# GEN-2015-073
# Impact Restudy for Generator Modification (Turbine Change)

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

SPP Southwest Power Pool

# Revision History

| Date | Author | Change Description |
|---|---|---|
| 3/30/2017 | SPP | GEN-2015-073 Impact Restudy for Generator Modification Report Issued |

# Executive Summary

The GEN-2015-073 Interconnection Customer has requested a modification to its Generator Interconnection Request (GIR) to change wind turbine generators. Originally, the GIR consisted of eight-seven (87) Siemens 2.3MW wind turbines for a total 200.1 MW. The requested change is fifty-eight (58) Vestas V126 GS 3.45MW wind turbines totaling 200.1MW. The point of interconnection (POI) is the Westar Energy (WERE) Emporia 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 was performed for the project 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-2015-073, 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 14.8Mvar. Reactive compensation devices are typically installed on the low side of the project's 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-2015-073 with fifty-eight (58) Vestas V126 GS 3.45MW wind turbines 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-2015-073 Interconnection Customer has requested a modification to its Generator Interconnection Request to change its wind turbine generators from eight-seven (87) Siemens 2.3MW wind turbines to fifty-eight (58) Vestas V126 GS 3.45MW wind turbines for a total 200.1 MW. The requested change is shown in **Table 1-1**.

**Table 1-1: Interconnection Request**

| Request | Capacity (MW) | Generator Model | Point of Interconnection |
|---|---|---|---|
| GEN-2015-073 | 200.1 | 58 x Vestas V126 GS 3.45MW | Emporia 345kV (532768) |

The POI is the WERE Emporia 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) |
| GEN-2010-005 | 299.2 | GE 1.6MW & Vestas V110 2.0MW | Viola 345kV (532798) |
| ASGI-2010-006 | 150 | GE1.5MW | Remington 138kV (301369) |
| GEN-2010-055 | 4.8 | GENROU | Wekiwa 138kV (509757) |
| GEN-2011-057 | 150.4 | GE 1.6MW | Creswell 138kV (532981) |
| GEN-2012-027 | 150.7 | GE 1.62MW | Shidler 138kV (510403) |
| KCPL Distributed: Osawatomie | 76.0 | GENROU (543078) | Paola 161kV |
| GEN-2012-032 | 300 | Vestas V112 3.0MW | Tap Rose Hill-Sooner 345kV (562318) |
| GEN-2012-033 | 98.8 | GE 1.62MW | Tap Bunch Creek-South 4th 138kV(562303) |
| GEN-2012-040 | 76.5 | GE 1.7MW | Chilocco 138kV (521198) |
| GEN-2012-041 | 85 Summer<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) |

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

| Request | Capacity (MW) | Generator Model | Point of Interconnection |
|---|---|---|---|
| GEN-2013-028 | 516.4 Summer 559.5 Winter | GENROU (583743, 583746) | Tap on Tulsa N to GRDA1 345kV (562423) |
| GEN-2013-029 | 300 | Vestas V100 VCSS 2MW (583753, 583756) | Renfrow 345kV(515543) |
| GEN-2014-001 | 200.6 | GE 1.7MW 100m (583853,583856) | Tap Wichita to Emporia Energy Center 345kV (562476) |
| GEN-2014-028 | 35 (Uprate) (Pgen=259W/256 S) | 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-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.

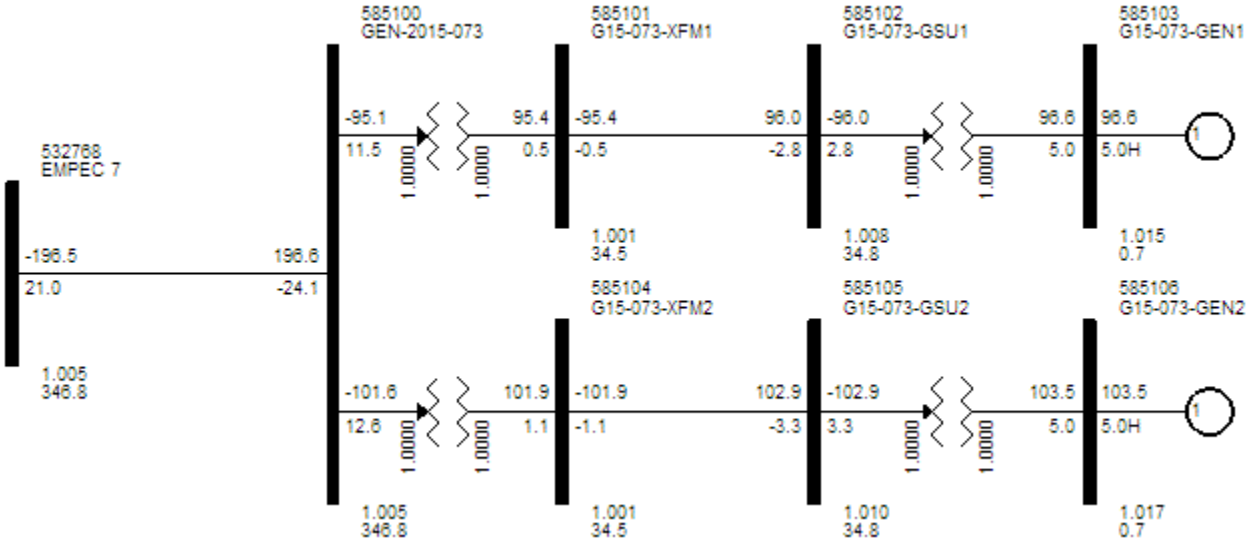
Short Circuit analysis was conducted using the current study upgrade 2017 summer peak and 2025 summer peak cases. The results from the Short circuit analysis are shown in Appendix F.

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-2015-073.

**Figure 2-1: GEN-2015-073 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. |

**Table 3-1: Contingencies Evaluated**

| Cont. No. | Contingency Name | Description |
|---|---|---|
| 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. |
| 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. |

**Table 3-1: Contingencies Evaluated**

| Cont. No. | Contingency Name | Description |
|---|---|---|
| 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. |
| 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. |

**Table 3-1: Contingencies Evaluated**

| Cont. No. | Contingency Name | Description |
|---|---|---|
| 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. |
| 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. |

**Table 3-1: Contingencies Evaluated**

| Cont. No. | Contingency Name | Description |
|---|---|---|
| 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. |
| 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. |

**Table 3-1: Contingencies Evaluated**

| Cont. No. | Contingency Name | Description |
|---|---|---|
| 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. |
| 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. |

**Table 3-1: Contingencies Evaluated**

| Cont. No. | Contingency Name | Description |
|---|---|---|
| 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. |
| 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. |

**Table 3-1: Contingencies Evaluated**

| Cont. No. | Contingency Name | Description |
|---|---|---|
| 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. |
| 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 |
| 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 |

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

| Contingency Number and Name | | 2016WP | 2017SP | 2025SP |
|---|---|---|---|---|
| 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 |
| 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-2015-073 was found to be in compliance with FERC Order 661A.

