines in Phase I which is in commercial operation and sixty-four (64) Vestas V110 2.0MW wind turbines in Phase II which is yet to be constructed. The total power remains at 299.2MW. The point of interconnection (POI) is the Westar Energy, Inc (WERE) Viola Substation 345kV.

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-2010-005, 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.

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-2010-05 with the GE 1.6MW and Vestas V110 2.0MW wind turbine generators should be able to interconnect reliably to the SPP transmission grid.

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.

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1. Introduction

The GEN-2010-005 Interconnection Customer has requested a modification to its Generator Interconnection Request to change its Phase II generators from GE 1.6 MW wind turbines to Vestas 2.0 MW wind turbines. Originally, Phase I and Phase II consisted of one-hundred eighty-seven (187) GE 1.6MW wind turbines for a total 299.2 MW. The requested change is shown in **Table 1-1**.

Table 1-1: Interconnection Request

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2010-005	299.2	107 x GE 1.6 (Phase I) = 171.2MW, and 64 x Vestas V110 2.0 (Phase II) = 128.0MW	Viola 345kV (532798)

The POI is the WERE Viola Substation 345kV. 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
GEN-2002-004	199.5	GE.1.5MW	Latham 345kV (532800)
GEN-2005-013	199.8	Vestes V90 1.8MW	Caney River 345kV (532780)
GEN-2007-025	299.2	GE 1.6MW	Viola 345kV (532798)
GEN-2008-013	300	G.E. 1.68MW	Hunter 345kV (515476)
GEN-2008-021	1261 Summer 1283 Winter	GENROU	Wolf Creek 345kV (532797)
GEN-2008-098	100.8	Vestas V100 1.8MW	Tap on the Wolf Creek – LaCygne 345kV line (560004)
GEN-2009-025	59.8	Siemens 2.3MW	Tap on the Deerck – Sincblk 69KV line (515528)
GEN-2010-003	100.8	Vestas V100 1.8MW	Tap on the Wolf Creek – LaCygne 345kV line (560004)
GEN-2010-005	299.2	GE 1.6MW	Viola 345kV (532798)
ASGI-2010-006	150	GE1.5MW	Remington 138kV (301369)
GEN-2010-055	4.8	GENROU	Wekiwa 138kV (509757)
GEN-2011-057	150.4	GE 1.6MW	Creswell 138kV (532981)
GEN-2012-027	150.7	GE 1.62MW	Shidler 138kV (510403)
KCPL Distributed: Osawatomie	76.0	GENROU (543078)	Paola 161kV
GEN-2012-032	300	Vestas V112 3.0MW	Tap Rose Hill-Sooner 345kV (562318)
GEN-2012-033	98.8	GE 1.62MW	Tap Bunch Creek-South 4th 138kV(562303)
GEN-2012-040	76.5	GE 1.7MW	Chilocco 138kV (521198)
GEN-2012-041	85 Summer 121.5 Winter	GENROU	Tap Rose Hill-Sooner 345kV (562318)
GEN-2013-012	4 x 168.0MW Summer 4 x 215MW Winter	GENROU (514910) (514911) (514912) (514942)	Redbud 345kV (514909)
GEN-2013-028	516.4 Summer 559.5 Winter	GENROU (583743, 583746)	Tap on Tulsa N to GRDA1 345kV (562423)
GEN-2013-029	300	Vestas V100 VCSS 2MW (583753, 583756)	Renfrow 345kV(515543)
GEN-2014-001	200.6	GE 1.7MW 100m (583853,583856)	Tap Wichita to Emporia Energy Center 345kV (562476)

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

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2014-028	35 (Uprate) (Pgen=259W/256S)	GENROU	Riverton 161kV (547469)
GEN-2014-064	248.4	GE 2.3MW	Otter 138kV (514708)
ASGI-2014-014	56.4W/54.3S	GENROU	Ferguson 69kV (512664)
GEN-2015-001	200.0	Vestas V110 2.0MW	Ranch Road 345kV
GEN-2015-015	154.6	Siemens 2.3MW with Power Boost (115kW => 2.415MW)	Tap Medford Tap – Coyote 138kV
GEN-2015-016	200.0	Vestas V110 2.0MW	Tap Centerville – Marmaton 161kV
GEN-2015-024	220.0	GE 2.0MW	Tap on Thistle to Wichita 345kV, ckt1&2 (560033)
GEN-2015-025	220.0	GE 2.0MW	Tap on Thistle to Wichita 345kV, ckt1&2 (560033)
GEN-2015-028	3.0 uprate to GEN-2009-025 for total 62.8MW	Siemens 2.3MW with Power Boost (115kW => 2.415MW)	Nardins 69kV
GEN-2015-030	200.1	GE 2.3MW	Sooner 345kV
ASGI-2015-004	54.300 Summer 56.364 Winter	GENSAL	Coffeyville Municipal Light & Power Northern Industrial Park Substation 69kV (512735)
GEN-2015-034	200	Vestes V112- 2MW (wind)	Ranch Road 345kV (515576)
GEN-2015-047	300	Vestes V110-2MW (wind)	Sooner 345kV Tap (514803)
GEN-2015-052	300	Vestes V110-2MW (wind)	Tap on Opensky (515621) to RoseHill (532794) 345 kV (560053)
GEN-2015-062	4.5	G.E. 1.79MW (wind)	Breckenridge 138kV (514815)
GEN-2015-063	300	Vestes V110-2MW (wind)	Tap on Woodring (514715) to Matthewson (515497) 345 kV (560055)
GEN-2015-066	248	G.E. 2.3MW (wind)	Tap on Cleveland (512694) to Sooner (514803) 345 kV (560056)
GEN-2015-067	150	PV inverter user model (solar)	Sooner 138kV (514802)
GEN-2015-069	300	Vestes V110-2MW (wind)	Union Ridge 230kV (532874)
GEN-2015-073	200.1	Siemens 2.3MW (wind)	Emporia/Lang 345kV (532768)
GEN-02015-083	125	G.E. 2.3MW (wind)	Belle Plain 138kV (533063)
GEN-2015-090	220	G.E. 2MW (wind)	Wichita (532796)-Thistle (539801) 345kV Tap (GEN-2015-024 (560033) 345kV)

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-2010-005. GEN-2007-025 has been included in the one-line because it is owned by the interconnection customer and GEN-2010-005 interconnects to the POI through GEN-2007-025. Phase II of GEN-2010-005 is shown in the red box in the one-line.

Figure 2-1*:* **GEN-2010-005 (and GEN-2007-025) One-line Diagram**
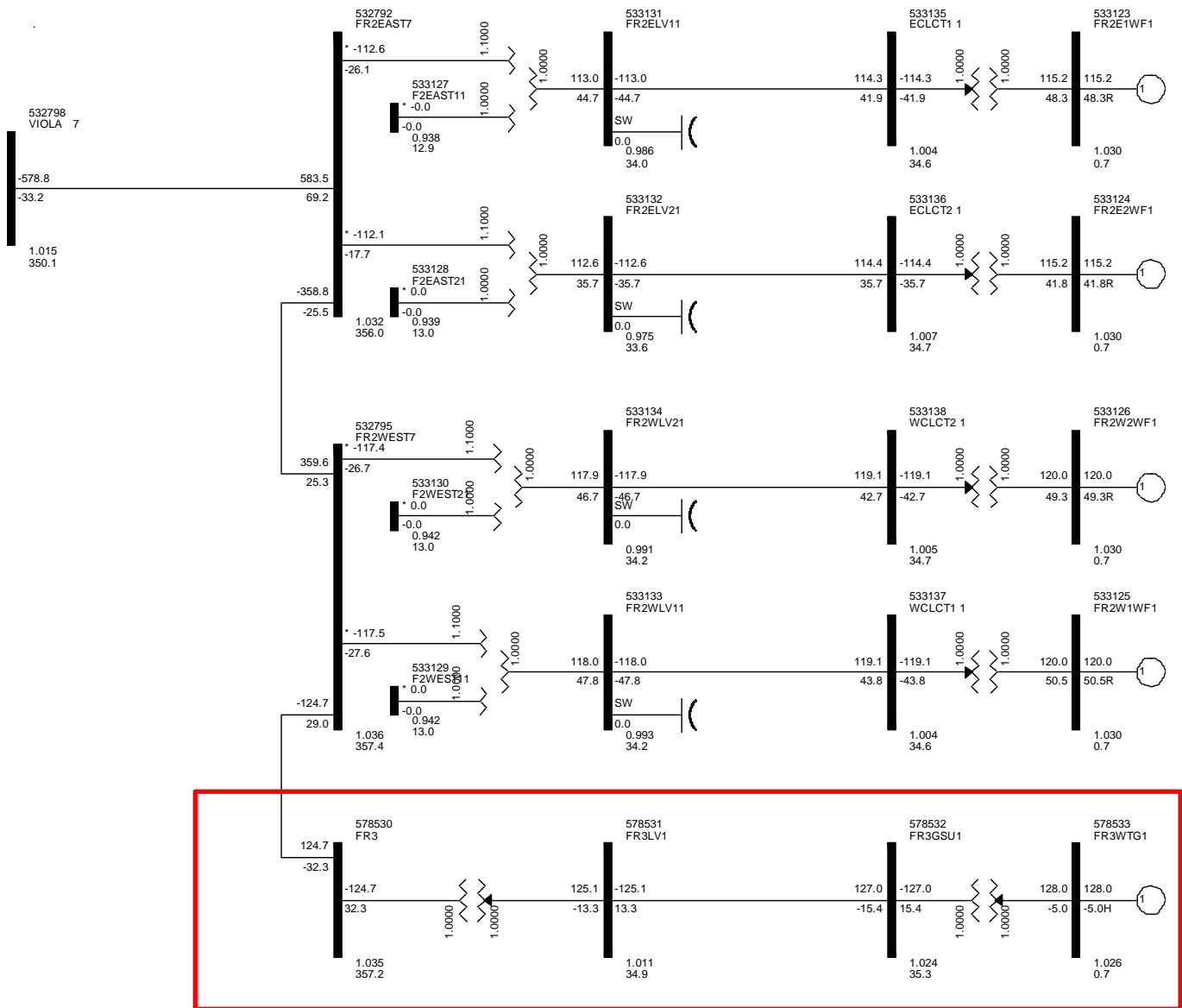
3. Stability Analysis

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

Ninety (90) 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:

- 520: American Electric Power (AEPW)
- 524: Oklahoma Gas and Electric Company (OKGE)
- 525: Western Farmers Electric Cooperative (WFEC)
- 526: Southwestern Public Service (SPS)

- 531: Midwest Energy, Inc. (MIDW)
- 534: Sunflower Electric Power Corp. (SUNC)
- 536: Westar Energy, Inc. (WERE)
- 541: Kansas City Power and Light (KCPL)

