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

**March 2017**
**Generator Interconnection**

# Revision History

| Date | Author | Change Description |
|---|---|---|
| 3/6/2017 | SPP | GEN-2010-005 Impact Restudy for Generator Modification Report Issued |
| 3/30/2017 | SPP | Clarify reactor requirement and moved a reactor analysis drawing from the appendix to the main body for better reference. State that the requested wind turbine change does not constitute a Material Modification. Short Circuit Analysis tables were revised. |

SPP Southwest Power Pool

# 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.

A power factor analysis for the 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. The interconnection customer's facility is required to install a reactor or an equivalent means of compensation that can inject approximately 7.6Mvar of inductive reactance. Reactive compensation devices are typically installed on the low side of the project's Phase II substation 345/34.5kV transformer.

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

With the assumptions outlined in this report and with all the required network upgrades from the DISIS 2015-002 in place, GEN-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. The change in wind turbine generator is not a Material Modification.

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

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

# Table of Contents

# 1. Introduction

The GEN-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<br>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 | Vestas 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<br>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) |
| 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<br>121.5 Winter | GENROU | Tap Rose Hill-Sooner 345kV (562318) |
| GEN-2013-012 | 4 x 168.0MW Summer<br>4 x 215MW Winter | GENROU<br>(514910)<br>(514911)<br>(514912)<br>(514942) | Redbud 345kV (514909) |
| GEN-2013-028 | 516.4 Summer<br>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 | 199.95 | Vestas V126 GS 3.3MW & 3.45MW | Ranch Road 345kV (515576) |
| GEN-2015-047 | 300 | Vestas V110-2MW (wind) | Sooner 345kV Tap (514803) |
| GEN-2015-052 | 300 | Vestas 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 | Vestas 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 | Vestas V110-2MW (wind) | Union Ridge 230kV (532874) |
| GEN-2015-073 | 200.1 | Vestas V126 3.45MW (wind) | Emporia 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.

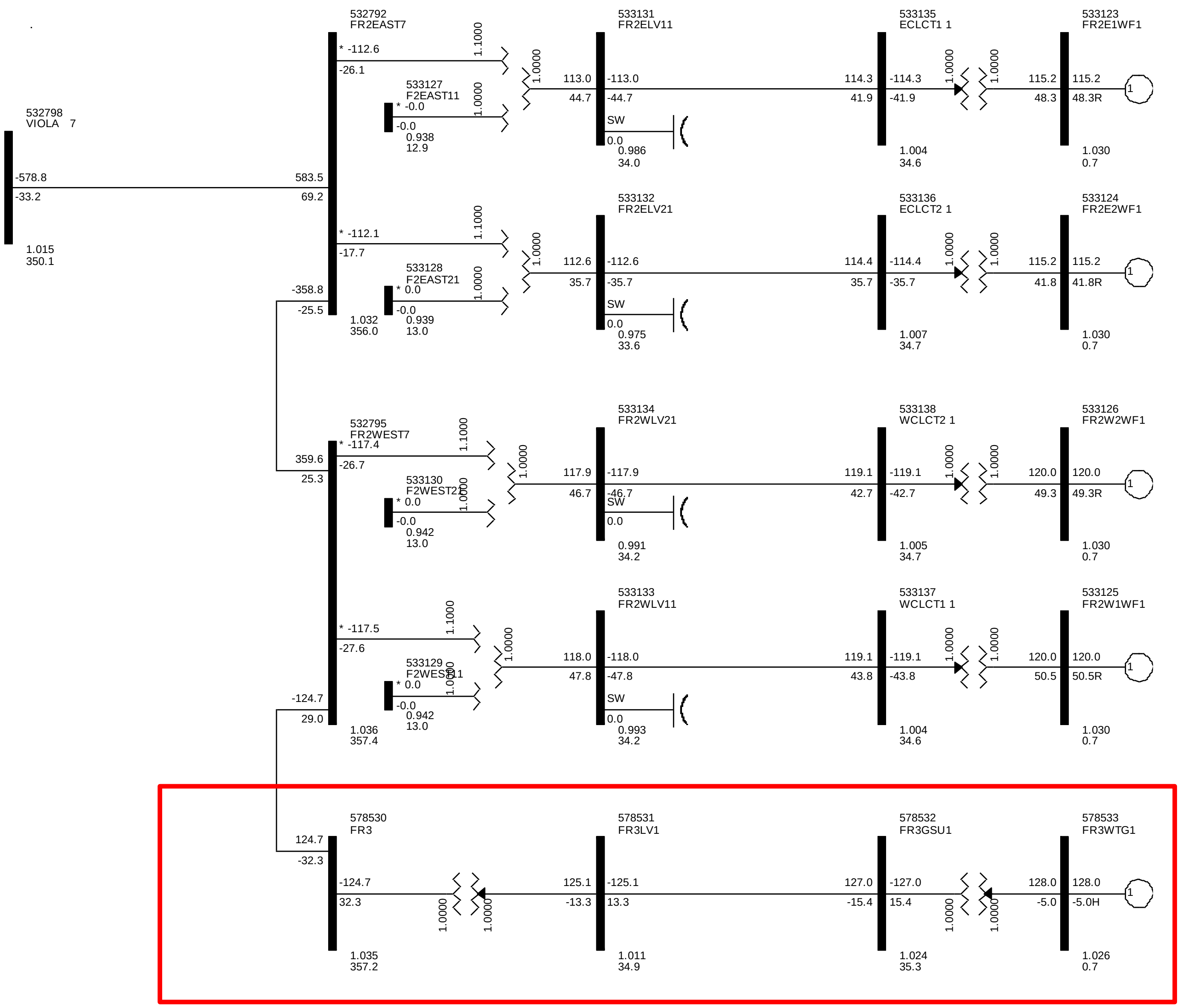
Short Circuit analysis was conducted using the current study upgrade 2017 summer peak and 2025 summer peak cases. The results from the Short circuit analysis are shown in Appendix F.