**Table 3-3 LVRT Contingencies**

| Contingency Number and Name | Description |
|---|---|
| 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. |
| 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. |
| 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. |
| 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. |

# 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-2015-073 | 200.1 | Emporia 345kV (532768) | Wind | Vestas V126 GS 3.45MW | 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-2015-073. 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 14.9Mvar) at the POI that is due to the capacitance of the project's transmission line and collector cables. **Figure 5-2** shows two reactors totaling 14.8Mvar on the low side buses of the project's 345/34.5kV transformers to offset the capacitive injection at the POI. The interconnection customer's facility is required to install a reactor or an equivalent means of compensation that can inject approximately 14.8Mvar. Reactive compensation devices are typically installed on the low side of the project's substation 345/34.5kV transformer.

**Figure 5-1*:* GEN-2015-073 with generators turned off**

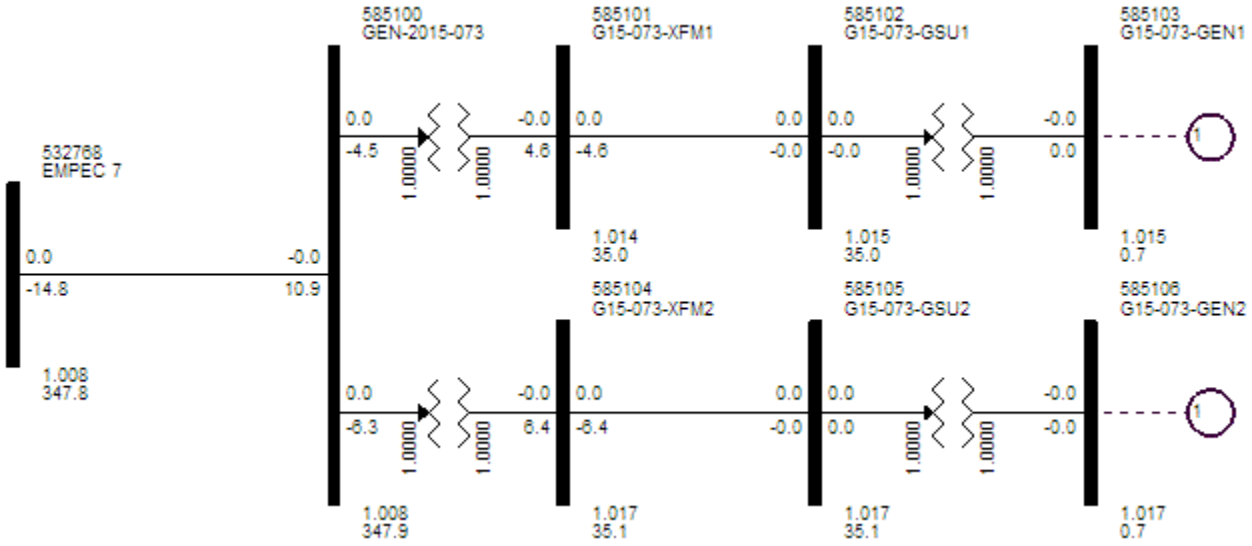
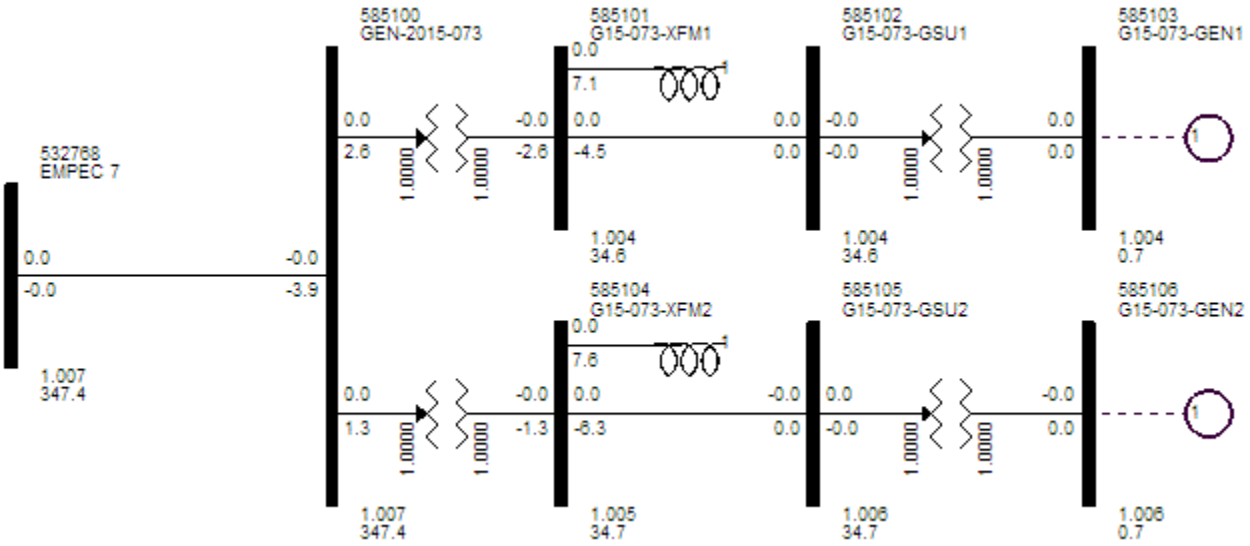



**Figure 5-2*:* GEN-2015-073 with shunt reactors at low side of project 345/34.5kV transformer and with generators turned off**



# 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 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 E, Table E-1** ***GEN-2015-073 Short Circuit Analysis Results (2017SP)*** and **Table E-2** ***GEN-2015-073 Short Circuit Analysis Results (2025SP)***.

