Southwest Power Pool

GEN-2014-001

Impact Restudy for Generator Modification

Published January 2020
By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
01/30/2020	SPP	Initial report issued.

CONTENTS

SUMMARY

The GEN-2014-001 Interconnection Customer has requested a modification to its 200.6 MW Interconnection Request. This system impact restudy was performed to determine the effects of changing turbines from 95 Gamesa 2.1 MW wind turbine generators (for a total of 199.5 MW) to 64 GE 2.82 MW and 8 GE 2.3 MW wind turbine generators (for a total of 198.88 MW). In addition, the modification request included changes to the collection system, GSU transformer and the generator substation transformer. The point of interconnection (POI) for GEN-2014-001 remains at the tap on Emporia Energy Center to Wichita 345 kV line.

This study was performed by Aneden Consulting to determine whether the request for modification is considered Material. A short circuit analysis, a low-wind/no-wind condition analysis, and stability analysis was performed for this modification request. The study report follows this executive summary.

The generating facility will be required to maintain a 95% lagging (providing VARs) and 95% leading (absorbing VArs) at the POI in accordance with FERC Order 827. Additionally, the GEN-2014-001 project will be required to install approximately 21.2 MVArs of reactor shunts on its substation 345 kV bus or provide an alternate means of reactive power compensation. This is necessary to offset the capacitive effect on the transmission network caused by the project's transmission line and collector system during low-wind/no-wind conditions.

There were no other machine rotor angle damping or transient voltage recovery violations observed in the simulated fault events. 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. The requested modification is not considered Material.

It should be noted that this study analyzed the requested modification to change generator technology 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 transmission service or delivery rights. If the customer wishes to obtain deliverability to final customers, a separate request for transmission service must be requested on Southwest Power Pool's OASIS by the customer.

A: CONSULTANT'S MATERIAL MODIFICATION STUDY REPORT

See next page for the Consultant's Material Modification Study report.

Submitted to

Southwest Power Pool

SPP Southwest Power Pool

Report On

GEN-2014-001
Modification Request Impact Study

Revision R1

Date of Submittal
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Executive Summary

Aneden Consulting (Aneden) was retained by the Southwest Power Pool (SPP) to perform a Modification Request Impact Study (Study) for GEN-2014-001, an active generation interconnection request with a point of interconnection (POI) on the Emporia Energy Center 345 kV to Wichita 345 kV Substation 345 kV line.

The GEN-2014-001 project is proposed to interconnect in the Westar Energy (WERE) control area with a capacity of 199.5 MW as shown in Table ES-1 below. This Study has been requested to evaluate the modification of GEN-2014-001 to change turbine configuration to a total of 64 x GE 2.82MW + 8 x GE 2.3MW wind turbines for total capacity of 198.88 MW. In addition, the modification request included changes to the collection system, GSU transformer, and the generator substation transformer. The modification request changes are shown in Table ES-2 below.

Table ES-1: GEN-2014-001 Configuration

Request	Capacity (MW)	Existing Generator Configuration	Point of Interconnection
GEN-2014-001	199.5	95 x Gamesa 2.1MW = 199.5 MW	Tap on Emporia Energy Center (532768) to Wichita (532796)