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 other queued projects as shown in **Table 1-2** and the 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.<br>a. Apply fault at the Viola 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Viola 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Renfrow 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Renfrow 345kV bus.<br>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.<br>a. Apply fault at the Hunter 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Woodring 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Woodring 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Woodring 345kV bus.<br>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.<br>a. Apply fault at the Mathewson 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Mathewson 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Mathewson 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Sooner 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Sooner 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Sooner 345kV bus.<br>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.<br>a. Apply fault at the Ranch Road 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Ranch Road 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Rosehill 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Rosehill 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Rosehill 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Rosehill 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Rosehill 345kV bus.<br>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.<br>a. Apply fault at the Northwest 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Northwest 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Northwest 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Northwest 345kV bus.<br>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.<br>a. Apply fault at the Benton 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Benton 345kV bus.<br>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.<br>a. Apply fault at the Wichita 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Wichita 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Wichita 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Wichita 345kV bus.<br>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.<br>a. Apply fault at the Thistle 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Thistle 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Thistle 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Thistle 345kV bus.<br>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.<br>a. Apply fault at the Reno 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Reno 345kV bus.<br>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.<br>a. Apply fault at the Summit 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Summit 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Summit 345kV bus.<br>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.<br>a. Apply fault at the EMPEC 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the EMPEC 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the EMPEC 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the EMPEC 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Morris 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Morris 345kV bus.<br>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.<br>a. Apply fault at the Swissvale 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Swissvale 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Swissvale 345kV bus.<br>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.<br>a. Apply fault at the WGardner 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the WGardner 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the WGardner 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the WGardner 345kV bus.<br>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.<br>a. Apply fault at the Stillwell 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Stillwell 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Stillwell 345kV bus.<br>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.<br>a. Apply fault at the Craig 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Craig 345kV bus.<br>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.<br>a. Apply fault at the Lacygne 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Lacygne 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Neosho 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Neosho 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Neosho 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Viola 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Viola 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Renfrow 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Hunter 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Woodring 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Woodring 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Sooner 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Sooner 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Ranch Road 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Ranch Road 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Rosehill 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Rosehill 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Rosehill 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Rosehill 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Wichita 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Wichita 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Wichita 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the EMPEC 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the EMPEC 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the EMPEC 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the EMPEC 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Morris 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the WGardner 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the WGardner 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the WGardner 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the WGardner 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the WGardner 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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 **Table 3-2.** The stability plots will be available upon customer request.

**Table 3-2: Summary of Results**

| 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 |

**Table 3-2: Summary of Results**

| Contingency Number and Name | | 2016WP | 2017SP | 2025SP |
|---|---|---|---|---|
| 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 |
| 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 (2016WP & 2017SP) | STABLE | STABLE | STABLE |
| 48 | FLT_47_Swissvale_Douglas_345kV_3PH (2025SP) | STABLE | STABLE | STABLE |
| 49 | FLT_48_Swissvale_Swissvale_345_230kV_3PH | STABLE | STABLE | STABLE |
| 50 | FLT_49_Wgardner_Stillwell_345kV_3PH | STABLE | STABLE | STABLE |
| 51 | FLT_50_Wgardner_Craig_345kV_3PH | STABLE | STABLE | STABLE |
| 52 | FLT_51_Wgardner_Lacygne_345kV_3PH | STABLE | STABLE | STABLE |
| 53 | FLT_52_Wgardner_Wgardner_345_161kV_3PH | STABLE | STABLE | STABLE |
| 54 | FLT_53_Stillwell_Peculiar_345kV_3PH | STABLE | STABLE | STABLE |
| 55 | FLT_54_Stillwell_Lacygne_345kV_3PH | STABLE | STABLE | STABLE |
| 56 | FLT_55_Stillwell_Stillwell_345_161kV_3PH | STABLE | STABLE | STABLE |
| 57 | FLT_56_Craig_87th_345kV_3PH | STABLE | STABLE | STABLE |
| 58 | FLT_57_Craig_Craig_345_161kV_3PH | STABLE | STABLE | STABLE |
| 59 | FLT_58_Lacygne_Neosho_345kV_3PH | STABLE | STABLE | STABLE |
| 60 | FLT_59_Lacygne_Waverly_345kV_3PH | STABLE | STABLE | STABLE |
| 61 | FLT_60_Neosho_Blackberry_345kV_3PH | STABLE | STABLE | STABLE |
| 62 | FLT_61_Neosho_Delaware_345kV_3PH | STABLE | STABLE | STABLE |
| 63 | FLT_62_Neosho_CaneyCreek_345kV_3PH | STABLE | STABLE | STABLE |
| 64 | FLT_63_Viola_Renfrow_345kV_1PH | STABLE | STABLE | STABLE |
| 65 | FLT_64_Viola_Wichita_345kV_1PH | STABLE | STABLE | STABLE |
| 66 | FLT_65_Renfrow_Hunter_345kV_1PH | STABLE | STABLE | STABLE |
| 67 | FLT_66_Hunter_Woodring_345kV_1PH | STABLE | STABLE | STABLE |
| 68 | FLT_67_Woodring_Sooner_345kV_1PH | STABLE | STABLE | STABLE |
| 69 | FLT_68_Woodring_G15063Tap_345kV_1PH | STABLE | STABLE | STABLE |
| 70 | FLT_69_Sooner_SpringCreek_345kV_1PH | STABLE | STABLE | STABLE |