# 7. Conclusion

The GEN-2015-073 Interconnection Customer has requested a modification to its Generator Interconnection Request (GIR) to change wind turbine generators. Originally, the GIR consisted of eight-seven (87) Siemens 2.3MW wind turbines for a total 200.1 MW. The requested change is fifty-eight (58) Vestas V126 GS 3.45MW wind turbines totaling 200.1MW. The point of interconnection (POI) is the Westar Energy (WERE) Emporia 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-2015-073, 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 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 equivalent compensation that can inject approximately 14.8Mvar of inductive reactance. Reactive compensation devices are typically installed on the low side of the project's 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-2015-073 with fifty-eight (58) Vestas V126 GS 3.45MW wind turbines 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-2015-073 Power Factor Analysis Results**

| Leading power factor is absorbing vars; Lagging power factor is providing vars | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | GEN-2015-073 Turbine Restudy<br>POI - EMPEC 345.00 (532768)<br>Power at POI (MW): 200.1 | 2016 Winter Peak<br>POI Voltage = 1.005 pu | | | 2017 Summer Peak<br>POI Voltage = 1.010 pu | | | 2025 Summer Peak<br>POI Voltage = 1.010 pu | | |
| | Contingency Name | Mvars at POI | Power Factor | | Mvars at POI | Power Factor | | Mvars at POI | Power Factor | |
| 0 | FLT_00_NoFault | -4.379 | 1.000 | LEAD | -4.837 | 1.000 | LEAD | -4.841 | 1.000 | LEAD |
| 1 | FLT_01_Viola_Renfrow_345kV | -3.868 | 1.000 | LEAD | -4.791 | 1.000 | LEAD | -5.875 | 1.000 | LEAD |
| 2 | FLT_02_Viola_Wichita_345kV | -6.703 | 0.999 | LEAD | -8.552 | 0.999 | LEAD | -6.029 | 1.000 | LEAD |
| 3 | FLT_03_Renfrow_Hunter_345kV | -1.184 | 1.000 | LEAD | -2.708 | 1.000 | LEAD | -3.998 | 1.000 | LEAD |
| 4 | FLT_04_Renfrow_Renfrow_345_138kV | -3.941 | 1.000 | LEAD | -4.306 | 1.000 | LEAD | -4.487 | 1.000 | LEAD |
| 5 | FLT_05_Hunter_Woodring_345kV | 4.211 | 1.000 | LAG | 1.382 | 1.000 | LAG | -0.884 | 1.000 | LEAD |
| 6 | FLT_06_Woodring_Sooner_345kV | -4.612 | 1.000 | LEAD | -5.151 | 1.000 | LEAD | -5.171 | 1.000 | LEAD |
| 7 | FLT_07_Woodring_G15063Tap_345kV | -0.952 | 1.000 | LEAD | -2.502 | 1.000 | LEAD | -2.798 | 1.000 | LEAD |
| 8 | FLT_08_Woodring_Woodring_345_138kV | -4.142 | 1.000 | LEAD | -4.589 | 1.000 | LEAD | -4.622 | 1.000 | LEAD |
| 9 | FLT_09_Mathewson_Northwest_345kV | -4.209 | 1.000 | LEAD | -4.709 | 1.000 | LEAD | -4.805 | 1.000 | LEAD |
| 10 | FLT_10_Mathewson_Cimarron_345kV | -4.124 | 1.000 | LEAD | -4.639 | 1.000 | LEAD | -4.674 | 1.000 | LEAD |
| 11 | FLT_11_Mathewson_Tatonga_345kV | -3.030 | 1.000 | LEAD | -3.995 | 1.000 | LEAD | -4.719 | 1.000 | LEAD |
| 12 | FLT_12_Sooner_SpringCreek_345kV | -2.341 | 1.000 | LEAD | -3.614 | 1.000 | LEAD | -3.528 | 1.000 | LEAD |
| 13 | FLT_13_Sooner_G15066T_345kV | 1.175 | 1.000 | LAG | -0.458 | 1.000 | LEAD | -1.133 | 1.000 | LEAD |
| 14 | FLT_14_Sooner_Sooner_345_138kV | -4.420 | 1.000 | LEAD | -4.914 | 1.000 | LEAD | -4.912 | 1.000 | LEAD |
| 15 | FLT_15_RanchRoad_Sooner_345kV | 2.614 | 1.000 | LAG | -0.610 | 1.000 | LEAD | -0.503 | 1.000 | LEAD |
| 16 | FLT_16_RanchRoad_OpenSky_345kV | -4.264 | 1.000 | LEAD | -5.262 | 1.000 | LEAD | -5.317 | 1.000 | LEAD |
| 17 | FLT_17_Rosehill_Benton_345kV | -5.325 | 1.000 | LEAD | -5.814 | 1.000 | LEAD | -6.208 | 1.000 | LEAD |
| 18 | FLT_18_Rosehill_WolfCreek_345kV | -2.625 | 1.000 | LEAD | -4.340 | 1.000 | LEAD | -4.193 | 1.000 | LEAD |
| 19 | FLT_19_Rosehill_Latham_345kV | -2.608 | 1.000 | LEAD | -3.312 | 1.000 | LEAD | -3.621 | 1.000 | LEAD |
| 20 | FLT_20_Rosehill_G15052T_345kV | -4.769 | 1.000 | LEAD | -6.689 | 0.999 | LEAD | -6.959 | 0.999 | LEAD |
| 21 | FLT_21_Rosehill_Rosehill_345_138kV | -4.060 | 1.000 | LEAD | -4.798 | 1.000 | LEAD | -4.815 | 1.000 | LEAD |
| 22 | FLT_22_Northwest_SpringCreek_345kV | -2.610 | 1.000 | LEAD | -3.191 | 1.000 | LEAD | -3.025 | 1.000 | LEAD |
| 23 | FLT_23_Northwest_Cimarron_345kV | -4.345 | 1.000 | LEAD | -4.807 | 1.000 | LEAD | -4.798 | 1.000 | LEAD |
| 24 | FLT_24_Northwest_Arcadia_345kV | -3.838 | 1.000 | LEAD | -4.787 | 1.000 | LEAD | -5.042 | 1.000 | LEAD |
| 25 | FLT_25_Northwest_Northwest_345_138kV | -4.369 | 1.000 | LEAD | -4.765 | 1.000 | LEAD | -4.800 | 1.000 | LEAD |
| 26 | FLT_26_Benton_WolfCreek_345kV | -2.543 | 1.000 | LEAD | -4.449 | 1.000 | LEAD | -4.370 | 1.000 | LEAD |
| 27 | FLT_27_Benton_Benton_345_138kV | -4.619 | 1.000 | LEAD | -5.106 | 1.000 | LEAD | -5.134 | 1.000 | LEAD |
| 28 | FLT_28_Wichita_Reno_345kV | 2.255 | 1.000 | LAG | 4.919 | 1.000 | LAG | 3.585 | 1.000 | LAG |
| 29 | FLT_29_Wichita_Benton_345kV | -6.627 | 0.999 | LEAD | -6.301 | 1.000 | LEAD | -7.588 | 0.999 | LEAD |
| 30 | FLT_30_Wichita_G1524&1525T_345kV | -3.398 | 1.000 | LEAD | -4.236 | 1.000 | LEAD | -4.291 | 1.000 | LEAD |
| 31 | FLT_31_Wichita_Evans_345_138kV | -3.964 | 1.000 | LEAD | -6.199 | 1.000 | LEAD | -6.515 | 0.999 | LEAD |
| 32 | FLT_32_Thistle_G1524&1525T_345kV | -2.173 | 1.000 | LEAD | -3.141 | 1.000 | LEAD | -2.951 | 1.000 | LEAD |
| 33 | FLT_33_Thistle_Woodward_345kV | -4.382 | 1.000 | LEAD | -4.827 | 1.000 | LEAD | -4.660 | 1.000 | LEAD |
| 34 | FLT_34_Thistle_ClarkCounty_345kV | -3.510 | 1.000 | LEAD | -4.249 | 1.000 | LEAD | -4.261 | 1.000 | LEAD |
| 35 | FLT_35_Thistle_Thistle_345_138kV | -4.308 | 1.000 | LEAD | -4.537 | 1.000 | LEAD | -4.697 | 1.000 | LEAD |
| 36 | FLT_36_Reno_Summit_345kV | -1.524 | 1.000 | LEAD | -1.683 | 1.000 | LEAD | -2.001 | 1.000 | LEAD |
| 37 | FLT_37_Reno_Reno_345_115kV | -4.155 | 1.000 | LEAD | -4.349 | 1.000 | LEAD | -4.607 | 1.000 | LEAD |