Table ES-2: GEN-2014-001 Modification Request

<table>
<tr><th>Facility</th><th colspan="2">Existing</th><th colspan="2">Modification</th></tr>
<tr><td>Point of Interconnection</td><td colspan="2">Tap on Emporia Energy Center (532768) to Wichita (532796) 345 kV line</td><td colspan="2">Tap on Emporia Energy Center (532768) to Wichita (532796) 345 kV line</td></tr>
<tr><td>Configuration/Capacity</td><td colspan="2">95 x Gamesa 2.1MW = 199.5 MW</td><td colspan="2">64 x GE 2.82MW + 8 x GE 2.3MW = 198.88 MW</td></tr>
<tr><td>Generation Interconnection Line</td><td colspan="2">Length = 17.4 miles
R = 0.000870 pu
X = 0.008530 pu
B = 0.144910 pu</td><td colspan="2">Length = 17.4 miles
R = 0.000870 pu
X = 0.008530 pu
B = 0.144910 pu</td></tr>
<tr><td>Main Substation Transformer</td><td>Z = 8.5%, Winding 67 MVA, Rating 112 MVA</td><td>Z = 8.5%, Winding 67 MVA, Rating 112 MVA</td><td colspan="2">Z = 10%, Winding 135 MVA, Rating 225 MVA</td></tr>
<tr><td>GSU Transformer</td><td>Gen 1 Equivalent Qty: 48:
Z = 11.56%, Rating 112.8 MVA</td><td>Gen 2 Equivalent Qty: 47:
Z = 11.56%, Rating 110.4 MVA</td><td>Gen 1 Equivalent Qty: 8:
Z = 5.72%, Rating 26 MVA</td><td>Gen 2 Equivalent Qty: 64:
Z = 5.72%, Rating 208 MVA</td></tr>
<tr><td>Equivalent Collector Line</td><td>R = 0.011070 pu
X = 0.009560 pu
B = 0.037900 pu</td><td>R = 0.022940 pu
X = 0.021180 pu
B = 0.050170 pu</td><td colspan="2">R = 0.003516 pu
X = 0.004349 pu
B = 0.067014 pu</td></tr>
</table>

Aneden performed reactive power analysis, short circuit analysis, and dynamic stability analysis using the modification request data on the initial DISIS-2016-002-1 Group 8 study models. All analyses were performed using the PTI PSS/E version 33.7 software and the results are summarized below.

A power factor analysis was not performed as there was no change in the point of interconnection for GEN-2014-001.

The results of the reactive power analysis, also known as the low-wind/no-wind condition analysis, performed using the 2017 Winter Peak, 2018 Summer Peak, and 2026 Summer Peak models showed that the GEN-2014-001 project may require a 21.2 MVAr shunt reactor on the 345 kV bus of the project substation. The shunt reactor is needed to reduce the reactive power transfer at the POI to approximately zero during low/no wind conditions while the generation interconnection project remains connected to the grid.

The results from the short circuit analysis showed that the maximum change in the fault currents in the immediate systems at or near GEN-2014-001 was approximately 0.82 kA for the 2018SP and 2026SP cases. All three-phase fault current levels with the GEN-2014-001 generator online were below 42 kA for the 2018SP models and 2026SP models. The GEN-2014-001 POI bus had a maximum fault current of 11.60 kA.

The dynamic stability analysis was performed using the three DISIS-2016-002-1 models 2017 Winter Peak, 2018 Summer Peak, 2026 Summer Peak. Up to 71 events were simulated, which included three-phase faults, three-phase faults on prior outage cases, and single-line-to-ground faults with stuck breakers faults.

The results of the dynamic stability analysis showed that there were no machine rotor angle damping or transient voltage recovery violations observed in the simulated fault events associated with this modification request study. Additionally, the project wind farm was found to stay connected during the other contingencies that were studied and, therefore, will meet the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

The results of this Study show that the GEN-2014-001 Modification Request does not constitute a material modification.

1.0 Introduction

Aneden Consulting (Aneden) was retained by the Southwest Power Pool (SPP) to perform a Modification Request Impact Study (Study) for GEN-2014-001, an active generation interconnection request with a point of interconnection (POI) on the Emporia Energy Center 345 kV to Wichita 345 kV Substation 345 kV line.

The GEN-2014-001 project is proposed to interconnect in the Westar Energy (WERE) control area with a combined capacity of 199.5 MW as shown in Table 1-1 below. Details of the modification request is provided in Section 2.0 below.