**Table 3-2: Summary of Results**

| Contingency Number and Name | | 2016WP | 2017SP | 2025SP |
|---|---|---|---|---|
| 71 | FLT_70_Sooner_G15066T_345kV_1PH | STABLE | STABLE | STABLE |
| 72 | FLT_71_RanchRoad_Sooner_345kV_1PH | STABLE | STABLE | STABLE |
| 73 | FLT_72_RanchRoad_OpenSky_345kV_1PH | STABLE | STABLE | STABLE |
| 74 | FLT_73_Rosehill_Benton_345kV_1PH | STABLE | STABLE | STABLE |
| 75 | FLT_74_Rosehill_WolfCreek_345kV_1PH | STABLE | STABLE | STABLE |
| 76 | FLT_75_Rosehill_Latham_345kV_1PH | STABLE | STABLE | STABLE |
| 77 | FLT_76_Rosehill_G15052T_345kV_1PH | STABLE | STABLE | STABLE |
| 78 | FLT_77_Wichita_Reno_345kV_1PH | STABLE | STABLE | STABLE |
| 79 | FLT_78_Wichita_Benton_345kV_1PH | STABLE | STABLE | STABLE |
| 80 | FLT_79_Wichita_G1524_1525T_345kV_1PH | STABLE | STABLE | STABLE |
| 81 | FLT_80_EMPEC_Lang_345kV_1PH | STABLE | STABLE | STABLE |
| 82 | FLT_81_EMPEC_Morris_345kV_1PH | STABLE | STABLE | STABLE |
| 83 | FLT_82_EMPEC_Swissvale_345kV_1PH | STABLE | STABLE | STABLE |
| 84 | FLT_83_EMPEC_G14001Tap_345kV_1PH | STABLE | STABLE | STABLE |
| 85 | FLT_84_Morris_JECN_345kV_1PH | STABLE | STABLE | STABLE |
| 86 | FLT_85_Wgardner_Stillwell_345kV_1PH | STABLE | STABLE | STABLE |
| 87 | FLT_86_Wgardner_Craig_345kV_1PH | STABLE | STABLE | STABLE |
| 88 | FLT_87_Wgardner_Lacygne_345kV_1PH | STABLE | STABLE | STABLE |
| 89 | FLT_88A_Wgardner_Swissvale_345kV_1PH (2016WP& 2017SP) | STABLE | STABLE | STABLE |
| 90 | FLT_88_Wgardner_Douglas_345kV_1PH (2025SP) | 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 3-3** were tested to meet Order 661A LVRT provisions. GEN-2010-005 was found to be in compliance with FERC Order 661A.

**Table 3-3 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.<br>a. Apply fault at the Viola 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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.<br>a. Apply fault at the Viola 345kV bus.<br>b. Clear fault after 5 cycles by tripping the faulted line.<br>c. Wait 20 cycles, and then re-close the line in (b) back into the fault.<br>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

The study project as well as other projects modeled at the same POI was 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** located in Appendix D. 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 indicates 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.