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
0	FLT_000_NOFAULT	No Fault Conditions
1	FLT_01_Viola_Renfrow_345kV_3PH	3 phase fault on the Viola (532798) to Renfrow (515543) 345kV line, near Viola. a. Apply fault at the Viola 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT_02_Viola_Wichita_345kV_3PH	3 phase fault on the Viola (532798) to Wichita (532796) 345kV line, near Viola. a. Apply fault at the Viola 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
3	FLT_03_Renfrow_Hunter_345kV_3PH	3 phase fault on the Renfrow (515543) to Hunter (515476) 345kV line, near Renfrow. a. Apply fault at the Renfrow 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT_04_Renfrow_Renfrow_345_138kV_3PH	3 phase fault on the Renfrow 345kV (515543) to Renfrow 138kV (515544) to Renfrow 13.8kV (515545) transformer, near Renfrow 345kV. a. Apply fault at the Renfrow 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
5	FLT_05_Hunter_Woodring_345kV_3PH	3 phase fault on the Hunter (515476) to Woodring (514715) 345kV line, near Hunter. a. Apply fault at the Hunter 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT_06_Woodring_Sooner_345kV_3PH	3 phase fault on Woodring (514715) to Sooner (514803) 345kV line, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
7	FLT_07_Woodring_G15063Tap_345kV_3PH	3 phase fault on Woodring (514715) to G1506Tap (560055) 345kV line, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
8	FLT_08_Woodring_Woodring_345_138kV_3PH	3 phase fault on the Woodring 345kV (514715) to Woodring 138kV (514714) to Woodring 13.8kV (515770) transformer, near Woodring 345kV. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
9	FLT_09_Mathewson_Northwest_345kV_3PH	3 phase fault on the Mathewson (515497) to Northwest (514880) 345kV line, near Mathewson. a. Apply fault at the Mathewson 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
10	FLT_10_Mathewson_Cimarron_345kV_3PH	3 phase fault on the Mathewson (515497) to Cimarron (514901) 345kV line, near Mathewson. a. Apply fault at the Mathewson 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
11	FLT_11_Mathewson_Tatonga_345kV_3PH	3 phase fault on the Mathewson (515497) to Tatonga (515407) 345kV line, near Mathewson. a. Apply fault at the Mathewson 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT_12_Sooner_SpringCreek_345kV_3PH	3 phase fault on the Sooner (514803) to Spring Creek (514881) 345kV line, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
13	FLT_13_Sooner_G15066T_345kV_3PH	3 phase fault on the Sooner (514803) to G15066T (560056) 345kV line, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
14	FLT_14_Sooner_Sooner_345_138kV_3PH	3 phase fault on the Sooner 345kV (514803) to Sooner 138kV (514802) to Sooner 13.8kV (515760) transformer, near Sooner 345kV. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
15	FLT_15_RanchRoad_Sooner_345kV_3PH	3 phase fault on the Ranch Road (515576) to Sooner (514803) 345kV line, near Ranch Road. a. Apply fault at the Ranch Road 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT_16_RanchRoad_OpenSky_345kV_3PH	3 phase fault on the Ranch Road (515576) to Open Sky (515621) 345kV line, near Ranch Road. a. Apply fault at the Ranch Road 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
17	FLT_17_Rosehill_Benton_345kV_3PH	3 phase fault on the Rosehill (532794) to Benton (532791) 345kV line, near Rosehill. a. Apply fault at the Rosehill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
18	FLT_18_Rosehill_WolfCreek_345kV_3PH	3 phase fault on the Rosehill (532794) to Wolf Creek (532797) 345kV line, near Rosehill. a. Apply fault at the Rosehill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
19	FLT_19_Rosehill_Latham_345kV_3PH	3 phase fault on the Rosehill (532794) to Latham (532800) 345kV line, near Rosehill. a. Apply fault at the Rosehill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT_20_Rosehill_G15052T_345kV_3PH	3 phase fault on the Rosehill (532794) to G15052T (560053) 345kV line, near Rosehill. a. Apply fault at the Rosehill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
21	FLT_21_Rosehill_Rosehill_345_138kV_3PH	3 phase fault on the Rosehill 345kV (532794) to Rosehill 138kV (533062) to Rosehill 13.8kV (532831) transformer, near Rosehill 345kV. a. Apply fault at the Rosehill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
22	FLT_22_Northwest_SpringCreek_345kV_3PH	3 phase fault on the Northwest (514880) to Spring Creek (514881) 345kV line, near Northwest. a. Apply fault at the Northwest 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
23	FLT_23_Northwest_Cimarron_345kV_3PH	3 phase fault on the Northwest (514880) to Cimarron (514901) 345kV line, near Northwest. a. Apply fault at the Northwest 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
24	FLT_24_Northwest_Arcadia_345kV_3PH	3 phase fault on the Northwest (514880) to Arcadia (514908) 345kV line, near Northwest. a. Apply fault at the Northwest 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
25	FLT_25_Northwest_Northwest_345_138kV_3PH	3 phase fault on the Northwest 345kV (514880) to Northwest 138kV (514879) to Northwest 13.8kV (515742) transformer, near Northwest 345kV. a. Apply fault at the Northwest 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
26	FLT_26_Benton_WolfCreek_345kV_3PH	3 phase fault on the Benton (532791) to Wolf Creek (532796) 345kV line, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
27	FLT_27_Benton_Benton_345_138kV_3PH	3 phase fault on the Benton 345kV (532791) to Benton 138kV (532986) to Benton 13.8kV (532821) transformer, near Benton 345kV. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
28	FLT_28_Wichita_Reno_345kV_3PH	3 phase fault on the Wichita (532796) to Reno (532771) 345kV line, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
29	FLT_29_Wichita_Benton_345kV_3PH	3 phase fault on the Wichita (532796) to Benton (532791) 345kV line, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
30	FLT_30_Wichita_G1524&1525T_345kV_3PH	3 phase fault on the Wichita (532796) to G1525&G1525T (560033) 345kV line, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
31	FLT_31_Wichita_Evans_345_138kV_3PH	3 phase fault on the Wichita 345kV (532796) to Evans 138kV (533040) to Evans 13.8kV (532830) transformer, near Wichita 345kV. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
32	FLT_32_Thistle_G1524&1525T_345kV_3PH	3 phase fault on the Thistle (539801) to G1524&G1525T (560033) 345kV line, near Thistle. a. Apply fault at the Thistle 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
33	FLT_33_Thistle_Woodward_345kV_3PH	3 phase fault on the Thistle (539801) to Woodward (515375) 345kV line, near Thistle. a. Apply fault at the Thistle 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
34	FLT_34_Thistle_ClarkCounty_345kV_3PH	3 phase fault on the Thistle (539801) to Clark County (539800) 345kV line, near Thistle. a. Apply fault at the Thistle 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
35	FLT_35_Thistle_Thistle_345_138kV_3PH	3 phase fault on the Thistle 345kV (539801) to Thistle 138kV (539804) to Thistle 13.8kV (539802) transformer, near Thistle 345kV. a. Apply fault at the Thistle 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
36	FLT_36_Reno_Summit_345kV_3PH	3 phase fault on the Reno (532771) to Summit (532773) 345kV line, near Reno. a. Apply fault at the Reno 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
37	FLT_37_Reno_Reno_345_115kV_3PH	3 phase fault on the Reno 345kV (532771) to Reno 138kV (533416) to Reno 14.4kV (532807) transformer, near Reno 345kV. a. Apply fault at the Reno 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
38	FLT_38_Summit_Blustem_345kV_3PH	3 phase fault on the Summit (532773) to Blustem (532767) 345kV line, near Summit. a. Apply fault at the Summit 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
39	FLT_39_Summit_ElmCreek_345kV_3PH	3 phase fault on the Summit (532773) to Elm Creek (539805) 345kV line, near Summit. a. Apply fault at the Summit 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
40	FLT_40_Summit_Summit_345_230kV_3PH	3 phase fault on the Summit 345kV (532773) to Summit 230kV (532873) to Summit 14.4kV (432813) transformer, near Summit 345kV. a. Apply fault at the Summit 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
41	FLT_41_EMPEC_Lang_345kV_3PH	3 phase fault on the EMPEC (532768) to Lang (532769) 345kV line, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
42	FLT_42_EMPEC_Morris_345kV_3PH	3 phase fault on the EMPEC (532768) to Morris (532770) 345kV line, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
43	FLT_43_EMPEC_Swissvale_345kV_3PH	3 phase fault on the EMPEC (532768) to Swissvale (532774) 345kV line, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT_44_EMPEC_G14001Tap_345kV_3PH	3 phase fault on the EMPEC (532768) to G14001Tap (562476) 345kV line, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
45	FLT_45_Morris_JECN_345kV_3PH	3 phase fault on the Morris (532770) to JECN (532766) 345kV line, near Morris. a. Apply fault at the Morris 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
46	FLT_46_Morris_Morris_345_230kV_3PH	3 phase fault on the Morris 345kV (532770) to Morris 230kV (532863) to Morris 14.4kV (532809) transformer, near Morris 345kV. a. Apply fault at the Morris 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
47	FLT_47_Swissvale_Wgardner_345kV_3PH (2016WP & 2017SP)	3 phase fault on the Swissvale (532774) to WGardner (542965) 345kV line, near Swissvale. a. Apply fault at the Swissvale 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
48	FLT_47_Swissvale_Douglas_345kV_3PH (2025SP)	3 phase fault on the Swissvale (532774) to Douglas (532776) 345kV line, near Swissvale. a. Apply fault at the Swissvale 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
49	FLT_48_Swissvale_Swissvale_345_230kV_3PH	3 phase fault on the Swissvale 345kV (532774) to Swissvale 230kV (532856) to Swissvale 14.4kV (532815) transformer, near Swissvale 345kV. a. Apply fault at the Swissvale 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
50	FLT_49_Wgardner_Stillwell_345kV_3PH	3 phase fault on the WGardner (542965) to Stillwell (542968) 345kV line, near WGardner. a. Apply fault at the WGardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
51	FLT_50_Wgardner_Craig_345kV_3PH	3 phase fault on the WGardner (542965) to Craig (542977) 345kV line, near WGardner. a. Apply fault at the WGardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
52	FLT_51_Wgardner_Lacygne_345kV_3PH	3 phase fault on the WGardner (542965) to LaCygne (542981) 345kV line, near WGardner. a. Apply fault at the WGardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
53	FLT_52_Wgardner_Wgardner_345_161kV_3PH	3 phase fault on the WGardner 345kV (532774) to WGardner 161kV (542966) to WGardner 14.4kV (543649) transformer, near WGardner 345kV. a. Apply fault at the WGardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
54	FLT_53_Stillwell_Peculiar_345kV_3PH	3 phase fault on the Stillwell (542968) to Peculiar (541198) 345kV line, near Stillwell. a. Apply fault at the Stillwell 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
55	FLT_54_Stillwell_Lacygne_345kV_3PH	3 phase fault on the Stillwell (542968) to LaCygne (542981) 345kV line, near Stillwell. a. Apply fault at the Stillwell 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
56	FLT_55_Stillwell_Stillwell_345_161kV_3PH	3 phase fault on the Stillwell 345kV (542968) to Stillwell 161kV (542969) to Stillwell 14.4kV (543648) transformer, near Stillwell 345kV. a. Apply fault at the Stillwell 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
57	FLT_56_Craig_87th_345kV_3PH	3 phase fault on the Craig (542977) to 87th (532775) 345kV line, near Craig. a. Apply fault at the Craig 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
58	FLT_57_Craig_Craig_345_161kV_3PH	3 phase fault on the Craig 345kV (542977) to Craig 161kV (542978) to Craig 14.4kV (543641) transformer, near Craig 345kV. a. Apply fault at the Craig 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
59	FLT_58_Lacygne_Neosho_345kV_3PH	3 phase fault on the Lacygne (542981) to Neosho (532793) 345kV line, near Lacygne. a. Apply fault at the Lacygne 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
60	FLT_59_Lacygne_Waverly_345kV_3PH	3 phase fault on the Lacygne (542981) to Waverly (532799) 345kV line, near Lacygne. a. Apply fault at the Lacygne 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
61	FLT_60_Neosho_Blackberry_345kV_3PH	3 phase fault on the Neosho (532793) to Blackberry (300739) 345kV line, near Neosho. a. Apply fault at the Neosho 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
62	FLT_61_Neosho_Delaware_345kV_3PH	3 phase fault on the Neosho (532793) to Delaware (510380) 345kV line, near Neosho. a. Apply fault at the Neosho 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
63	FLT_62_Neosho_CaneyCreek_345kV_3PH	3 phase fault on the Neosho (532793) to Caney Creek (532780) 345kV line, near Neosho. a. Apply fault at the Neosho 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
64	FLT_63_Viola_Renfrow_345kV_1PH	Single phase fault on the Viola (532798) to Renfrow (515543) 345kV line, near Viola. a. Apply fault at the Viola 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
65	FLT_64_Viola_Wichita_345kV_1PH	Single phase fault on the Viola (532798) to Wichita (532796) 345kV line, near Viola. a. Apply fault at the Viola 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
66	FLT_65_Renfrow_Hunter_345kV_1PH	Single phase fault on the Renfrow (515543) to Hunter (515476) 345kV line, near Renfrow. a. Apply fault at the Renfrow 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
67	FLT_66_Hunter_Woodring_345kV_1PH	Single phase fault on the Hunter (515476) to Woodring (514715) 345kV line, near Hunter. a. Apply fault at the Hunter 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
68	FLT_67_Woodring_Sooner_345kV_1PH	Single phase fault on Woodring (514715) to Sooner (514803) 345kV line, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
69	FLT_68_Woodring_G15063Tap_345kV_1PH	Single phase fault on Woodring (514715) to G1506Tap (560055) 345kV line, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
70	FLT_69_Sooner_SpringCreek_345kV_1PH	Single phase fault on the Sooner (514803) to Spring Creek (514881) 345kV line, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
71	FLT_70_Sooner_G15066T_345kV_1PH	Single phase fault on the Sooner (514803) to G15066T (560056) 345kV line, near Sooner. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
72	FLT_71_RanchRoad_Sooner_345kV_1PH	Single phase fault on the Ranch Road (515576) to Sooner (514803) 345kV line, near Ranch Road. a. Apply fault at the Ranch Road 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
73	FLT_72_RanchRoad_OpenSky_345kV_1PH	Single phase fault on the Ranch Road (515576) to Open Sky (515621) 345kV line, near Ranch Road. a. Apply fault at the Ranch Road 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
74	FLT_73_Rosehill_Benton_345kV_1PH	Single phase fault on the Rosehill (532794) to Benton (532791) 345kV line, near Rosehill. a. Apply fault at the Rosehill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
75	FLT_74_Rosehill_WolfCreek_345kV_1PH	Single phase fault on the Rosehill (532794) to Wolf Creek (532797) 345kV line, near Rosehill. a. Apply fault at the Rosehill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
76	FLT_75_Rosehill_Latham_345kV_1PH	Single phase fault on the Rosehill (532794) to Latham (532800) 345kV line, near Rosehill. a. Apply fault at the Rosehill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
77	FLT_76_Rosehill_G15052T_345kV_1PH	Single phase fault on the Rosehill (532794) to G15052T (560053) 345kV line, near Rosehill. a. Apply fault at the Rosehill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
78	FLT_77_Wichita_Reno_345kV_1PH	Single phase fault on the Wichita (532796) to Reno (532771) 345kV line, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
79	FLT_78_Wichita_Benton_345kV_1PH	Single phase fault on the Wichita (532796) to Benton (532791) 345kV line, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
80	FLT_79_Wichita_G1524_1525T_345kV_1PH	Single phase fault on the Wichita (532796) to G1525&G1525T (560033) 345kV line, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
81	FLT_80_EMPEC_Lang_345kV_1PH	Single phase fault on the EMPEC (532768) to Lang (532769) 345kV line, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
82	FLT_81_EMPEC_Morris_345kV_1PH	Single phase fault on the EMPEC (532768) to Morris (532770) 345kV line, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
83	FLT_82_EMPEC_Swissvale_345kV_1PH	Single phase fault on the EMPEC (532768) to Swissvale (532774) 345kV line, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
84	FLT_83_EMPEC_G14001Tap_345kV_1PH	Single phase fault on the EMPEC (532768) to G14001Tap (562476) 345kV line, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
85	FLT_84_Morris_JECN_345kV_1PH	Single phase fault on the Morris (532770) to JECN (532766) 345kV line, near Morris. a. Apply fault at the Morris 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
86	FLT_85_Wgardner_Stillwell_345kV_1PH	Single phase fault on the WGardner (542965) to Stillwell (542968) 345kV line, near WGardner. a. Apply fault at the WGardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
87	FLT_86_Wgardner_Craig_345kV_1PH	Single phase fault on the WGardner (542965) to Craig (542977) 345kV line, near WGardner. a. Apply fault at the WGardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
88	FLT_87_Wgardner_Lacygne_345kV_1PH	Single phase fault on the WGardner (542965) to LaCygne (542981) 345kV line, near WGardner. a. Apply fault at the WGardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
89	FLT_88A_Wgardner_Swissvale_345kV_1PH (2016WP& 2017SP)	3 phase fault on the WGardner (542965) to Swissvale (532774) 345kV line, near WGardner. a. Apply fault at the WGardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
90	FLT_88_Wgardner_Douglas_345kV_1PH (2025SP)	3 phase fault on the WGardner (542965) to Douglas (532776) 345kV line, near WGardner. a. Apply fault at the WGardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