| Leading power factor is absorbing vars; Lagging power factor is providing vars | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | GEN-2015-073 Turbine Restudy<br>POI - EMPEC 345.00 (532768)<br>Power at POI (MW): 200.1 | 2016 Winter Peak<br>POI Voltage = 1.005 pu | | | 2017 Summer Peak<br>POI Voltage = 1.010 pu | | | 2025 Summer Peak<br>POI Voltage = 1.010 pu | | |
| | **Contingency Name** | **Mvars at POI** | **Power Factor** | | **Mvars at POI** | **Power Factor** | | **Mvars at POI** | **Power Factor** | |
| 38 | FLT_38_Summit_JECN_345kV | -3.817 | 1.000 | LEAD | -4.042 | 1.000 | LEAD | -4.304 | 1.000 | LEAD |
| 39 | FLT_39_Summit_ElmCreek_345kV | -2.598 | 1.000 | LEAD | -3.136 | 1.000 | LEAD | -3.355 | 1.000 | LEAD |
| 40 | FLT_40_Summit_Summit_345_230kV | -4.528 | 1.000 | LEAD | -3.920 | 1.000 | LEAD | -3.951 | 1.000 | LEAD |
| 41 | FLT_41_EMPEC_Lang_345kV | -10.385 | 0.999 | LEAD | -8.952 | 0.999 | LEAD | -9.541 | 0.999 | LEAD |
| 42 | FLT_42_EMPEC_Morris_345kV | 6.749 | 0.999 | LAG | 6.044 | 1.000 | LAG | 5.584 | 1.000 | LAG |
| 43 | FLT_43_EMPEC_Swissvale_345kV | -13.286 | 0.998 | LEAD | -15.774 | 0.997 | LEAD | -16.044 | 0.997 | LEAD |
| 44 | FLT_44_EMPEC_G14001Tap_345kV | -5.870 | 1.000 | LEAD | -8.940 | 0.999 | LEAD | -7.177 | 0.999 | LEAD |
| 45 | FLT_45_Morris_JECN_345kV | 2.956 | 1.000 | LAG | -0.893 | 1.000 | LEAD | -1.159 | 1.000 | LEAD |
| 46 | FLT_46_Morris_Morris_345_230kV | -7.029 | 0.999 | LEAD | -4.780 | 1.000 | LEAD | -4.822 | 1.000 | LEAD |
| 47 | FLT_47_Swissvale_Wgardner_345kV | -14.337 | 0.997 | LEAD | -16.485 | 0.997[1] | LEAD | -13.985 | 0.998 | LEAD |
| 48 | FLT_48_Swissvale_Swissvale_345_230kV | -6.678 | 0.999 | LEAD | -4.894 | 1.000 | LEAD | -5.026 | 1.000 | LEAD |
| 49 | FLT_49_Wgardner_Stillwell_345kV | -4.927 | 1.000 | LEAD | -5.922 | 1.000 | LEAD | -6.014 | 1.000 | LEAD |
| 50 | FLT_50_Wgardner_Craig_345kV | -3.242 | 1.000 | LEAD | -4.424 | 1.000 | LEAD | -3.828 | 1.000 | LEAD |
| 51 | FLT_51_Wgardner_Lacygne_345kV | 5.444 | 1.000 | LAG | 5.721 | 1.000 | LAG | 5.363 | 1.000 | LAG |
| 52 | FLT_52_Wgardner_Wgardner_345_161kV | -5.435 | 1.000 | LEAD | -5.343 | 1.000 | LEAD | -5.360 | 1.000 | LEAD |
| 53 | FLT_53_Stillwell_Peculiar_345kV | -1.916 | 1.000 | LEAD | -2.855 | 1.000 | LEAD | -2.878 | 1.000 | LEAD |
| 54 | FLT_54_Stillwell_Lacygne_345kV | 9.599 | 0.999 | LAG | 9.749 | 0.999 | LAG | 9.564 | 0.999 | LAG |
| 55 | FLT_55_Stillwell_Stillwell_345_161kV | -4.075 | 1.000 | LEAD | -4.602 | 1.000 | LEAD | -4.607 | 1.000 | LEAD |
| 56 | FLT_56_Craig_87th_345kV | -2.229 | 1.000 | LEAD | -1.433 | 1.000 | LEAD | -1.737 | 1.000 | LEAD |
| 57 | FLT_57_Craig_Craig_345_161kV | -3.998 | 1.000 | LEAD | -4.577 | 1.000 | LEAD | -4.593 | 1.000 | LEAD |
| 58 | FLT_58_Lacygne_Neosho_345kV | -4.324 | 1.000 | LEAD | -4.954 | 1.000 | LEAD | -4.978 | 1.000 | LEAD |
| 59 | FLT_59_Lacygne_Waverly_345kV | 22.914 | 0.994[2] | LAG | 15.240 | 0.997 | LAG | 13.566 | 0.998 | LAG |
| 60 | FLT_60_Neosho_Blackberry_345kV | -2.867 | 1.000 | LEAD | -3.806 | 1.000 | LEAD | -3.741 | 1.000 | LEAD |
| 61 | FLT_61_Neosho_Delaware_345kV | -3.162 | 1.000 | LEAD | -3.984 | 1.000 | LEAD | -3.984 | 1.000 | LEAD |
| 62 | FLT_62_Neosho_CaneyCreek_345kV | 3.183 | 1.000 | LAG | 1.924 | 1.000 | LAG | 1.300 | 1.000 | LAG |