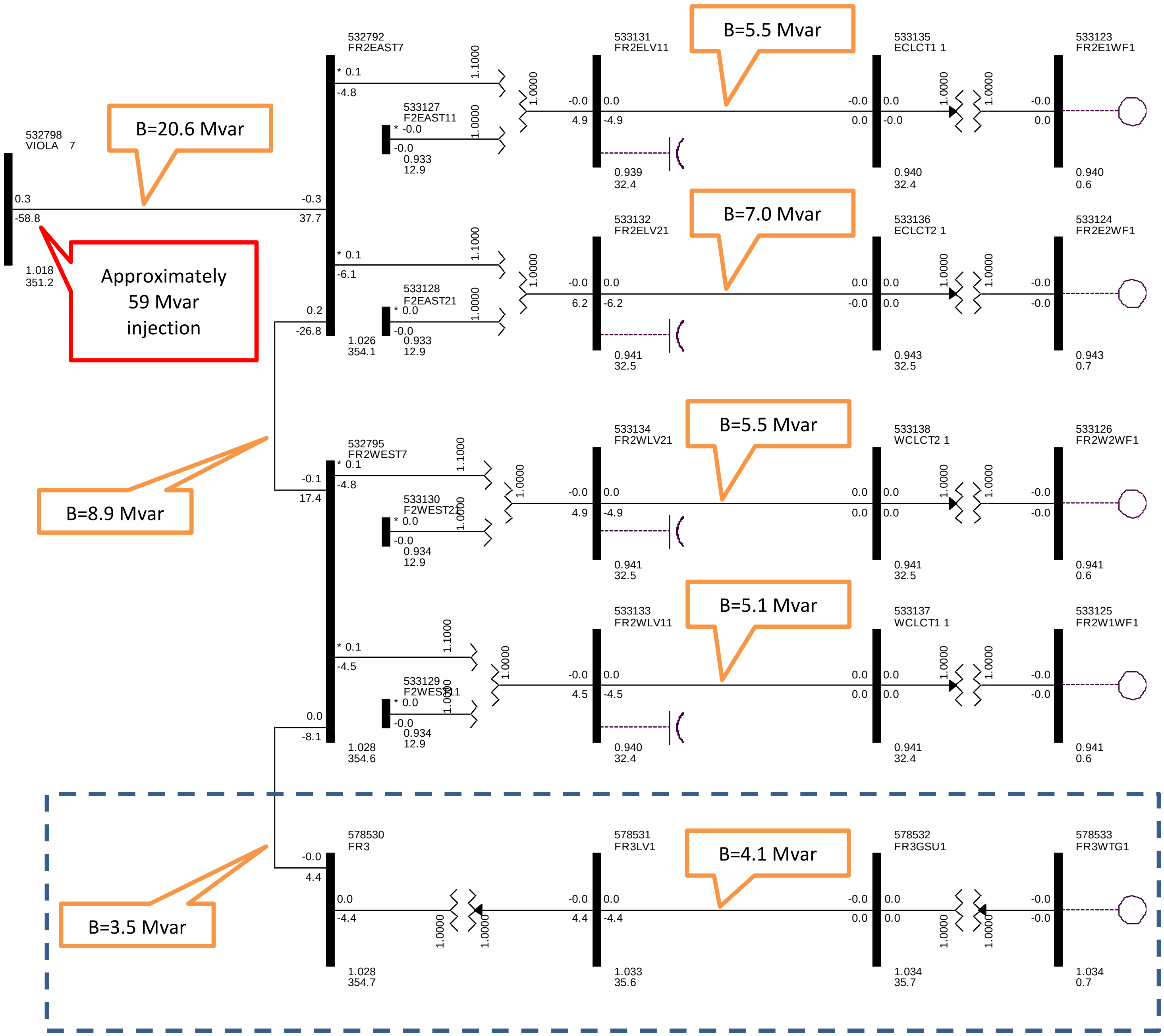
# 5. Reduced Wind Generation Analysis

A low wind analysis was performed for GEN-2015-005. GEN-2007-025 was included 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 reactive power injected at the POI.

The study generator and capacitors (if any) were turned off in the base case. **Figure 5-1** shows the resulting reactive power injection (approximately 59Mvar) at the POI that is due to the capacitance of the projects' transmission lines and collector cables. Also, the figure shows how the capacitance is distributed throughout the projects. In this impact restudy GEN-2010-005 is responsible for a 7.6Mvar reactor needed to offset the capacitive effects of the Phase II collector system (4.1Mvar) and of the transmission lead (3.5Mvar) that connects the Phase II 345/34.5kV transformer to the Phase I 345/34.5kV transformer. The interconnection customer's facility is required to install a reactor or an equivalent means of compensation that can inject approximately 7.6Mvar of inductive reactance. Reactive compensation devices are typically installed on the low side of the project's Phase II substation 345/34.5kV transformer.

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 shown in **Figure E-1** located in Appendix E. A reactor of approximately 56 Mvar will negate the capacitive effect of both projects at the POI. **This is shown for information only and not as a requirement**.

**Figure 5-1: GEN-2010-005 and GEN-2007-025 with generators and capacitor banks turned off**




Notes:

1. Amber boxes show distribution of charging capacitance in the facilities
2. Red box shows the net effect of all the charging capacitances at the POI
3. Dashed rectangular box shows what the interconnection customer is responsible for which is approximately 7.6Mvars

# 6. Short Circuit Analysis

The short circuit analysis was performed on the 2017 and 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 and other buses up to and including five levels away from the POI.

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* **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. The interconnection customer's facility is required to install a reactor or an equivalent means of compensation that can inject approximately 7.6Mvar of inductive reactance. Reactive compensation devices are typically installed on the low side of the project's Phase II substation 345/34.5kV transformer.

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

With the assumptions outlined in this report and with all the required network upgrades from the DISIS 2015-002 in place, GEN-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. The change in wind turbine generator is not a Material Modification.

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

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

# 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 |

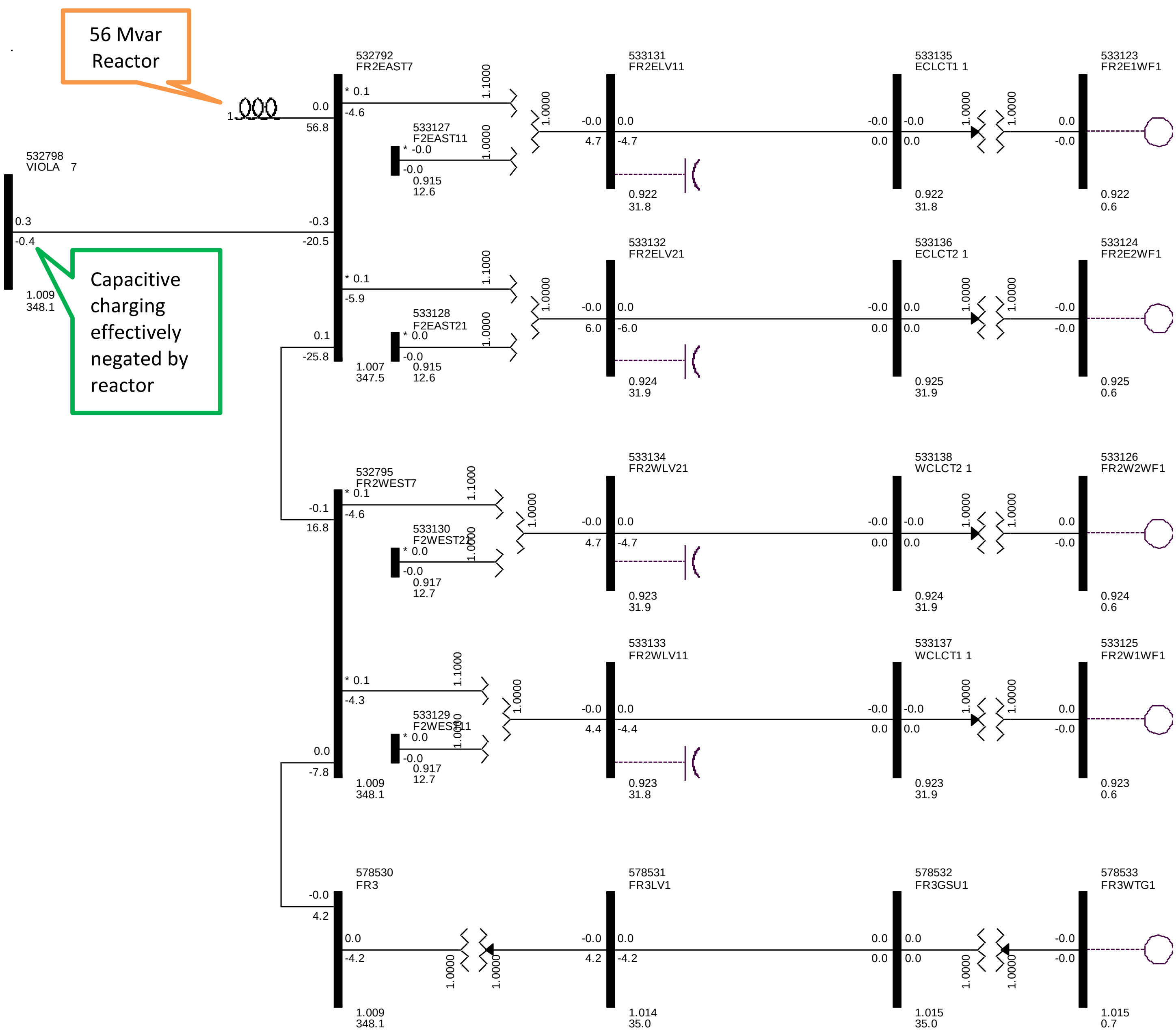
[1] Most lagging power factor
[2] Most leading power factor