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_Viola_Renfrow_345kV_3PH	STABLE	STABLE	STABLE
2	FLT_02_Viola_Wichita_345kV_3PH	STABLE	STABLE	STABLE
3	FLT_03_Renfrow_Hunter_345kV_3PH	STABLE	STABLE	STABLE
4	FLT_04_Renfrow_Renfrow_345_138kV_3PH	STABLE	STABLE	STABLE
5	FLT_05_Hunter_Woodring_345kV_3PH	STABLE	STABLE	STABLE
6	FLT_06_Woodring_Sooner_345kV_3PH	STABLE	STABLE	STABLE
7	FLT_07_Woodring_G15063Tap_345kV_3PH	STABLE	STABLE	STABLE
8	FLT_08_Woodring_Woodring_345_138kV_3PH	STABLE	STABLE	STABLE
9	FLT_09_Mathewson_Northwest_345kV_3PH	STABLE	STABLE	STABLE
10	FLT_10_Mathewson_Cimarron_345kV_3PH	STABLE	STABLE	STABLE
11	FLT_11_Mathewson_Tatonga_345kV_3PH	STABLE	STABLE	STABLE
12	FLT_12_Sooner_SpringCreek_345kV_3PH	STABLE	STABLE	STABLE
13	FLT_13_Sooner_G15066T_345kV_3PH	STABLE	STABLE	STABLE
14	FLT_14_Sooner_Sooner_345_138kV_3PH	STABLE	STABLE	STABLE
15	FLT_15_RanchRoad_Sooner_345kV_3PH	STABLE	STABLE	STABLE
16	FLT_16_RanchRoad_OpenSky_345kV_3PH	STABLE	STABLE	STABLE
17	FLT_17_Rosehill_Benton_345kV_3PH	STABLE	STABLE	STABLE

	Contingency Number and Name	2016WP	2017SP	2025SP
18	FLT_18_Rosehill_WolfCreek_345kV_3PH	STABLE	STABLE	STABLE
19	FLT_19_Rosehill_Latham_345kV_3PH	STABLE	STABLE	STABLE
20	FLT_20_Rosehill_G15052T_345kV_3PH	STABLE	STABLE	STABLE
21	FLT_21_Rosehill_Rosehill_345_138kV_3PH	STABLE	STABLE	STABLE
22	FLT_22_Northwest_SpringCreek_345kV_3PH	STABLE	STABLE	STABLE
23	FLT_23_Northwest_Cimarron_345kV_3PH	STABLE	STABLE	STABLE
24	FLT_24_Northwest_Arcadia_345kV_3PH	STABLE	STABLE	STABLE
25	FLT_25_Northwest_Northwest_345_138kV_3PH	STABLE	STABLE	STABLE
26	FLT_26_Benton_WolfCreek_345kV_3PH	STABLE	STABLE	STABLE
27	FLT_27_Benton_Benton_345_138kV_3PH	STABLE	STABLE	STABLE
28	FLT_28_Wichita_Reno_345kV_3PH	STABLE	STABLE	STABLE
29	FLT_29_Wichita_Benton_345kV_3PH	STABLE	STABLE	STABLE
30	FLT_30_Wichita_G1524&1525T_345kV_3PH	STABLE	STABLE	STABLE
31	FLT_31_Wichita_Evans_345_138kV_3PH	STABLE	STABLE	STABLE
32	FLT_32_Thistle_G1524&1525T_345kV_3PH	STABLE	STABLE	STABLE
33	FLT_33_Thistle_Woodward_345kV_3PH	STABLE	STABLE	STABLE
34	FLT_34_Thistle_ClarkCounty_345kV_3PH	STABLE	STABLE	STABLE
35	FLT_35_Thistle_Thistle_345_138kV_3PH	STABLE	STABLE	STABLE
36	FLT_36_Reno_Summit_345kV_3PH	STABLE	STABLE	STABLE
37	FLT_37_Reno_Reno_345_115kV_3PH	STABLE	STABLE	STABLE
38	FLT_38_Summit_Blustem_345kV_3PH	STABLE	STABLE	STABLE
39	FLT_39_Summit_ElmCreek_345kV_3PH	STABLE	STABLE	STABLE
40	FLT_40_Summit_Summit_345_230kV_3PH	STABLE	STABLE	STABLE
41	FLT_41_EMPEC_Lang_345kV_3PH	STABLE	STABLE	STABLE
42	FLT_42_EMPEC_Morris_345kV_3PH	STABLE	STABLE	STABLE
43	FLT_43_EMPEC_Swissvale_345kV_3PH	STABLE	STABLE	STABLE
44	FLT_44_EMPEC_G14001Tap_345kV_3PH	STABLE	STABLE	STABLE
45	FLT_45_Morris_JECN_345kV_3PH	STABLE	STABLE	STABLE
46	FLT_46_Morris_Morris_345_230kV_3PH	STABLE	STABLE	STABLE
47	FLT_47_Swissvale_Wgardner_345kV_3PH	STABLE	STABLE	STABLE
48	FLT_48_Swissvale_Swissvale_345_230kV_3PH	STABLE	STABLE	STABLE
49	FLT_49_Wgardner_Stillwell_345kV_3PH	STABLE	STABLE	STABLE
50	FLT_50_Wgardner_Craig_345kV_3PH	STABLE	STABLE	STABLE
51	FLT_51_Wgardner_Lacygne_345kV_3PH	STABLE	STABLE	STABLE
52	FLT_52_Wgardner_Wgardner_345_161kV_3PH	STABLE	STABLE	STABLE
53	FLT_53_Stillwell_Peculiar_345kV_3PH	STABLE	STABLE	STABLE
54	FLT_54_Stillwell_Lacygne_345kV_3PH	STABLE	STABLE	STABLE
55	FLT_55_Stillwell_Stillwell_345_161kV_3PH	STABLE	STABLE	STABLE
56	FLT_56_Craig_87th_345kV_3PH	STABLE	STABLE	STABLE
57	FLT_57_Craig_Craig_345_161kV_3PH	STABLE	STABLE	STABLE
58	FLT_58_Lacygne_Neosho_345kV_3PH	STABLE	STABLE	STABLE
59	FLT_59_Lacygne_Waverly_345kV_3PH	STABLE	STABLE	STABLE
60	FLT_60_Neosho_Blackberry_345kV_3PH	STABLE	STABLE	STABLE
61	FLT_61_Neosho_Delaware_345kV_3PH	STABLE	STABLE	STABLE
62	FLT_62_Neosho_CaneyCreek_345kV_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-2010-005 was found to be in compliance with FERC Order 661A.