1. Most leading power factor
2. Most lagging power factor

# Appendix E – Short Circuit Analysis Results

**Table E-1: GEN-2015-073 Short Circuit Analysis Results (2017SP)**

```
                              PSS(R)E-32.2.2 ASCC SHORT CIRCUIT CURRENTS          TUE, FEB
14 2017  17:11
2015 MDWG FINAL WITH 2013 MMWG, UPDATED WITH 2014 SERC & MRO
MDWG 17S WITH MMWG 15S, MRO 16W TOPO/16S PROF, SERC 16S

OPTIONS USED:
    - FLAT CONDITIONS
         - BUS VOLTAGES SET TO 1 PU AT 0 PHASE ANGLE
         - GENERATOR P=0, Q=0
         - TRANSFOMRER TAP RATIOS=1.0 PU and PHASE ANGLES=0.0
         - LINE CHARGING=0.0 IN +/-/0 SEQUENCE
         - LOAD=0.0 IN +/- SEQUENCE, CONSIDERED IN ZERO SEQUENCE
         - LINE/FIXED/SWITCHED SHUNTS=0.0 AND MAGNETIZING ADMITTANCE=0.0 IN +/-/0 SEQUENCE
         - DC LINES AND FACTS DEVICES BLOCKED
         - TRANSFORMER ZERO SEQUENCE IMPEDANCE CORRECTIONS IGNORED

                                  THREE PHASE FAULT
X---------- BUS ----------X         /I+/    AN(I+)
532768 [EMPEC 7     345.00] AMP    17283.1   -86.19
532769 [LANG   7    345.00] AMP    17072.2   -86.18
532770 [MORRIS 7    345.00] AMP    12731.0   -85.54
532774 [SWISVAL7    345.00] AMP    16423.8   -85.37
562476 [G14-001-TAP 345.00] AMP    10942.5   -85.04
585100 [GEN-2015-073345.00] AMP    14171.8   -85.65
532766 [JEC N  7    345.00] AMP    23298.6   -87.51
532796 [WICHITA7    345.00] AMP    23718.1   -86.10
532856 [SWISVAL6    230.00] AMP    21813.3   -85.42
532863 [MORRIS 6    230.00] AMP    13782.0   -85.33
533304 [LANG   3    115.00] AMP    14440.2   -85.16
542965 [W.GRDNR7    345.00] AMP    25251.9   -85.83
583850 [GEN-2014-001345.00] AMP     7502.8   -84.76
532765 [HOYT   7    345.00] AMP    15354.2   -85.76
532767 [BLUSTEM7    345.00] AMP     9609.0   -86.22
532771 [RENO   7    345.00] AMP    10671.1   -85.59
532791 [BENTON 7    345.00] AMP    19033.4   -85.71
532798 [VIOLA   7   345.00] AMP    11409.3   -85.09
532851 [AUBURN 6    230.00] AMP    13446.6   -83.79
532852 [JEC    6    230.00] AMP    24522.2   -87.76
532857 [TECHILL6    230.00] AMP    11266.9   -84.32
532858 [BALDWIN6    230.00] AMP    13734.8   -84.53
532862 [MCDOWEL6    230.00] AMP     6892.7   -84.87
532874 [UNIONRG6    230.00] AMP     8763.7   -83.67
533040 [EVANS N4    138.00] AMP    37053.0   -87.18
533301 [EAST ST3    115.00] AMP     9202.6   -82.09
533305 [MORRIS 3    115.00] AMP    12407.5   -86.31
533306 [READING3    115.00] AMP     6390.9   -73.71
533307 [PRAIRIE3    115.00] AMP     9248.7   -82.46
542966 [WGARDNR5    161.00] AMP    27244.1   -86.92
542968 [STILWEL7    345.00] AMP    24264.6   -85.89
542977 [CRAIG  7    345.00] AMP    21510.9   -85.70
542981 [LACYGNE7    345.00] AMP    24950.3   -86.88
560033 [G1524&G1525T345.00] AMP    19150.8   -86.29
515543 [RENFROW7    345.00] AMP    11221.6   -84.65
532772 [STRANGR7    345.00] AMP    22142.2   -85.94
```

```
532773 [SUMMIT 7    345.00] AMP    10231.9   -85.73
532775 [87TH 7      345.00] AMP    19924.0   -85.69
532792 [FR2EAST7    345.00] AMP     6214.1   -85.59
532793 [NEOSHO 7    345.00] AMP    16198.2   -84.49
532794 [ROSEHIL7    345.00] AMP    18824.7   -85.80
532797 [WOLFCRK7    345.00] AMP    15971.2   -86.81
532799 [WAVERLY7    345.00] AMP    14712.8   -86.51
532853 [LAWHILL6    230.00] AMP    13751.9   -85.20
532861 [EMANHAT6    230.00] AMP     9565.6   -85.60
532873 [SUMMIT 6    230.00] AMP    12906.7   -85.19
532986 [BENTON 4    138.00] AMP    27908.2   -85.85
533041 [EVANS S4    138.00] AMP    37053.0   -87.18
533065 [SG12COL4    138.00] AMP    20146.8   -85.76
533151 [AUBURN 3    115.00] AMP    21702.4   -84.05
533163 [HOYT   3    115.00] AMP    22824.7   -85.67
533171 [OSAGE J3    115.00] AMP     5151.5   -72.86
533182 [TECHILE3    115.00] AMP    30018.6   -82.91
533232 [BALDCRK3    115.00] AMP    19909.9   -84.58
533309 [WEMPORI3    115.00] AMP     9770.3   -81.62
533335 [MCDOWEL3    115.00] AMP    17702.0   -85.31
533336 [BLUSTEM3    115.00] AMP    16964.4   -86.43
533359 [UNIONRG3    115.00] AMP     3784.2   -87.74
533390 [MAIZEW 4    138.00] AMP    25939.2   -85.53
533416 [RENO   3    115.00] AMP    21539.8   -85.57
539801 [THISTLE7    345.00] AMP    15378.5   -85.86
541198 [PECULR 7    345.00] AMP    20114.0   -85.62
542969 [STILWEL5    161.00] AMP    38986.5   -85.84
542978 [CRAIG  5    161.00] AMP    39235.8   -85.69
543049 [CEDRCRK5    161.00] AMP    27477.8   -84.94
543054 [CEDARNL5    161.00] AMP    13621.2   -84.61
543077 [PLSTVAL5    161.00] AMP     9737.8   -83.35
543105 [BULLCRK5    161.00] AMP    24968.2   -87.10
543132 [BNSF   5    161.00] AMP    19921.4   -85.74