| Leading power factor is absorbing vars; Lagging power factor is providing vars | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| GEN-2010-005 & GEN-2007-025<br>POI: Viola 345 kV (532798)<br>Power at POI (MW): 598.4 | | 2016 Winter Peak<br>POI Voltage = 1.009 pu | | | 2017 Summer Peak<br>POI Voltage = 1.009 pu | | | 2025 Summer Peak<br>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 figure is from the 2016WP model with identified upgrades in-service. The other two cases (2017SP and 2025SP) were almost identical since the Interconnection Request facilities design is the same in all cases.

**Figure E-1: GEN-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  17:10
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+)
532798 [VIOLA   7   345.00] AMP    11409.3   -85.09
515543 [RENFROW7    345.00] AMP    11221.6   -84.65
532792 [FR2EAST7    345.00] AMP     6214.1   -85.59
532796 [WICHITA7    345.00] AMP    23718.1   -86.10
515476 [HUNTERS7    345.00] AMP    12085.2   -84.69
515544 [RENFROW4    138.00] AMP    13395.7   -84.83
532771 [RENO   7    345.00] AMP    10671.1   -85.59
532791 [BENTON 7    345.00] AMP    19033.4   -85.71
532795 [FR2WEST7    345.00] AMP     5204.9   -85.65
533040 [EVANS N4    138.00] AMP    37053.0   -87.18
560033 [G1524&G1525T345.00] AMP    19150.8   -86.29
562476 [G14-001-TAP 345.00] AMP    10942.5   -85.04
583750 [GEN-2013-029345.00] AMP    10000.2   -84.61
514715 [WOODRNG7    345.00] AMP    16959.2   -84.81
515477 [CHSHLMV7    345.00] AMP    12069.2   -84.69
515546 [GRANTCO4    138.00] AMP     6232.0   -81.17
515569 [MDFRDTP4    138.00] AMP    10854.0   -83.45
520409 [RENFROW4    138.00] AMP     9946.2   -83.12
532768 [EMPEC 7     345.00] AMP    17283.1   -86.19
532773 [SUMMIT 7    345.00] AMP    10231.9   -85.73
532794 [ROSEHIL7    345.00] AMP    18824.7   -85.80
532797 [WOLFCRK7    345.00] AMP    15971.2   -86.81
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
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
578530 [FR3         345.00] AMP     4839.4   -85.62
583850 [GEN-2014-001345.00] AMP     7502.8   -84.76
584659 [G15024G15025345.00] AMP     6650.0   -86.46
514714 [WOODRNG4    138.00] AMP    18627.1   -83.28
514803 [SOONER 7    345.00] AMP    24554.8   -86.49
515375 [WWRDEHV7    345.00] AMP    18092.5   -85.93
520205 [WAKITAS4    138.00] AMP     5641.1   -80.47
522397 [MDFRDJCT    138.00] AMP     7153.1   -82.24
532767 [BLUSTEM7    345.00] AMP     9609.0   -86.22
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
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532799 [WAVERLY7    345.00] AMP    14712.8   -86.51
532800 [LATHAMS7    345.00] AMP    10459.6   -85.56
532873 [SUMMIT 6    230.00] AMP    12906.7   -85.19
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
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
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
560031 [G15-015-TAP 138.00] AMP     8035.1   -81.07
560053 [G15-052T    345.00] AMP    13120.0   -86.45
560055 [G15-063T    345.00] AMP    16815.0   -84.89
584660 [GEN-2015-024345.00] AMP     5405.6   -86.43
584670 [GEN-2015-025345.00] AMP     6534.5   -86.43
585100 [GEN-2015-073345.00] AMP    14171.8   -85.65
585250 [GEN-2015-090345.00] AMP     3101.8   -85.71
514708 [OTTER  4    138.00] AMP     9517.5   -82.41
514709 [FRMNTAP4    138.00] AMP    17452.3   -82.86
514711 [WAUKOTP4    138.00] AMP    14930.7   -81.70
514733 [MARSHL 4    138.00] AMP     7781.9   -80.53
514802 [SOONER 4    138.00] AMP    31300.9   -86.78
514881 [SPRNGCK7    345.00] AMP    21364.0   -85.53
515376 [WWRDEHV4    138.00] AMP    24270.5   -84.93
515458 [BORDER     7345.00] AMP     5004.3   -86.21
515497 [MATHWSN7    345.00] AMP    27500.2   -85.77
515576 [RANCHRD7    345.00] AMP    13752.1   -86.64
515581 [COYOTE 4    138.00] AMP     8000.5   -80.46
515599 [NBUFFRG7    345.00] AMP     8239.3   -85.98
515621 [OPENSKY7    345.00] AMP    12757.4   -86.62
520212 [WAKITA4     138.00] AMP     5603.3   -80.46
522398 [PONDCREEK   138.00] AMP     5333.4   -81.65
530592 [SMOKYHL6    230.00] AMP     6884.6   -84.32
532766 [JEC N  7    345.00] AMP    23298.6   -87.51
532780 [CANEYRV7    345.00] AMP     9887.0   -85.50
532801 [ELKRVR17    345.00] AMP     9235.9   -85.46
532802 [WAVERTX7    345.00] AMP    12556.3   -86.05
532856 [SWISVAL6    230.00] AMP    21813.3   -85.42
532863 [MORRIS 6    230.00] AMP    13782.0   -85.33
532871 [CIRCLE 6    230.00] AMP     8522.2   -84.20
532872 [EMCPHER6    230.00] AMP     7716.0   -83.42
532874 [UNIONRG6    230.00] AMP     8763.7   -83.67
532987 [BUTLER 4    138.00] AMP     9874.8   -79.45
532991 [WEAVER 4    138.00] AMP    21745.4   -83.96