Table 3-2 LVRT Contingencies

Contingency Number and Name	Description
FLT_01_Viola_Renfrow_345kV_3PH	3 phase fault on the Viola (532798) to Renfrow (515543) 345kV line, near Viola. a. Apply fault at the Viola 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT_02_Viola_Wichita_345kV_3PH	3 phase fault on the Viola (532798) to Wichita (532796) 345kV line, near Viola. a. Apply fault at the Viola 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

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-2010-005	299.2	Viola 345kV (532798)	Wind	GE 1.6 and Vestas V110 2.0	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-2015-005 and GEN-2007-025 since both are owned by the same interconnection customer, and GEN-2010-005 interconnects to the POI through GEN-2007-025 via a 345kV transmission lead. SPP performed this low wind analysis to determine the capacitive charging current injected at the POI by the two projects.

The project generators and capacitors (if any) were turned off in the base case. The resulting reactive power injection into the transmission network that comes from the capacitance of the project's transmission lines and collector cables is shown in **Figure E-1**. Also, the figure shows how much capacitance is from the transmission lines and collector cables in GEN-2010-005 and GEN-2007-025. A shunt reactor was added at the GEN-2007-025 project substation 345 kV bus to bring the Mvar flow into the POI down to approximately zero as show in **Figure E-2**. A reactor of approximately 56 Mvar will negate the capacitive effect 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-2010-005 Short Circuit Analysis Results (2017SP)* and

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                PSS(R)E-32.2.2 ASCC SHORT CIRCUIT CURRENTS          TUE, FEB 14 2017  17:11
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+)
532768 [EMPEC 7     345.00] AMP     17283.1   -86.19
532769 [LANG   7    345.00] AMP     17072.2   -86.18
532770 [MORRIS 7    345.00] AMP     12731.0   -85.54
532774 [SWISVAL7    345.00] AMP     16423.8   -85.37
562476 [G14-001-TAP 345.00] AMP     10942.5   -85.04
585100 [GEN-2015-073345.00] AMP     14171.8   -85.65
532766 [JEC N  7    345.00] AMP     23298.6   -87.51
532796 [WICHITA7    345.00] AMP     23718.1   -86.10
532856 [SWISVAL6    230.00] AMP     21813.3   -85.42
532863 [MORRIS 6    230.00] AMP     13782.0   -85.33
533304 [LANG   3    115.00] AMP     14440.2   -85.16
542965 [W.GRDNR7    345.00] AMP     25251.9   -85.83
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583850 [GEN-2014-001345.00] AMP      7502.8   -84.76
532765 [HOYT    7    345.00] AMP     15354.2   -85.76
532767 [BLUSTEM7    345.00] AMP      9609.0   -86.22
532771 [RENO    7    345.00] AMP     10671.1   -85.59
532791 [BENTON 7    345.00] AMP     19033.4   -85.71
532798 [VIOLA   7    345.00] AMP     11409.3   -85.09
532851 [AUBURN 6    230.00] AMP     13446.6   -83.79
532852 [JEC     6    230.00] AMP     24522.2   -87.76
532857 [TECHILL6    230.00] AMP     11266.9   -84.32
532858 [BALDWIN6    230.00] AMP     13734.8   -84.53
532862 [MCDOWEL6    230.00] AMP      6892.7   -84.87
532874 [UNIONRG6    230.00] AMP      8763.7   -83.67
533040 [EVANS N4    138.00] AMP     37053.0   -87.18
533301 [EAST ST3    115.00] AMP      9202.6   -82.09
533305 [MORRIS 3    115.00] AMP     12407.5   -86.31
533306 [READING3    115.00] AMP      6390.9   -73.71
533307 [PRAIRIE3    115.00] AMP      9248.7   -82.46
542966 [WGARDNR5    161.00] AMP     27244.1   -86.92
542968 [STILWEL7    345.00] AMP     24264.6   -85.89
542977 [CRAIG   7    345.00] AMP     21510.9   -85.70
542981 [LACYGNE7    345.00] AMP     24950.3   -86.88
560033 [G1524&G1525T345.00] AMP     19150.8   -86.29
515543 [RENFROW7    345.00] AMP     11221.6   -84.65
532772 [STRANGR7    345.00] AMP     22142.2   -85.94
532773 [SUMMIT 7    345.00] AMP     10231.9   -85.73
532775 [87TH 7     345.00] AMP     19924.0   -85.69
532792 [FR2EAST7    345.00] AMP      6214.1   -85.59
532793 [NEOSHO 7    345.00] AMP     16198.2   -84.49
532794 [ROSEHIL7    345.00] AMP     18824.7   -85.80
532797 [WOLFCRK7    345.00] AMP     15971.2   -86.81
532799 [WAVERLY7    345.00] AMP     14712.8   -86.51
532853 [LAWHILL6    230.00] AMP     13751.9   -85.20
532861 [EMANHAT6    230.00] AMP      9565.6   -85.60
532873 [SUMMIT 6    230.00] AMP     12906.7   -85.19
532986 [BENTON 4    138.00] AMP     27908.2   -85.85
533041 [EVANS S4    138.00] AMP     37053.0   -87.18
533065 [SG12COL4    138.00] AMP     20146.8   -85.76
533151 [AUBURN 3    115.00] AMP     21702.4   -84.05
533163 [HOYT    3    115.00] AMP     22824.7   -85.67
533171 [OSAGE J3    115.00] AMP      5151.5   -72.86
533182 [TECHILE3    115.00] AMP     30018.6   -82.91
533232 [BALDCRK3    115.00] AMP     19909.9   -84.58
533309 [WEMPORI3    115.00] AMP      9770.3   -81.62
533335 [MCDOWEL3    115.00] AMP     17702.0   -85.31
533336 [BLUSTEM3    115.00] AMP     16964.4   -86.43
533359 [UNIONRG3    115.00] AMP      3784.2   -87.74
533390 [MAIZEW 4    138.00] AMP     25939.2   -85.53
533416 [RENO    3    115.00] AMP     21539.8   -85.57
539801 [THISTLE7    345.00] AMP     15378.5   -85.86
541198 [PECULR 7    345.00] AMP     20114.0   -85.62
542969 [STILWEL5    161.00] AMP     38986.5   -85.84
542978 [CRAIG   5    161.00] AMP     39235.8   -85.69
543049 [CEDRCRK5    161.00] AMP     27477.8   -84.94
543054 [CEDARNL5    161.00] AMP     13621.2   -84.61
543077 [PLSTVAL5    161.00] AMP      9737.8   -83.35
543105 [BULLCRK5    161.00] AMP     24968.2   -87.10
543132 [BNSF    5    161.00] AMP     19921.4   -85.74
584659 [G15024G15025345.00] AMP      6650.0   -86.46
585070 [GEN-2015-069230.00] AMP      6570.4   -84.48
300739 [7BLACKBERRY 345.00] AMP     12247.8   -84.37
510380 [DELWARE7    345.00] AMP     11393.8   -84.84
515375 [WWRDEHV7    345.00] AMP     18092.5   -85.93
515476 [HUNTERS7    345.00] AMP     12085.2   -84.69
515544 [RENFROW4    138.00] AMP     13395.7   -84.83
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530592 [SMOKYHL6     230.00] AMP     6884.6   -84.32
532780 [CANEYRV7     345.00] AMP     9887.0   -85.50
532795 [FR2WEST7     345.00] AMP     5204.9   -85.65
532800 [LATHAMS7     345.00] AMP    10459.6   -85.56
532802 [WAVERTX7     345.00] AMP    12556.3   -86.05
532854 [LEC U5 6     230.00] AMP    13616.5   -85.09
532855 [MIDLAND6     230.00] AMP    12175.6   -84.82
532865 [NMANHT6      230.00] AMP     8770.7   -85.16
532872 [EMCPHER6     230.00] AMP     7716.0   -83.42
532920 [TECHILL5     161.00] AMP     5771.5   -84.75
532937 [NEOSHO 5     161.00] AMP    21992.2   -84.26
532988 [BELAIRE4     138.00] AMP    18637.6   -84.79
532990 [MIDIAN 4     138.00] AMP    10061.0   -80.49
533015 [BENTLEY4     138.00] AMP     9827.5   -85.10
533021 [NEOSHO 4     138.00] AMP    23036.3   -84.46
533024 [29TH   4     138.00] AMP    19399.9   -85.12
533035 [CHISHLM4     138.00] AMP    21786.1   -84.81
533053 [LAKERDG4     138.00] AMP    17996.8   -85.60
533054 [MAIZE  4     138.00] AMP    22202.1   -85.18
533062 [ROSEHIL4     138.00] AMP    30970.3   -86.16
533074 [45TH ST4     138.00] AMP    25950.4   -85.68
533153 [COLINE 3     115.00] AMP    23235.0   -81.04
533155 [CROOKED3     115.00] AMP    20489.6   -84.01
533166 [INDIANH3     115.00] AMP    17630.7   -82.26
533167 [KEENE  3     115.00] AMP    10051.0   -84.37
533169 [NTHLAND3     115.00] AMP    15021.4   -82.70
533170 [OSAGE  3     115.00] AMP     4384.3   -71.72
533176 [SHAWNEE3     115.00] AMP    12205.2   -82.20
533177 [6 GOLDN3     115.00] AMP    16256.1   -81.89
533180 [TEC E  3     115.00] AMP    29606.0   -82.94
533187 [27CROCO3     115.00] AMP    20243.5   -83.01
533194 [SHERWOD3     115.00] AMP    19824.1   -83.74
533197 [HARTLND3     115.00] AMP     4720.2   -74.94
533198 [HOYTJS 3     115.00] AMP    19905.8   -84.88
533199 [HOYTJN 3     115.00] AMP    18913.7   -84.62
533250 [LWRNCHL3     115.00] AMP    27782.9   -83.95
533268 [STRANGR3     115.00] AMP    31925.0   -86.81
533270 [STULL T3     115.00] AMP    12144.4   -72.49
533271 [SWLWRNC3     115.00] AMP    18543.3   -80.95
533283 [87TH   3     115.00] AMP    26058.7   -85.95
533308 [VAUGHN 3     115.00] AMP     2811.4   -71.29
533311 [WMBROSJ3     115.00] AMP     6761.4   -76.34
533326 [EMANHAT3     115.00] AMP    13088.0   -85.59
533328 [FT JCT 3     115.00] AMP    14504.6   -85.84
533341 [STAGGHL3     115.00] AMP     9504.6   -83.82
533350 [SMAN_W_3     115.00] AMP    12505.2   -79.35
533360 [TCHOPE 3     115.00] AMP     3364.3   -87.26
533362 [CHAPMAN3     115.00] AMP    10324.2   -85.53
533381 [SUMMIT 3     115.00] AMP    16809.6   -86.26
533392 [SCRNTJS3     115.00] AMP     5082.8   -74.25
533413 [CIRCLE 3     115.00] AMP    18064.1   -85.03
533415 [DAVIS  3     115.00] AMP     8102.7   -82.40
533429 [MOUNDRG3     115.00] AMP     7010.5   -83.06
533438 [WMCPHER3     115.00] AMP    10832.7   -84.14
539800 [CLARKCOUNTY7345.00] AMP    12611.4   -84.73
539804 [THISTLE4     138.00] AMP    16296.2   -86.47
539805 [ELMCREEK7    345.00] AMP     5251.7   -85.37
541200 [PHILL 7      345.00] AMP    18156.0   -85.65
541231 [STRANGR5     161.00] AMP    15155.9   -87.58
541341 [S.HARP 5     161.00] AMP    25055.9   -85.17
541342 [PECULR 5     161.00] AMP    24419.7   -85.47
542979 [PFLUMM 5     161.00] AMP    26860.2   -85.04
542982 [IATAN  7     345.00] AMP    25786.0   -86.70
542994 [HICKMAN5     161.00] AMP    18422.9   -83.90
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542995 [MONTROS5    161.00] AMP    17462.5    -84.08
543031 [SHWNMSN5    161.00] AMP    31001.3    -84.73
543038 [LENEXAS5    161.00] AMP    26147.1    -85.03
543039 [LENEXAN5    161.00] AMP    27167.3    -84.72
543044 [MOONLT 5    161.00] AMP    16510.9    -85.05
543048 [COLLEGE5    161.00] AMP    27872.2    -84.69
543050 [ANTIOCH5    161.00] AMP    21947.3    -84.42
543053 [REDEL  5    161.00] AMP    23838.3    -84.19
543055 [SEOTTWA5    161.00] AMP     6692.0    -81.12
543057 [BUCYRUS5    161.00] AMP    19128.2    -84.31
543126 [LACKMAN5    161.00] AMP    13045.0    -83.85
543131 [CLARE  5    161.00] AMP    13981.8    -84.49
560053 [G15-052T    345.00] AMP    13120.0    -86.45
583750 [GEN-2013-029345.00] AMP    10000.2    -84.61
584660 [GEN-2015-024345.00] AMP     5405.6    -86.43
584670 [GEN-2015-025345.00] AMP     6534.5    -86.43
585250 [GEN-2015-090345.00] AMP     3101.8    -85.71
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Table *F-2 GEN-2010-005 Short Circuit Analysis Results (2025SP)*.