584659 [G15024G15025345.00] AMP     6650.0   -86.46
585070 [GEN-2015-069230.00] AMP     6570.4   -84.48
300739 [7BLACKBERRY 345.00] AMP    12247.8   -84.37
510380 [DELWARE7    345.00] AMP    11393.8   -84.84
515375 [WWRDEHV7    345.00] AMP    18092.5   -85.93
515476 [HUNTERS7    345.00] AMP    12085.2   -84.69
515544 [RENFROW4    138.00] AMP    13395.7   -84.83
530592 [SMOKYHL6    230.00] AMP     6884.6   -84.32
532780 [CANEYRV7    345.00] AMP     9887.0   -85.50
532795 [FR2WEST7    345.00] AMP     5204.9   -85.65
532800 [LATHAMS7    345.00] AMP    10459.6   -85.56
532802 [WAVERTX7    345.00] AMP    12556.3   -86.05
532854 [LEC U5 6    230.00] AMP    13616.5   -85.09
532855 [MIDLAND6    230.00] AMP    12175.6   -84.82
532865 [NMANHT6     230.00] AMP     8770.7   -85.16
532872 [EMCPHER6    230.00] AMP     7716.0   -83.42
532920 [TECHILL5    161.00] AMP     5771.5   -84.75
532937 [NEOSHO 5    161.00] AMP    21992.2   -84.26
532988 [BELAIRE4    138.00] AMP    18637.6   -84.79
532990 [MIDIAN 4    138.00] AMP    10061.0   -80.49
533015 [BENTLEY4    138.00] AMP     9827.5   -85.10
533021 [NEOSHO 4    138.00] AMP    23036.3   -84.46
533024 [29TH   4    138.00] AMP    19399.9   -85.12
533035 [CHISHLM4    138.00] AMP    21786.1   -84.81
533053 [LAKERDG4    138.00] AMP    17996.8   -85.60
533054 [MAIZE  4    138.00] AMP    22202.1   -85.18
533062 [ROSEHIL4    138.00] AMP    30970.3   -86.16
533074 [45TH ST4    138.00] AMP    25950.4   -85.68
```

```
533153 [COLINE 3    115.00] AMP    23235.0   -81.04
533155 [CROOKED3    115.00] AMP    20489.6   -84.01
533166 [INDIANH3    115.00] AMP    17630.7   -82.26
533167 [KEENE  3    115.00] AMP    10051.0   -84.37
533169 [NTHLAND3    115.00] AMP    15021.4   -82.70
533170 [OSAGE  3    115.00] AMP     4384.3   -71.72
533176 [SHAWNEE3    115.00] AMP    12205.2   -82.20
533177 [6 GOLDN3    115.00] AMP    16256.1   -81.89
533180 [TEC E  3    115.00] AMP    29606.0   -82.94
533187 [27CROCO3    115.00] AMP    20243.5   -83.01
533194 [SHERWOD3    115.00] AMP    19824.1   -83.74
533197 [HARTLND3    115.00] AMP     4720.2   -74.94
533198 [HOYTJS 3    115.00] AMP    19905.8   -84.88
533199 [HOYTJN 3    115.00] AMP    18913.7   -84.62
533250 [LWRNCHL3    115.00] AMP    27782.9   -83.95
533268 [STRANGR3    115.00] AMP    31925.0   -86.81
533270 [STULL T3    115.00] AMP    12144.4   -72.49
533271 [SWLWRNC3    115.00] AMP    18543.3   -80.95
533283 [87TH 3      115.00] AMP    26058.7   -85.95
533308 [VAUGHN 3    115.00] AMP     2811.4   -71.29
533311 [WMBROSJ3    115.00] AMP     6761.4   -76.34
533326 [EMANHAT3    115.00] AMP    13088.0   -85.59
533328 [FT JCT 3    115.00] AMP    14504.6   -85.84
533341 [STAGGHL3    115.00] AMP     9504.6   -83.82
533350 [SMAN_W_3    115.00] AMP    12505.2   -79.35
533360 [TCHOPE 3    115.00] AMP     3364.3   -87.26
533362 [CHAPMAN3    115.00] AMP    10324.2   -85.53
533381 [SUMMIT 3    115.00] AMP    16809.6   -86.26
533392 [SCRNTJS3    115.00] AMP     5082.8   -74.25
533413 [CIRCLE 3    115.00] AMP    18064.1   -85.03
533415 [DAVIS  3    115.00] AMP     8102.7   -82.40
533429 [MOUNDRG3    115.00] AMP     7010.5   -83.06
533438 [WMCPHER3    115.00] AMP    10832.7   -84.14
539800 [CLARKCOUNTY7345.00] AMP    12611.4   -84.73
539804 [THISTLE4    138.00] AMP    16296.2   -86.47
539805 [ELMCREEK7   345.00] AMP     5251.7   -85.37
541200 [PHILL 7     345.00] AMP    18156.0   -85.65
541231 [STRANGR5    161.00] AMP    15155.9   -87.58
541341 [S.HARP 5    161.00] AMP    25055.9   -85.17
541342 [PECULR 5    161.00] AMP    24419.7   -85.47
542979 [PFLUMM 5    161.00] AMP    26860.2   -85.04
542982 [IATAN  7    345.00] AMP    25786.0   -86.70
542994 [HICKMAN5    161.00] AMP    18422.9   -83.90
542995 [MONTROS5    161.00] AMP    17462.5   -84.08
543031 [SHWNMSN5    161.00] AMP    31001.3   -84.73
543038 [LENEXAS5    161.00] AMP    26147.1   -85.03
543039 [LENEXAN5    161.00] AMP    27167.3   -84.72
543044 [MOONLT 5    161.00] AMP    16510.9   -85.05
543048 [COLLEGE5    161.00] AMP    27872.2   -84.69
543050 [ANTIOCH5    161.00] AMP    21947.3   -84.42
543053 [REDEL  5    161.00] AMP    23838.3   -84.19
543055 [SEOTTWA5    161.00] AMP     6692.0   -81.12
543057 [BUCYRUS5    161.00] AMP    19128.2   -84.31
543126 [LACKMAN5    161.00] AMP    13045.0   -83.85
543131 [CLARE  5    161.00] AMP    13981.8   -84.49
560053 [G15-052T    345.00] AMP    13120.0   -86.45
583750 [GEN-2013-029345.00] AMP    10000.2   -84.61
584660 [GEN-2015-024345.00] AMP     5405.6   -86.43
584670 [GEN-2015-025345.00] AMP     6534.5   -86.43
585250 [GEN-2015-090345.00] AMP     3101.8   -85.71
```