533012 [HALSTDS4    138.00] AMP     4213.6   -85.32
533013 [MOUND  4    138.00] AMP     4799.9   -84.74
533016 [WWUPLNT4    138.00] AMP     7583.1   -84.70
533031 [BURNSTP4    138.00] AMP     4469.5   -76.64
533037 [COMOTAR4    138.00] AMP    18394.3   -84.62
533038 [COWSKIN4    138.00] AMP    18334.6   -84.63
533039 [ELPASO 4    138.00] AMP    24291.5   -84.19
533049 [HOOVERN4    138.00] AMP    17648.9   -84.96
533060 [NOEASTE4    138.00] AMP    20280.6   -84.76
533064 [17TH   4    138.00] AMP    17535.6   -84.54
533068 [STEARMN4    138.00] AMP    19342.0   -84.21
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    533304 [LANG   3    115.00] AMP    14440.2   -85.16
    533336 [BLUSTEM3    115.00] AMP    16964.4   -86.43
    533372 [PHILIPS3    115.00] AMP    12014.8   -84.15
    533380 [SPRGCRK3    115.00] AMP     3589.8   -72.59
    533381 [SUMMIT 3    115.00] AMP    16809.6   -86.26
    533391 [MAIZEE 4    138.00] AMP    20950.0   -85.00
    533412 [ARKVALJ3    115.00] AMP     9755.6   -83.28
    533414 [CITIES 3    115.00] AMP     8103.5   -82.20
    533419 [HEC    3    115.00] AMP    16911.8   -84.92
    533421 [HEC GT 3    115.00] AMP    17570.5   -85.04
    533422 [HEC U4 3    115.00] AMP    17126.9   -84.70
    533426 [MANVILE3    115.00] AMP     8273.2   -82.50
    533428 [MCPHER 3    115.00] AMP    10463.5   -84.18
    533439 [WHEATLD3    115.00] AMP     7303.1   -83.61
    539638 [FLATRDG4    138.00] AMP    14623.8   -85.83
    539639 [ELMCREK6    230.00] AMP     7279.5   -84.78
    539803 [IRONWOOD7   345.00] AMP    12837.3   -84.51
    542965 [W.GRDNR7    345.00] AMP    25251.9   -85.83
    542981 [LACYGNE7    345.00] AMP    24950.3   -86.88
    560000 [G11-14-TAP  345.00] AMP    13223.5   -86.30
    560002 [IRONWOOD7   345.00] AMP    12871.2   -85.12
    560056 [G15-066T    345.00] AMP    17956.6   -86.54
    562075 [G11-051-TAP 345.00] AMP    12110.3   -86.54
    582008 [GEN-2011-008345.00] AMP    10471.8   -84.37
    582019 [GEN-2011-019345.00] AMP    18092.5   -85.93
    582020 [GEN-2011-020345.00] AMP    18092.5   -85.93
    583370 [GEN-2012-024345.00] AMP    10839.3   -84.64
    584570 [GEN-2015-015138.00] AMP     5665.4   -81.68
    584690 [GEN-2015-030345.00] AMP    18710.1   -85.92
    584880 [GEN-2015-047345.00] AMP    11487.6   -83.76
    584900 [GEN-2015-052345.00] AMP    13069.8   -86.42
    585010 [GEN-2015-063345.00] AMP    16756.6   -84.86
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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  17:12
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+)
532798 [VIOLA   7   345.00] AMP    13506.5   -85.45
515543 [RENFROW7    345.00] AMP    11853.9   -84.75
532792 [FR2EAST7    345.00] AMP     6648.9   -85.72
532796 [WICHITA7    345.00] AMP    24680.8   -86.24
533075 [VIOLA  4    138.00] AMP    22036.2   -86.03
515476 [HUNTERS7    345.00] AMP    12445.0   -84.73
515544 [RENFROW4    138.00] AMP    13620.7   -84.89
532771 [RENO   7    345.00] AMP    11457.1   -85.98
532791 [BENTON 7    345.00] AMP    19393.9   -85.74
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532795 [FR2WEST7    345.00] AMP     5481.1   -85.75
532984 [SUMNER 4    138.00] AMP    10180.1   -82.91
533036 [CLEARWT4    138.00] AMP    21755.7   -85.40
533040 [EVANS N4    138.00] AMP    42055.9   -87.26
533046 [GILL S 4    138.00] AMP    28357.0   -85.43
560033 [G1524&G1525T345.00] AMP    19678.1   -86.39
562476 [G14-001-TAP 345.00] AMP    11042.5   -85.05
583750 [GEN-2013-029345.00] AMP    10492.1   -84.69
514715 [WOODRNG7    345.00] AMP    17310.7   -84.83
515477 [CHSHLMV7    345.00] AMP    12428.0   -84.73
515546 [GRANTCO4    138.00] AMP     6278.3   -81.16
515569 [MDFRDTP4    138.00] AMP    10995.2   -83.46
520409 [RENFROW4    138.00] AMP    10059.0   -83.14
532768 [EMPEC 7     345.00] AMP    17389.2   -86.18
532773 [SUMMIT 7    345.00] AMP    10600.8   -85.90
532794 [ROSEHIL7    345.00] AMP    19128.0   -85.82
532797 [WOLFCRK7    345.00] AMP    16039.4   -86.82
532982 [OXFORD 4    138.00] AMP     9220.5   -82.96
532986 [BENTON 4    138.00] AMP    28458.3   -85.85
532992 [TIMBJCT4    138.00] AMP     5687.2   -83.30
533029 [59TH ST4    138.00] AMP    18951.4   -83.68
533041 [EVANS S4    138.00] AMP    42055.9   -87.26
533045 [GILL W 4    138.00] AMP    28357.0   -85.43
533063 [SC10BEL4    138.00] AMP    10109.9   -81.91
533065 [SG12COL4    138.00] AMP    21501.9   -85.71
533390 [MAIZEW 4    138.00] AMP    27864.2   -85.44
533416 [RENO   3    115.00] AMP    25059.6   -86.11
533880 [GODDARD2    138.00] AMP    18933.2   -85.91
539675 [MILANTP4    138.00] AMP     7082.4   -75.28
539801 [THISTLE7    345.00] AMP    15716.4   -85.88