7. Conclusion

The GEN-2010-005 Interconnection Customer has requested a modification to its Generator Interconnection Request to change its Phase II generators from GE 1.6 MW wind turbines to Vestas 2.0 MW wind turbines. Originally, Phase I and Phase II consisted of one-hundred eighty-seven (187) GE 1.6MW wind turbines for a total 299.2 MW. The requested change is one hundred seven (107) GE 1.6MW wind turbines in Phase I and sixty-four (64) Vestas V110 2.0MW wind turbines in Phase II (total 299.2MW). The point of interconnection (POI) is the Westar Energy, Inc (WERE) Viola Substation 345kV.

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-2010-005, 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.

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-2010-05 with the GE 1.6MW and Vestas V110 2.0MW wind turbine generators should be able to interconnect reliably to the SPP transmission grid.

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.

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-2010-005 and GEN-2007-025 Power Factor Analysis Results

	Leading power factor is absorbing vars; Lagging power factor is providing vars								
	GEN-2010-005 & GEN-2007-025 **POI: Viola 345 kV (532798)** **Power at POI (MW): 598.4**	2016 Winter Peak POI Voltage = 1.009 pu			2017 Summer Peak POI Voltage = 1.009 pu			2025 Summer Peak POI Voltage = 1.008 pu		
	Contingency Name	**Mvars at POI**	**Power Factor**		**Mvars at POI**	**Power Factor**		**Mvars at POI**	**Power Factor**	
0	FLT_00_NoFault	-3.640	1.000	LEAD	-11.673	1.000	LEAD	-19.965	0.999	LEAD
1	FLT_01_Viola_Renfrow_345kV	2.794	1.000	LAG	-6.393	1.000	LEAD	-25.026	0.999	LEAD
2	FLT_02_Viola_Wichita_345kV	40.704	0.998	LAG	34.932	0.998	LAG	20.749	0.999	LAG
3	FLT_03_Renfrow_Hunter_345kV	22.720	0.999	LAG	17.449	1.000	LAG	2.906	1.000	LAG
4	FLT_04_Renfrow_Renfrow_345_138kV	-3.250	1.000	LEAD	-15.829	1.000	LEAD	-29.400	0.999	LEAD
5	FLT_05_Hunter_Woodring_345kV	91.203	0.989[1]	LAG	74.923	0.992	LAG	52.930	0.996	LAG
6	FLT_06_Woodring_Sooner_345kV	-1.775	1.000	LEAD	-12.377	1.000	LEAD	-23.631	0.999	LEAD
7	FLT_07_Woodring_G15063Tap_345kV	19.022	0.999	LAG	9.377	1.000	LAG	8.220	1.000	LAG
8	FLT_08_Woodring_Woodring_345_138kV	0.555	1.000	LAG	-9.379	1.000	LEAD	-18.531	1.000	LEAD
9	FLT_09_Mathewson_Northwest_345kV	-6.294	1.000	LEAD	-13.621	1.000	LEAD	-22.861	0.999	LEAD
10	FLT_10_Mathewson_Cimarron_345kV	-2.127	1.000	LEAD	-10.466	1.000	LEAD	-19.262	0.999	LEAD
11	FLT_11_Mathewson_Tatonga_345kV	4.903	1.000	LAG	-7.260	1.000	LEAD	-16.956	1.000	LEAD
12	FLT_12_Sooner_SpringCreek_345kV	23.520	0.999	LAG	6.107	1.000	LAG	1.828	1.000	LAG
13	FLT_13_Sooner_G15066T_345kV	19.382	0.999	LAG	5.090	1.000	LAG	-0.847	1.000	LEAD
14	FLT_14_Sooner_Sooner_345_138kV	-2.486	1.000	LEAD	-14.779	1.000	LEAD	-20.663	0.999	LEAD
15	FLT_15_RanchRoad_Sooner_345kV	25.385	0.999	LAG	-0.281	1.000	LEAD	-8.740	1.000	LEAD
16	FLT_16_RanchRoad_OpenSky_345kV	-1.391	1.000	LEAD	-9.031	1.000	LEAD	-16.786	1.000	LEAD
17	FLT_17_Rosehill_Benton_345kV	-5.443	1.000	LEAD	-14.365	1.000	LEAD	-20.275	0.999	LEAD
18	FLT_18_Rosehill_WolfCreek_345kV	13.266	1.000	LAG	-6.217	1.000	LEAD	-8.930	1.000	LEAD
19	FLT_19_Rosehill_Latham_345kV	-3.692	1.000	LEAD	-10.488	1.000	LEAD	-19.464	0.999	LEAD
20	FLT_20_Rosehill_G15052T_345kV	43.634	0.997	LAG	34.019	0.998	LAG	34.665	0.998	LAG
21	FLT_21_Rosehill_Rosehill_345_138kV	-0.706	1.000	LEAD	-13.280	1.000	LEAD	-17.304	1.000	LEAD
22	FLT_22_Northwest_SpringCreek_345kV	19.112	0.999	LAG	14.477	1.000	LAG	12.755	1.000	LAG
23	FLT_23_Northwest_Cimarron_345kV	-2.975	1.000	LEAD	-11.028	1.000	LEAD	-19.031	0.999	LEAD
24	FLT_24_Northwest_Arcadia_345kV	0.221	1.000	LAG	-11.596	1.000	LEAD	-20.731	0.999	LEAD
25	FLT_25_Northwest_Northwest_345_138kV	-4.585	1.000	LEAD	-11.639	1.000	LEAD	-20.676	0.999	LEAD
26	FLT_26_Benton_WolfCreek_345kV	17.530	1.000	LAG	-2.927	1.000	LEAD	-6.428	1.000	LEAD
27	FLT_27_Benton_Benton_345_138kV	-6.427	1.000	LEAD	-17.085	1.000	LEAD	-21.159	0.999	LEAD
28	FLT_28_Wichita_Reno_345kV	29.393	0.999	LAG	-6.472	1.000	LEAD	-7.091	1.000	LEAD
29	FLT_29_Wichita_Benton_345kV	-28.068	0.999	LEAD	-31.900	0.999	LEAD	-43.010	0.997[2]	LEAD
30	FLT_30_Wichita_G1524&1525T_345kV	7.217	1.000	LAG	-4.288	1.000	LEAD	-13.343	1.000	LEAD
31	FLT_31_Wichita_Evans_345_138kV	-5.593	1.000	LEAD	-23.157	0.999	LEAD	-32.877	0.998	LEAD
32	FLT_32_Thistle_G1524&1525T_345kV	12.443	1.000	LAG	-0.955	1.000	LEAD	-9.499	1.000	LEAD
33	FLT_33_Thistle_Woodward_345kV	-3.256	1.000	LEAD	-11.459	1.000	LEAD	-20.541	0.999	LEAD