**Table E-2: GEN-2015-073 Short Circuit Analysis Results (2025SP)**

```
                            PSS(R)E-32.2.2 ASCC SHORT CIRCUIT CURRENTS          TUE, FEB 14
2017  17:14
2015 MDWG FINAL WITH 2013 MMWG, UPDATED WITH 2014 SERC & MRO
MDWG 2025S WITH MMWG 2024S, MRO & SERC 2025 SUMMER

OPTIONS USED:
    - FLAT CONDITIONS
        - BUS VOLTAGES SET TO 1 PU AT 0 PHASE ANGLE
        - GENERATOR P=0, Q=0
        - TRANSFOMRER TAP RATIOS=1.0 PU and PHASE ANGLES=0.0
        - LINE CHARGING=0.0 IN +/-/0 SEQUENCE
        - LOAD=0.0 IN +/- SEQUENCE, CONSIDERED IN ZERO SEQUENCE
        - LINE/FIXED/SWITCHED SHUNTS=0.0 AND MAGNETIZING ADMITTANCE=0.0 IN +/-/0 SEQUENCE
        - DC LINES AND FACTS DEVICES BLOCKED
        - TRANSFORMER ZERO SEQUENCE IMPEDANCE CORRECTIONS IGNORED

                                  THREE PHASE FAULT
X---------- BUS ----------X         /I+/    AN(I+)
532768 [EMPEC 7     345.00] AMP    17389.2   -86.18
532769 [LANG   7    345.00] AMP    17175.8   -86.17
532770 [MORRIS 7    345.00] AMP    12794.9   -85.53
532774 [SWISVAL7    345.00] AMP    16681.3   -85.36
562476 [G14-001-TAP 345.00] AMP    11042.5   -85.05
585100 [GEN-2015-073345.00] AMP    14242.4   -85.64
532766 [JEC N  7    345.00] AMP    23513.3   -87.51
532776 [DOUGLAS7    345.00] AMP    18181.1   -85.14
532796 [WICHITA7    345.00] AMP    24680.8   -86.24
532856 [SWISVAL6    230.00] AMP    21903.8   -85.41
532863 [MORRIS 6    230.00] AMP    13858.1   -85.32
533304 [LANG   3    115.00] AMP    14470.0   -85.15
583850 [GEN-2014-001345.00] AMP     7545.9   -84.77
532765 [HOYT   7    345.00] AMP    15628.7   -85.78
532767 [BLUSTEM7    345.00] AMP     9737.1   -86.29
532771 [RENO   7    345.00] AMP    11457.1   -85.98
532791 [BENTON 7    345.00] AMP    19393.9   -85.74
532798 [VIOLA   7   345.00] AMP    13506.5   -85.45
532851 [AUBURN 6    230.00] AMP    13515.0   -83.80
532852 [JEC    6    230.00] AMP    24643.2   -87.76
532857 [TECHILL6    230.00] AMP    11312.4   -84.30
532858 [BALDWIN6    230.00] AMP    14316.5   -84.69
532862 [MCDOWEL6    230.00] AMP     6912.1   -84.93
532874 [UNIONRG6    230.00] AMP     8856.4   -83.66
533040 [EVANS N4    138.00] AMP    42055.9   -87.26
533285 [DOUGLAS3    115.00] AMP    23976.7   -85.78
533301 [EAST ST3    115.00] AMP     9217.3   -82.07
533305 [MORRIS 3    115.00] AMP    12438.3   -86.31
533306 [READING3    115.00] AMP     6396.0   -73.69
533307 [PRAIRIE3    115.00] AMP     9264.2   -82.45
542965 [W.GRDNR7    345.00] AMP    25938.2   -85.83
560033 [G1524&G1525T345.00] AMP    19678.1   -86.39
515543 [RENFROW7    345.00] AMP    11853.9   -84.75
532772 [STRANGR7    345.00] AMP    24242.2   -86.19
532773 [SUMMIT 7    345.00] AMP    10600.8   -85.90
532792 [FR2EAST7    345.00] AMP     6648.9   -85.72
532794 [ROSEHIL7    345.00] AMP    19128.0   -85.82
532797 [WOLFCRK7    345.00] AMP    16039.4   -86.82
532853 [LAWHILL6    230.00] AMP    14469.7   -85.39
532861 [EMANHAT6    230.00] AMP     9599.6   -85.62
```

```
532873 [SUMMIT 6    230.00] AMP    13478.4   -85.34
532986 [BENTON 4    138.00] AMP    28458.3   -85.85
533041 [EVANS S4    138.00] AMP    42055.9   -87.26
533065 [SG12COL4    138.00] AMP    21501.9   -85.71
533075 [VIOLA  4    138.00] AMP    22036.2   -86.03
533151 [AUBURN 3    115.00] AMP    21977.4   -84.09
533163 [HOYT   3    115.00] AMP    23018.6   -85.75
533171 [OSAGE J3    115.00] AMP     5155.5   -72.85
533182 [TECHILE3    115.00] AMP    30488.4   -82.76
533232 [BALDCRK3    115.00] AMP    21675.0   -84.85
533236 [FAIRGDS3    115.00] AMP    22153.2   -81.51
533271 [SWLWRNC3    115.00] AMP    22816.0   -81.96
533309 [WEMPORI3    115.00] AMP     9790.0   -81.60
533335 [MCDOWEL3    115.00] AMP    17763.0   -85.57
533336 [BLUSTEM3    115.00] AMP    17078.9   -86.54
533359 [UNIONRG3    115.00] AMP     3792.8   -87.75
533390 [MAIZEW 4    138.00] AMP    27864.2   -85.44
533416 [RENO   3    115.00] AMP    25059.6   -86.11
539801 [THISTLE7    345.00] AMP    15716.4   -85.88
542966 [WGARDNR5    161.00] AMP    27436.8   -86.93
542968 [STILWEL7    345.00] AMP    24401.2   -85.86
542977 [CRAIG  7    345.00] AMP    21942.5   -85.75
542981 [LACYGNE7    345.00] AMP    25069.4   -86.87
584659 [G15024G15025345.00] AMP     6698.0   -86.48