578530 [FR3         345.00] AMP     5072.8   -85.71
583850 [GEN-2014-001345.00] AMP     7545.9   -84.77
584659 [G15024G15025345.00] AMP     6698.0   -86.48
514714 [WOODRNG4    138.00] AMP    18753.3   -83.27
514803 [SOONER 7    345.00] AMP    24754.9   -86.49
515375 [WWRDEHV7    345.00] AMP    20414.7   -86.01
520205 [WAKITAS4    138.00] AMP     5664.4   -80.47
522397 [MDFRDJCT    138.00] AMP     7214.1   -82.23
532767 [BLUSTEM7    345.00] AMP     9737.1   -86.29
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
532799 [WAVERLY7    345.00] AMP    14764.2   -86.51
532800 [LATHAMS7    345.00] AMP    10515.9   -85.56
532873 [SUMMIT 6    230.00] AMP    13478.4   -85.34
532981 [CRESWLN4    138.00] AMP     7946.4   -81.84
532985 [TCROCK 4    138.00] AMP     5318.8   -83.30
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
533039 [ELPASO 4    138.00] AMP    25582.3   -84.20
533042 [FARBER 4    138.00] AMP    16371.7   -83.75
533044 [GILL E 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
533072 [WACO   4    138.00] AMP    23416.6   -85.30
533074 [45TH ST4    138.00] AMP    29217.4   -86.42
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
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|---|---|---|---|---|
| 539668 | [HARPER 4 138.00] | AMP | 5950.8 | -79.19 |
| 539676 | [MILAN 4 138.00] | AMP | 4204.6 | -73.50 |
| 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 |
| 560031 | [G15-015-TAP 138.00] | AMP | 8141.8 | -80.98 |
| 560053 | [G15-052T 345.00] | AMP | 13192.5 | -86.46 |
| 560055 | [G15-063T 345.00] | AMP | 17261.2 | -84.94 |
| 584660 | [GEN-2015-024345.00] | AMP | 5436.3 | -86.45 |
| 584670 | [GEN-2015-025345.00] | AMP | 6580.7 | -86.45 |
| 585100 | [GEN-2015-073345.00] | AMP | 14242.4 | -85.64 |
| 585200 | [GEN-2015-083138.00] | AMP | 6978.0 | -80.57 |
| 585250 | [GEN-2015-090345.00] | AMP | 3110.7 | -85.71 |
| 514708 | [OTTER 4 138.00] | AMP | 9547.2 | -82.39 |
| 514709 | [FRMNTAP4 138.00] | AMP | 17564.3 | -82.85 |
| 514711 | [WAUKOTP4 138.00] | AMP | 15017.6 | -81.70 |
| 514733 | [MARSHL 4 138.00] | AMP | 7799.1 | -80.52 |
| 514802 | [SOONER 4 138.00] | AMP | 31805.6 | -86.81 |
| 514804 | [MIDLTNT4 138.00] | AMP | 7806.1 | -79.70 |
| 514881 | [SPRNGCK7 345.00] | AMP | 21877.0 | -85.53 |
| 515376 | [WWRDEHV4 138.00] | AMP | 25235.7 | -85.11 |
| 515458 | [BORDER 7345.00] | AMP | 5118.6 | -86.21 |
| 515497 | [MATHWSN7 345.00] | AMP | 29723.6 | -86.08 |
| 515576 | [RANCHRD7 345.00] | AMP | 13791.9 | -86.64 |
| 515581 | [COYOTE 4 138.00] | AMP | 8127.8 | -80.35 |
| 515599 | [NBUFFRG7 345.00] | AMP | 8595.2 | -85.98 |
| 515621 | [OPENSKY7 345.00] | AMP | 12795.8 | -86.62 |
| 520212 | [WAKITA4 138.00] | AMP | 5626.1 | -80.45 |
| 522398 | [PONDCREEK 138.00] | AMP | 5367.2 | -81.64 |
| 530592 | [SMOKYHL6 230.00] | AMP | 6941.3 | -84.30 |
| 532766 | [JEC N 7 345.00] | AMP | 23513.3 | -87.51 |
| 532776 | [DOUGLAS7 345.00] | AMP | 18181.1 | -85.14 |
| 532780 | [CANEYRV7 345.00] | AMP | 9931.3 | -85.50 |
| 532801 | [ELKRVR17 345.00] | AMP | 9279.4 | -85.46 |
| 532802 | [WAVERTX7 345.00] | AMP | 12593.0 | -86.05 |
| 532856 | [SWISVAL6 230.00] | AMP | 21903.8 | -85.41 |
| 532863 | [MORRIS 6 230.00] | AMP | 13858.1 | -85.32 |
| 532871 | [CIRCLE 6 230.00] | AMP | 9520.3 | -84.80 |
| 532872 | [EMCPHER6 230.00] | AMP | 8520.3 | -83.90 |
| 532874 | [UNIONRG6 230.00] | AMP | 8856.4 | -83.66 |
| 532987 | [BUTLER 4 138.00] | AMP | 10036.8 | -81.33 |
| 532991 | [WEAVER 4 138.00] | AMP | 22305.4 | -84.07 |
| 533012 | [HALSTDS4 138.00] | AMP | 4264.6 | -85.38 |
| 533013 | [MOUND 4 138.00] | AMP | 4877.3 | -84.82 |
| 533016 | [WWUPLNT4 138.00] | AMP | 7756.1 | -84.66 |
| 533031 | [BURNSTP4 138.00] | AMP | 4501.5 | -77.18 |
| 533032 | [BU11PON4 138.00] | AMP | 15174.5 | -80.35 |
| 533034 | [CENTENN4 138.00] | AMP | 16602.6 | -84.63 |
| 533037 | [COMOTAR4 138.00] | AMP | 18668.0 | -84.58 |
| 533038 | [COWSKIN4 138.00] | AMP | 20310.5 | -85.57 |
| 533049 | [HOOVERN4 138.00] | AMP | 18843.3 | -84.96 |
| 533051 | [INTERST4 138.00] | AMP | 17421.0 | -84.27 |
| 533060 | [NOEASTE4 138.00] | AMP | 20635.5 | -84.72 |
| 533064 | [17TH 4 138.00] | AMP | 17994.0 | -84.51 |
| 533066 | [64TH 4 138.00] | AMP | 14454.4 | -83.03 |
| 533068 | [STEARMN4 138.00] | AMP | 19903.0 | -84.17 |
| 533070 | [SLATECRK4 138.00] | AMP | 4502.0 | -81.76 |
| 533304 | [LANG 3 115.00] | AMP | 14470.0 | -85.15 |
| 533336 | [BLUSTEM3 115.00] | AMP | 17078.9 | -86.54 |
| 533372 | [PHILIPS3 115.00] | AMP | 12363.6 | -84.25 |
| 533380 | [SPRGCRK3 115.00] | AMP | 3618.4 | -72.52 |
| 533381 | [SUMMIT 3 115.00] | AMP | 17359.3 | -86.39 |
| 533391 | [MAIZEE 4 138.00] | AMP | 21888.6 | -84.94 |
| 533412 | [ARKVALJ3 115.00] | AMP | 10849.0 | -83.58 |