[1] Most lagging power factor

[2] Most leading power factor

		2016 Winter Peak			2017 Summer Peak			2025 Summer Peak		
	Leading power factor is absorbing vars; Lagging power factor is providing vars										
	GEN-2010-005 & GEN-2007-025 **POI: Viola 345 kV (532798)** **Power at POI (MW): 598.4**	2016 Winter Peak POI Voltage = 1.009 pu			2017 Summer Peak POI Voltage = 1.009 pu			2025 Summer Peak POI Voltage = 1.008 pu		
	Contingency Name	**Mvars at POI**	**Power Factor**		**Mvars at POI**	**Power Factor**		**Mvars at POI**	**Power Factor**	
34	FLT_34_Thistle_ClarkCounty_345kV	2.322	1.000	LAG	-7.988	1.000	LEAD	-15.947	1.000	LEAD
35	FLT_35_Thistle_Thistle_345_138kV	-3.343	1.000	LEAD	-10.215	1.000	LEAD	-16.270	1.000	LEAD
36	FLT_36_Reno_Summit_345kV	11.406	1.000	LAG	1.249	1.000	LAG	-11.892	1.000	LEAD
37	FLT_37_Reno_Reno_345_115kV	-2.088	1.000	LEAD	-11.932	1.000	LEAD	-19.846	0.999	LEAD
38	FLT_38_Summit_JECN_345kV	-0.562	1.000	LEAD	-10.214	1.000	LEAD	-19.339	0.999	LEAD
39	FLT_39_Summit_ElmCreek_345kV	-0.230	1.000	LEAD	-8.562	1.000	LEAD	-17.566	1.000	LEAD
40	FLT_40_Summit_Summit_345_230kV	-7.438	1.000	LEAD	-12.287	1.000	LEAD	-20.943	0.999	LEAD
41	FLT_41_EMPEC_Lang_345kV	-4.248	1.000	LEAD	-11.319	1.000	LEAD	-19.433	0.999	LEAD
42	FLT_42_EMPEC_Morris_345kV	2.045	1.000	LAG	-8.484	1.000	LEAD	-16.954	1.000	LEAD
43	FLT_43_EMPEC_Swissvale_345kV	3.412	1.000	LAG	-11.217	1.000	LEAD	-19.569	0.999	LEAD
44	FLT_44_EMPEC_G14001Tap_345kV	12.661	1.000	LAG	1.601	1.000	LAG	-7.970	1.000	LEAD
45	FLT_45_Morris_JECN_345kV	-0.544	1.000	LEAD	-10.768	1.000	LEAD	-19.186	0.999	LEAD
46	FLT_46_Morris_Morris_345_230kV	-3.658	1.000	LEAD	-10.760	1.000	LEAD	-19.035	0.999	LEAD
47	FLT_47_Swissvale_Wgardner_345kV	-5.499	1.000	LEAD	-16.117	1.000	LEAD	-23.503	0.999	LEAD
48	FLT_48_Swissvale_Swissvale_345_230kV	-4.337	1.000	LEAD	-11.603	1.000	LEAD	-19.922	0.999	LEAD
49	FLT_49_Wgardner_Stillwell_345kV	-4.026	1.000	LEAD	-12.198	1.000	LEAD	-20.442	0.999	LEAD
50	FLT_50_Wgardner_Craig_345kV	-0.988	1.000	LEAD	-9.933	1.000	LEAD	-18.257	1.000	LEAD
51	FLT_51_Wgardner_Lacygne_345kV	3.979	1.000	LAG	-5.113	1.000	LEAD	-13.000	1.000	LEAD
52	FLT_52_Wgardner_Wgardner_345_161kV	-3.527	1.000	LEAD	-11.643	1.000	LEAD	-19.929	0.999	LEAD
53	FLT_53_Stillwell_Peculiar_345kV	-0.663	1.000	LEAD	-10.409	1.000	LEAD	-18.658	1.000	LEAD
54	FLT_54_Stillwell_Lacygne_345kV	9.724	1.000	LAG	-1.849	1.000	LEAD	-9.592	1.000	LEAD
55	FLT_55_Stillwell_Stillwell_345_161kV	-3.223	1.000	LEAD	-11.453	1.000	LEAD	-19.728	0.999	LEAD
56	FLT_56_Craig_87th_345kV	-3.402	1.000	LEAD	-11.537	1.000	LEAD	-19.740	0.999	LEAD
57	FLT_57_Craig_Craig_345_161kV	-3.484	1.000	LEAD	-11.697	1.000	LEAD	-19.971	0.999	LEAD
58	FLT_58_Lacygne_Neosho_345kV	-0.171	1.000	LEAD	-10.344	1.000	LEAD	-18.264	1.000	LEAD
59	FLT_59_Lacygne_Waverly_345kV	82.833	0.991	LAG	36.133	0.998	LAG	26.496	0.999	LAG
60	FLT_60_Neosho_Blackberry_345kV	-3.843	1.000	LEAD	-12.386	1.000	LEAD	-21.245	0.999	LEAD
61	FLT_61_Neosho_Delaware_345kV	0.310	1.000	LAG	-9.538	1.000	LEAD	-16.715	1.000	LEAD
62	FLT_62_Neosho_CaneyCreek_345kV	8.978	1.000	LAG	-3.518	1.000	LEAD	-13.519	1.000	LEAD

Appendix E – Reduced Wind Generation Analysis Results

Below figures are 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-2010-005 and GEN-2007-025 with generators and capacitor banks turned off**

(Amber boxes show distribution of charging capacitance in the facilities. Red box shows net effect of all the charging capacitance)
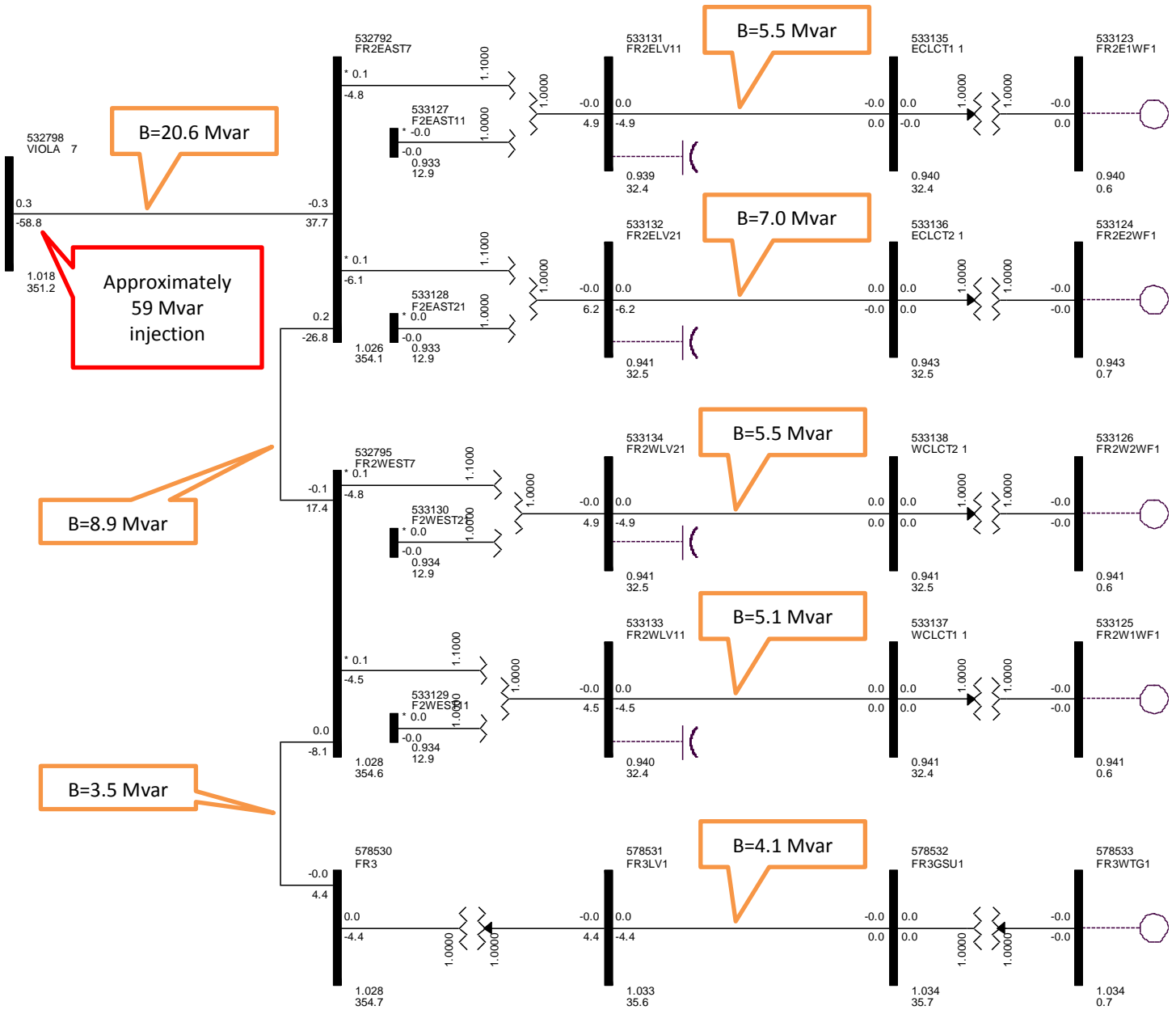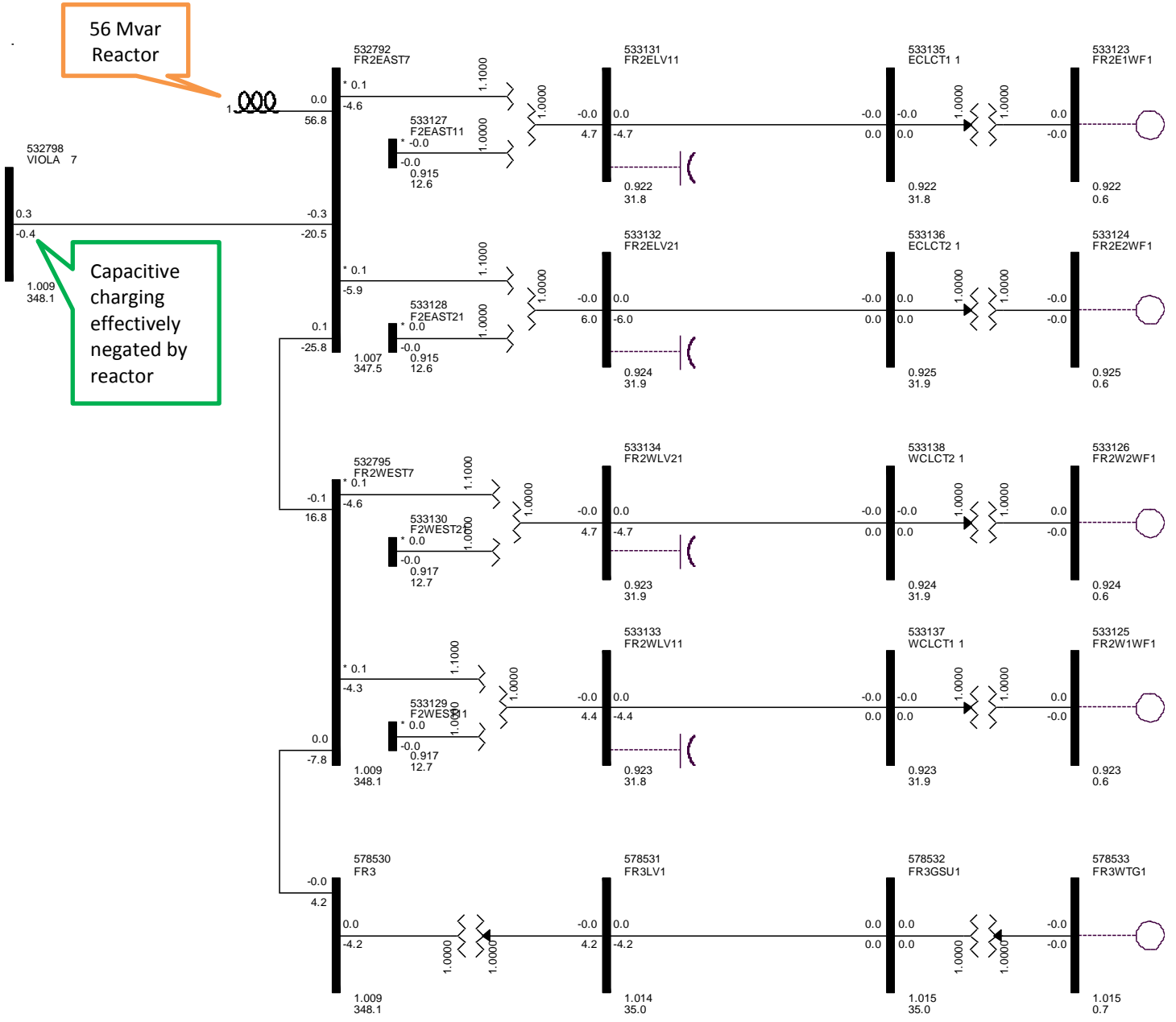
Figure E-2: GEN-2010-005 and GEN-2007-025 with generators turned off and shunt reactor added to the 345kV side of the customer substation