585070 [GEN-2015-069230.00] AMP     6610.8   -84.48
515375 [WWRDEHV7    345.00] AMP    20414.7   -86.01
515476 [HUNTERS7    345.00] AMP    12445.0   -84.73
515544 [RENFROW4    138.00] AMP    13620.7   -84.89
530592 [SMOKYHL6    230.00] AMP     6941.3   -84.30
532775 [87TH 7      345.00] AMP    20389.3   -85.75
532793 [NEOSHO 7    345.00] AMP    16293.0   -84.49
532795 [FR2WEST7    345.00] AMP     5481.1   -85.75
532799 [WAVERLY7    345.00] AMP    14764.2   -86.51
532800 [LATHAMS7    345.00] AMP    10515.9   -85.56
532854 [LEC U5 6    230.00] AMP    14314.9   -85.27
532855 [MIDLAND6    230.00] AMP    12771.6   -84.98
532865 [NMANHT6     230.00] AMP     8802.0   -85.19
532872 [EMCPHER6    230.00] AMP     8520.3   -83.90
532920 [TECHILL5    161.00] AMP     5790.7   -84.76
532984 [SUMNER 4    138.00] AMP    10180.1   -82.91
532988 [BELAIRE4    138.00] AMP    18906.2   -84.76
532990 [MIDIAN 4    138.00] AMP    10208.1   -81.79
533015 [BENTLEY4    138.00] AMP    10120.2   -85.06
533024 [29TH   4    138.00] AMP    19689.4   -85.09
533035 [CHISHLM4    138.00] AMP    22456.6   -84.77
533036 [CLEARWT4    138.00] AMP    21755.7   -85.40
533046 [GILL S 4    138.00] AMP    28357.0   -85.43
533053 [LAKERDG4    138.00] AMP    18961.9   -85.56
533054 [MAIZE  4    138.00] AMP    23381.2   -85.11
533062 [ROSEHIL4    138.00] AMP    31772.9   -86.17
533074 [45TH ST4    138.00] AMP    29217.4   -86.42
533153 [COLINE 3    115.00] AMP    23427.4   -80.93
533155 [CROOKED3    115.00] AMP    20734.5   -84.04
533166 [INDIANH3    115.00] AMP    17814.9   -82.22
533167 [KEENE  3    115.00] AMP    10031.8   -85.12
533169 [NTHLAND3    115.00] AMP    15094.3   -82.68
533170 [OSAGE  3    115.00] AMP     4387.2   -71.70
533176 [SHAWNEE3    115.00] AMP    12271.5   -82.16
533177 [6 GOLDN3    115.00] AMP    16334.2   -81.83
533180 [TEC E  3    115.00] AMP    30049.2   -82.79
533187 [27CROCO3    115.00] AMP    20481.8   -82.89
```

```
533194 [SHERWOD3    115.00] AMP    20135.9   -83.72
533197 [HARTLND3    115.00] AMP    13015.2   -81.23
533198 [HOYTJS 3    115.00] AMP    20048.8   -84.93
533199 [HOYTJN 3    115.00] AMP    19061.0   -84.73
533234 [BISMARK3    115.00] AMP    22060.4   -80.86
533240 [EUDORA 3    115.00] AMP    12123.5   -81.77
533250 [LWRNCHL3    115.00] AMP    30883.2   -83.97
533253 [MOCKBRD3    115.00] AMP    20606.4   -79.49
533256 [19THST 3    115.00] AMP    19242.5   -80.73
533257 [19THSTJ3    115.00] AMP    19836.4   -80.95
533268 [STRANGR3    115.00] AMP    33054.2   -86.94
533270 [STULL T3    115.00] AMP    12659.0   -72.25
533308 [VAUGHN 3    115.00] AMP     2812.9   -71.28
533311 [WMBROSJ3    115.00] AMP     6774.1   -76.31
533326 [EMANHAT3    115.00] AMP    13123.0   -85.63
533328 [FT JCT 3    115.00] AMP    14585.1   -85.96
533340 [SMANHAT3    115.00] AMP    11996.4   -85.49
533341 [STAGGHL3    115.00] AMP     9524.1   -83.88
533360 [TCHOPE 3    115.00] AMP     3371.1   -87.27
533362 [CHAPMAN3    115.00] AMP    10381.9   -85.59
533381 [SUMMIT 3    115.00] AMP    17359.3   -86.39
533392 [SCRNTJS3    115.00] AMP     5088.0   -74.23
533413 [CIRCLE 3    115.00] AMP    22714.6   -85.87
533415 [DAVIS  3    115.00] AMP     8741.9   -82.40
533429 [MOUNDRG3    115.00] AMP     7183.7   -83.13
533438 [WMCPHER3    115.00] AMP    12426.2   -84.78
533880 [GODDARD2    138.00] AMP    18933.2   -85.91
539800 [CLARKCOUNTY7345.00] AMP    12693.8   -84.73
539804 [THISTLE4    138.00] AMP    16515.4   -86.38
539805 [ELMCREEK7   345.00] AMP     5313.6   -85.43
541198 [PECULR 7    345.00] AMP    20152.7   -85.60
542969 [STILWEL5    161.00] AMP    38867.9   -85.83
542978 [CRAIG  5    161.00] AMP    39829.9   -85.73
542982 [IATAN  7    345.00] AMP    27000.3   -86.67
543049 [CEDRCRK5    161.00] AMP    27769.4   -84.96
543054 [CEDARNL5    161.00] AMP    13668.6   -84.61
543077 [PLSTVAL5    161.00] AMP     9761.0   -83.35
543105 [BULLCRK5    161.00] AMP    25120.8   -87.11
543132 [BNSF   5    161.00] AMP    20023.6   -85.74
560053 [G15-052T    345.00] AMP    13192.5   -86.46
583750 [GEN-2013-029345.00] AMP    10492.1   -84.69
584660 [GEN-2015-024345.00] AMP     5436.3   -86.45
584670 [GEN-2015-025345.00] AMP     6580.7   -86.45
585250 [GEN-2015-090345.00] AMP     3110.7   -85.71
```