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533414 [CITIES 3    115.00] AMP     8884.2   -82.20
533419 [HEC    3    115.00] AMP    22185.6   -85.85
533422 [HEC U4 3    115.00] AMP    21785.0   -85.66
533426 [MANVILE3    115.00] AMP    10206.9   -83.83
533428 [MCPHER 3    115.00] AMP    11944.6   -84.75
533439 [WHEATLD3    115.00] AMP     7900.6   -83.95
539000 [RAGO   4    138.00] AMP     3602.5   -81.08
539001 [ANTHONY4    138.00] AMP     3616.3   -80.97
539004 [MAYFLD 4    138.00] AMP     3740.3   -75.96
539638 [FLATRDG4    138.00] AMP    14826.5   -85.71
539639 [ELMCREK6    230.00] AMP     7341.9   -84.83
539803 [IRONWOOD7   345.00] AMP    12904.4   -84.48
542981 [LACYGNE7    345.00] AMP    25069.4   -86.87
560000 [G11-14-TAP  345.00] AMP    13556.7   -86.32
560002 [IRONWOOD7   345.00] AMP    12938.9   -85.10
560056 [G15-066T    345.00] AMP    18051.6   -86.54
562075 [G11-051-TAP 345.00] AMP    17171.7   -86.37
582008 [GEN-2011-008345.00] AMP    10522.1   -84.37
582019 [GEN-2011-019345.00] AMP    20414.7   -86.01
582020 [GEN-2011-020345.00] AMP    20414.7   -86.01
583370 [GEN-2012-024345.00] AMP    10899.7   -84.64
584570 [GEN-2015-015138.00] AMP     5713.4   -81.62
584690 [GEN-2015-030345.00] AMP    18824.9   -85.92
584880 [GEN-2015-047345.00] AMP    11525.8   -83.74
584900 [GEN-2015-052345.00] AMP    13141.7   -86.43
585010 [GEN-2015-063345.00] AMP    17199.4   -84.91
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