Appendix F – Short Circuit Analysis Results

Table F-1: GEN-2010-005 Short Circuit Analysis Results (2017SP)

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                              PSS(R)E-32.2.2 ASCC SHORT CIRCUIT CURRENTS        TUE, FEB 14 2017  17:11
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+)
532768 [EMPEC 7    345.00] AMP     17283.1   -86.19
532769 [LANG   7   345.00] AMP     17072.2   -86.18
532770 [MORRIS 7   345.00] AMP     12731.0   -85.54
532774 [SWISVAL7   345.00] AMP     16423.8   -85.37
562476 [G14-001-TAP 345.00] AMP    10942.5   -85.04
585100 [GEN-2015-073345.00] AMP    14171.8   -85.65
532766 [JEC N  7   345.00] AMP     23298.6   -87.51
532796 [WICHITA7   345.00] AMP     23718.1   -86.10
532856 [SWISVAL6   230.00] AMP     21813.3   -85.42
532863 [MORRIS 6   230.00] AMP     13782.0   -85.33
533304 [LANG   3   115.00] AMP     14440.2   -85.16
542965 [W.GRDNR7   345.00] AMP     25251.9   -85.83
583850 [GEN-2014-001345.00] AMP     7502.8   -84.76
532765 [HOYT   7   345.00] AMP     15354.2   -85.76
532767 [BLUSTEM7   345.00] AMP      9609.0   -86.22
532771 [RENO   7   345.00] AMP     10671.1   -85.59
532791 [BENTON 7   345.00] AMP     19033.4   -85.71
532798 [VIOLA  7   345.00] AMP     11409.3   -85.09
532851 [AUBURN 6   230.00] AMP     13446.6   -83.79
532852 [JEC    6   230.00] AMP     24522.2   -87.76
532857 [TECHILL6   230.00] AMP     11266.9   -84.32
532858 [BALDWIN6   230.00] AMP     13734.8   -84.53
532862 [MCDOWEL6   230.00] AMP      6892.7   -84.87
532874 [UNIONRG6   230.00] AMP      8763.7   -83.67
533040 [EVANS N4   138.00] AMP     37053.0   -87.18
533301 [EAST ST3   115.00] AMP      9202.6   -82.09
533305 [MORRIS 3   115.00] AMP     12407.5   -86.31
533306 [READING3   115.00] AMP      6390.9   -73.71
533307 [PRAIRIE3   115.00] AMP      9248.7   -82.46
542966 [WGARDNR5   161.00] AMP     27244.1   -86.92
542968 [STILWEL7   345.00] AMP     24264.6   -85.89
542977 [CRAIG  7   345.00] AMP     21510.9   -85.70
542981 [LACYGNE7   345.00] AMP     24950.3   -86.88
560033 [G1524&G1525T345.00] AMP    19150.8   -86.29
515543 [RENFROW7   345.00] AMP     11221.6   -84.65
532772 [STRANGR7   345.00] AMP     22142.2   -85.94
532773 [SUMMIT 7   345.00] AMP     10231.9   -85.73
532775 [87TH 7     345.00] AMP     19924.0   -85.69
532792 [FR2EAST7   345.00] AMP      6214.1   -85.59
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532793 [NEOSHO 7    345.00] AMP     16198.2   -84.49
532794 [ROSEHIL7    345.00] AMP     18824.7   -85.80
532797 [WOLFCRK7    345.00] AMP     15971.2   -86.81
532799 [WAVERLY7    345.00] AMP     14712.8   -86.51
532853 [LAWHILL6    230.00] AMP     13751.9   -85.20
532861 [EMANHAT6    230.00] AMP      9565.6   -85.60
532873 [SUMMIT 6    230.00] AMP     12906.7   -85.19
532986 [BENTON 4    138.00] AMP     27908.2   -85.85
533041 [EVANS S4    138.00] AMP     37053.0   -87.18
533065 [SG12COL4    138.00] AMP     20146.8   -85.76
533151 [AUBURN 3    115.00] AMP     21702.4   -84.05
533163 [HOYT   3    115.00] AMP     22824.7   -85.67
533171 [OSAGE J3    115.00] AMP      5151.5   -72.86
533182 [TECHILE3    115.00] AMP     30018.6   -82.91
533232 [BALDCRK3    115.00] AMP     19909.9   -84.58
533309 [WEMPORI3    115.00] AMP      9770.3   -81.62
533335 [MCDOWEL3    115.00] AMP     17702.0   -85.31
533336 [BLUSTEM3    115.00] AMP     16964.4   -86.43
533359 [UNIONRG3    115.00] AMP      3784.2   -87.74
533390 [MAIZEW 4    138.00] AMP     25939.2   -85.53
533416 [RENO   3    115.00] AMP     21539.8   -85.57
539801 [THISTLE7    345.00] AMP     15378.5   -85.86
541198 [PECULR 7    345.00] AMP     20114.0   -85.62
542969 [STILWEL5    161.00] AMP     38986.5   -85.84
542978 [CRAIG  5    161.00] AMP     39235.8   -85.69
543049 [CEDRCRK5    161.00] AMP     27477.8   -84.94
543054 [CEDARNL5    161.00] AMP     13621.2   -84.61
543077 [PLSTVAL5    161.00] AMP      9737.8   -83.35
543105 [BULLCRK5    161.00] AMP     24968.2   -87.10
543132 [BNSF   5    161.00] AMP     19921.4   -85.74
584659 [G15024G15025345.00] AMP      6650.0   -86.46
585070 [GEN-2015-069230.00] AMP      6570.4   -84.48
300739 [7BLACKBERRY 345.00] AMP     12247.8   -84.37
510380 [DELWARE7    345.00] AMP     11393.8   -84.84
515375 [WWRDEHV7    345.00] AMP     18092.5   -85.93
515476 [HUNTERS7    345.00] AMP     12085.2   -84.69
515544 [RENFROW4    138.00] AMP     13395.7   -84.83
530592 [SMOKYHL6    230.00] AMP      6884.6   -84.32
532780 [CANEYRV7    345.00] AMP      9887.0   -85.50
532795 [FR2WEST7    345.00] AMP      5204.9   -85.65
532800 [LATHAMS7    345.00] AMP     10459.6   -85.56
532802 [WAVERTX7    345.00] AMP     12556.3   -86.05
532854 [LEC U5 6    230.00] AMP     13616.5   -85.09
532855 [MIDLAND6    230.00] AMP     12175.6   -84.82
532865 [NMANHT6     230.00] AMP      8770.7   -85.16
532872 [EMCPHER6    230.00] AMP      7716.0   -83.42
532920 [TECHILL5    161.00] AMP      5771.5   -84.75
532937 [NEOSHO 5    161.00] AMP     21992.2   -84.26
532988 [BELAIRE4    138.00] AMP     18637.6   -84.79
532990 [MIDIAN 4    138.00] AMP     10061.0   -80.49
533015 [BENTLEY4    138.00] AMP      9827.5   -85.10
533021 [NEOSHO 4    138.00] AMP     23036.3   -84.46
533024 [29TH   4    138.00] AMP     19399.9   -85.12
533035 [CHISHLM4    138.00] AMP     21786.1   -84.81
533053 [LAKERDG4    138.00] AMP     17996.8   -85.60
533054 [MAIZE  4    138.00] AMP     22202.1   -85.18
533062 [ROSEHIL4    138.00] AMP     30970.3   -86.16
533074 [45TH ST4    138.00] AMP     25950.4   -85.68
533153 [COLINE 3    115.00] AMP     23235.0   -81.04
533155 [CROOKED3    115.00] AMP     20489.6   -84.01
533166 [INDIANH3    115.00] AMP     17630.7   -82.26
533167 [KEENE  3    115.00] AMP     10051.0   -84.37
533169 [NTHLAND3    115.00] AMP     15021.4   -82.70
533170 [OSAGE  3    115.00] AMP      4384.3   -71.72
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533176 [SHAWNEE3     115.00] AMP    12205.2   -82.20
533177 [6 GOLDN3     115.00] AMP    16256.1   -81.89
533180 [TEC E  3     115.00] AMP    29606.0   -82.94
533187 [27CROCO3     115.00] AMP    20243.5   -83.01
533194 [SHERWOD3     115.00] AMP    19824.1   -83.74
533197 [HARTLND3     115.00] AMP     4720.2   -74.94
533198 [HOYTJS 3     115.00] AMP    19905.8   -84.88
533199 [HOYTJN 3     115.00] AMP    18913.7   -84.62
533250 [LWRNCHL3     115.00] AMP    27782.9   -83.95
533268 [STRANGR3     115.00] AMP    31925.0   -86.81
533270 [STULL T3     115.00] AMP    12144.4   -72.49
533271 [SWLWRNC3     115.00] AMP    18543.3   -80.95
533283 [87TH  3      115.00] AMP    26058.7   -85.95
533308 [VAUGHN 3     115.00] AMP     2811.4   -71.29
533311 [WMBROSJ3     115.00] AMP     6761.4   -76.34
533326 [EMANHAT3     115.00] AMP    13088.0   -85.59
533328 [FT JCT 3     115.00] AMP    14504.6   -85.84
533341 [STAGGHL3     115.00] AMP     9504.6   -83.82
533350 [SMAN_W_3     115.00] AMP    12505.2   -79.35
533360 [TCHOPE 3     115.00] AMP     3364.3   -87.26
533362 [CHAPMAN3     115.00] AMP    10324.2   -85.53
533381 [SUMMIT 3     115.00] AMP    16809.6   -86.26
533392 [SCRNTJS3     115.00] AMP     5082.8   -74.25
533413 [CIRCLE 3     115.00] AMP    18064.1   -85.03
533415 [DAVIS  3     115.00] AMP     8102.7   -82.40
533429 [MOUNDRG3     115.00] AMP     7010.5   -83.06
533438 [WMCPHER3     115.00] AMP    10832.7   -84.14
539800 [CLARKCOUNTY7345.00] AMP    12611.4   -84.73
539804 [THISTLE4     138.00] AMP    16296.2   -86.47
539805 [ELMCREEK7    345.00] AMP     5251.7   -85.37
541200 [PHILL 7      345.00] AMP    18156.0   -85.65
541231 [STRANGR5     161.00] AMP    15155.9   -87.58
541341 [S.HARP 5     161.00] AMP    25055.9   -85.17
541342 [PECULR 5     161.00] AMP    24419.7   -85.47
542979 [PFLUMM 5     161.00] AMP    26860.2   -85.04
542982 [IATAN  7     345.00] AMP    25786.0   -86.70
542994 [HICKMAN5     161.00] AMP    18422.9   -83.90
542995 [MONTROS5     161.00] AMP    17462.5   -84.08
543031 [SHWNMSN5     161.00] AMP    31001.3   -84.73
543038 [LENEXAS5     161.00] AMP    26147.1   -85.03
543039 [LENEXAN5     161.00] AMP    27167.3   -84.72
543044 [MOONLT 5     161.00] AMP    16510.9   -85.05
543048 [COLLEGE5     161.00] AMP    27872.2   -84.69
543050 [ANTIOCH5     161.00] AMP    21947.3   -84.42
543053 [REDEL  5     161.00] AMP    23838.3   -84.19
543055 [SEOTTWA5     161.00] AMP     6692.0   -81.12
543057 [BUCYRUS5     161.00] AMP    19128.2   -84.31
543126 [LACKMAN5     161.00] AMP    13045.0   -83.85
543131 [CLARE  5     161.00] AMP    13981.8   -84.49
560053 [G15-052T     345.00] AMP    13120.0   -86.45
583750 [GEN-2013-029345.00] AMP    10000.2   -84.61
584660 [GEN-2015-024345.00] AMP     5405.6   -86.43
584670 [GEN-2015-025345.00] AMP     6534.5   -86.43
585250 [GEN-2015-090345.00] AMP     3101.8   -85.71
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Table F-2: GEN-2010-005 Short Circuit Analysis Results (2025SP)

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                          PSS(R)E-32.2.2 ASCC SHORT CIRCUIT CURRENTS          TUE, FEB 14 2017  17:14
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+)
532768 [EMPEC 7    345.00] AMP      17389.2   -86.18
532769 [LANG   7   345.00] AMP      17175.8   -86.17
532770 [MORRIS 7   345.00] AMP      12794.9   -85.53
532774 [SWISVAL7   345.00] AMP      16681.3   -85.36
562476 [G14-001-TAP 345.00] AMP     11042.5   -85.05
585100 [GEN-2015-073345.00] AMP     14242.4   -85.64
532766 [JEC N  7   345.00] AMP      23513.3   -87.51
532776 [DOUGLAS7   345.00] AMP      18181.1   -85.14
532796 [WICHITA7   345.00] AMP      24680.8   -86.24
532856 [SWISVAL6   230.00] AMP      21903.8   -85.41
532863 [MORRIS 6   230.00] AMP      13858.1   -85.32
533304 [LANG   3   115.00] AMP      14470.0   -85.15
583850 [GEN-2014-001345.00] AMP      7545.9   -84.77
532765 [HOYT   7   345.00] AMP      15628.7   -85.78
532767 [BLUSTEM7   345.00] AMP       9737.1   -86.29
532771 [RENO   7   345.00] AMP      11457.1   -85.98
532791 [BENTON 7   345.00] AMP      19393.9   -85.74
532798 [VIOLA   7  345.00] AMP      13506.5   -85.45
532851 [AUBURN 6   230.00] AMP      13515.0   -83.80
532852 [JEC    6   230.00] AMP      24643.2   -87.76
532857 [TECHILL6   230.00] AMP      11312.4   -84.30
532858 [BALDWIN6   230.00] AMP      14316.5   -84.69
532862 [MCDOWEL6   230.00] AMP       6912.1   -84.93
532874 [UNIONRG6   230.00] AMP       8856.4   -83.66
533040 [EVANS N4   138.00] AMP      42055.9   -87.26
533285 [DOUGLAS3   115.00] AMP      23976.7   -85.78
533301 [EAST ST3   115.00] AMP       9217.3   -82.07
533305 [MORRIS 3   115.00] AMP      12438.3   -86.31
533306 [READING3   115.00] AMP       6396.0   -73.69
533307 [PRAIRIE3   115.00] AMP       9264.2   -82.45
542965 [W.GRDNR7   345.00] AMP      25938.2   -85.83
560033 [G1524&G1525T345.00] AMP     19678.1   -86.39
515543 [RENFROW7   345.00] AMP      11853.9   -84.75
532772 [STRANGR7   345.00] AMP      24242.2   -86.19
532773 [SUMMIT 7   345.00] AMP      10600.8   -85.90
532792 [FR2EAST7   345.00] AMP       6648.9   -85.72
532794 [ROSEHIL7   345.00] AMP      19128.0   -85.82
532797 [WOLFCRK7   345.00] AMP      16039.4   -86.82
532853 [LAWHILL6   230.00] AMP      14469.7   -85.39
532861 [EMANHAT6   230.00] AMP       9599.6   -85.62
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532873 [SUMMIT 6    230.00] AMP    13478.4   -85.34
532986 [BENTON 4    138.00] AMP    28458.3   -85.85
533041 [EVANS S4    138.00] AMP    42055.9   -87.26
533065 [SG12COL4    138.00] AMP    21501.9   -85.71
533075 [VIOLA  4    138.00] AMP    22036.2   -86.03
533151 [AUBURN 3    115.00] AMP    21977.4   -84.09
533163 [HOYT   3    115.00] AMP    23018.6   -85.75
533171 [OSAGE J3    115.00] AMP     5155.5   -72.85
533182 [TECHILE3    115.00] AMP    30488.4   -82.76
533232 [BALDCRK3    115.00] AMP    21675.0   -84.85
533236 [FAIRGDS3    115.00] AMP    22153.2   -81.51
533271 [SWLWRNC3    115.00] AMP    22816.0   -81.96
533309 [WEMPORI3    115.00] AMP     9790.0   -81.60
533335 [MCDOWEL3    115.00] AMP    17763.0   -85.57
533336 [BLUSTEM3    115.00] AMP    17078.9   -86.54
533359 [UNIONRG3    115.00] AMP     3792.8   -87.75
533390 [MAIZEW 4    138.00] AMP    27864.2   -85.44
533416 [RENO   3    115.00] AMP    25059.6   -86.11
539801 [THISTLE7    345.00] AMP    15716.4   -85.88
542966 [WGARDNR5    161.00] AMP    27436.8   -86.93
542968 [STILWEL7    345.00] AMP    24401.2   -85.86
542977 [CRAIG  7    345.00] AMP    21942.5   -85.75
542981 [LACYGNE7    345.00] AMP    25069.4   -86.87
584659 [G15024G15025345.00] AMP     6698.0   -86.48
585070 [GEN-2015-069230.00] AMP     6610.8   -84.48
515375 [WWRDEHV7    345.00] AMP    20414.7   -86.01
515476 [HUNTERS7    345.00] AMP    12445.0   -84.73
515544 [RENFROW4    138.00] AMP    13620.7   -84.89
530592 [SMOKYHL6    230.00] AMP     6941.3   -84.30
532775 [87TH 7      345.00] AMP    20389.3   -85.75
532793 [NEOSHO 7    345.00] AMP    16293.0   -84.49
532795 [FR2WEST7    345.00] AMP     5481.1   -85.75
532799 [WAVERLY7    345.00] AMP    14764.2   -86.51
532800 [LATHAMS7    345.00] AMP    10515.9   -85.56
532854 [LEC U5 6    230.00] AMP    14314.9   -85.27
532855 [MIDLAND6    230.00] AMP    12771.6   -84.98
532865 [NMANHT6     230.00] AMP     8802.0   -85.19
532872 [EMCPHER6    230.00] AMP     8520.3   -83.90
532920 [TECHILL5    161.00] AMP     5790.7   -84.76
532984 [SUMNER 4    138.00] AMP    10180.1   -82.91
532988 [BELAIRE4    138.00] AMP    18906.2   -84.76
532990 [MIDIAN 4    138.00] AMP    10208.1   -81.79
533015 [BENTLEY4    138.00] AMP    10120.2   -85.06
533024 [29TH   4    138.00] AMP    19689.4   -85.09
533035 [CHISHLM4    138.00] AMP    22456.6   -84.77
533036 [CLEARWT4    138.00] AMP    21755.7   -85.40
533046 [GILL S 4    138.00] AMP    28357.0   -85.43
533053 [LAKERDG4    138.00] AMP    18961.9   -85.56
533054 [MAIZE  4    138.00] AMP    23381.2   -85.11
533062 [ROSEHIL4    138.00] AMP    31772.9   -86.17
533074 [45TH ST4    138.00] AMP    29217.4   -86.42
533153 [COLINE 3    115.00] AMP    23427.4   -80.93
533155 [CROOKED3    115.00] AMP    20734.5   -84.04
533166 [INDIANH3    115.00] AMP    17814.9   -82.22
533167 [KEENE  3    115.00] AMP    10031.8   -85.12
533169 [NTHLAND3    115.00] AMP    15094.3   -82.68
533170 [OSAGE  3    115.00] AMP     4387.2   -71.70
533176 [SHAWNEE3    115.00] AMP    12271.5   -82.16
533177 [6 GOLDN3    115.00] AMP    16334.2   -81.83
533180 [TEC E  3    115.00] AMP    30049.2   -82.79
533187 [27CROCO3    115.00] AMP    20481.8   -82.89
533194 [SHERWOD3    115.00] AMP    20135.9   -83.72
533197 [HARTLND3    115.00] AMP    13015.2   -81.23
533198 [HOYTJS 3    115.00] AMP    20048.8   -84.93
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533199 [HOYTJN 3     115.00] AMP    19061.0   -84.73
533234 [BISMARK3     115.00] AMP    22060.4   -80.86
533240 [EUDORA 3     115.00] AMP    12123.5   -81.77
533250 [LWRNCHL3     115.00] AMP    30883.2   -83.97
533253 [MOCKBRD3     115.00] AMP    20606.4   -79.49
533256 [19THST 3     115.00] AMP    19242.5   -80.73
533257 [19THSTJ3     115.00] AMP    19836.4   -80.95
533268 [STRANGR3     115.00] AMP    33054.2   -86.94
533270 [STULL T3     115.00] AMP    12659.0   -72.25
533308 [VAUGHN 3     115.00] AMP     2812.9   -71.28
533311 [WMBROSJ3     115.00] AMP     6774.1   -76.31
533326 [EMANHAT3     115.00] AMP    13123.0   -85.63
533328 [FT JCT 3     115.00] AMP    14585.1   -85.96
533340 [SMANHAT3     115.00] AMP    11996.4   -85.49
533341 [STAGGHL3     115.00] AMP     9524.1   -83.88
533360 [TCHOPE 3     115.00] AMP     3371.1   -87.27
533362 [CHAPMAN3     115.00] AMP    10381.9   -85.59
533381 [SUMMIT 3     115.00] AMP    17359.3   -86.39
533392 [SCRNTJS3     115.00] AMP     5088.0   -74.23
533413 [CIRCLE 3     115.00] AMP    22714.6   -85.87
533415 [DAVIS  3     115.00] AMP     8741.9   -82.40
533429 [MOUNDRG3     115.00] AMP     7183.7   -83.13
533438 [WMCPHER3     115.00] AMP    12426.2   -84.78
533880 [GODDARD2     138.00] AMP    18933.2   -85.91
539800 [CLARKCOUNTY7345.00] AMP    12693.8   -84.73
539804 [THISTLE4     138.00] AMP    16515.4   -86.38
539805 [ELMCREEK7    345.00] AMP     5313.6   -85.43
541198 [PECULR 7     345.00] AMP    20152.7   -85.60
542969 [STILWEL5     161.00] AMP    38867.9   -85.83
542978 [CRAIG  5     161.00] AMP    39829.9   -85.73
542982 [IATAN  7     345.00] AMP    27000.3   -86.67
543049 [CEDRCRK5     161.00] AMP    27769.4   -84.96
543054 [CEDARNL5     161.00] AMP    13668.6   -84.61
543077 [PLSTVAL5     161.00] AMP     9761.0   -83.35
543105 [BULLCRK5     161.00] AMP    25120.8   -87.11
543132 [BNSF   5     161.00] AMP    20023.6   -85.74
560053 [G15-052T     345.00] AMP    13192.5   -86.46
583750 [GEN-2013-029345.00] AMP    10492.1   -84.69
584660 [GEN-2015-024345.00] AMP     5436.3   -86.45
584670 [GEN-2015-025345.00] AMP     6580.7   -86.45
585250 [GEN-2015-090345.00] AMP     3110.7   -85.71
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