Table 1-1: Existing GEN-2014-001 Configuration

Request	Capacity (MW)	Existing Generator Configuration	Point of Interconnection
GEN-2014-001	199.5	95 x Gamesa 2.1MW = 199.5 MW	Tap on Emporia Energy Center (532768) to Wichita (532796)

1.1 Scope

The Study included reactive power, short circuit, and dynamic stability analyses. The methodology, assumptions and results of the analyses are presented in the following five main sections:

1. Project and Modification Request
2. Reactive Power Analysis
3. Short Circuit Analysis
4. Dynamic Stability Analysis
5. Conclusions

Aneden performed a reactive power analysis using a set of modified study models developed using the modification request data and the three DISIS-2016-002 ReStudy #1 study models:

1. 2017 Winter Peak (2017WP),
2. 2018 Summer Peak (2018SP), and
3. 2026 Summer Peak (2026SP).

All analyses were performed using the PTI PSS/E version 33.7 software. The results of each analysis are presented in the following sections.

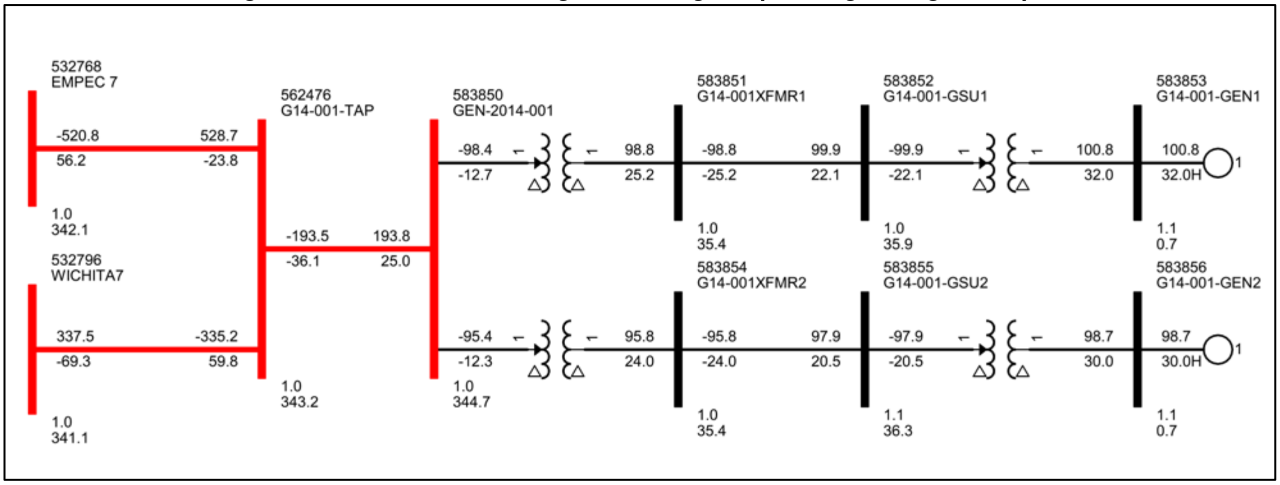
1.2 Study Limitations

The assessments and conclusions provided in this report are based on assumptions and information provided to Aneden by others. While the assumptions and information provided may be appropriate for the purposes of this report, Aneden does not guarantee that those conditions assumed will occur. In addition, Aneden did not independently verify the accuracy or completeness of the information provided. As such, the conclusions and results presented in this report may vary depending on the extent to which actual future conditions differ from the assumptions made or information used herein.

2.0 Project and Modification Request

GEN-2014-001 was originally studied as part of Group 8 in the DISIS-2016-002 study. Figure 2-1 shows the power flow model single line diagram for the existing GEN-2014-001 configuration.

Figure 2-1: GEN-2014-001 Single Line Diagram (Existing Configuration)



The GEN-2014-001 Modification Request included a turbine configuration change to a total of 64 x GE 2.82MW + 8 x GE 2.3MW wind turbines for total capacity of 198.88 MW. In addition, the modification request also included changes to the collection system, GSU transformer, and the generator substation transformer. The major modification request changes are shown in Figure 2-2 and Table 2-1 below.

Figure 2-2: GEN-2014-001 Single Line Diagram (New Configuration)

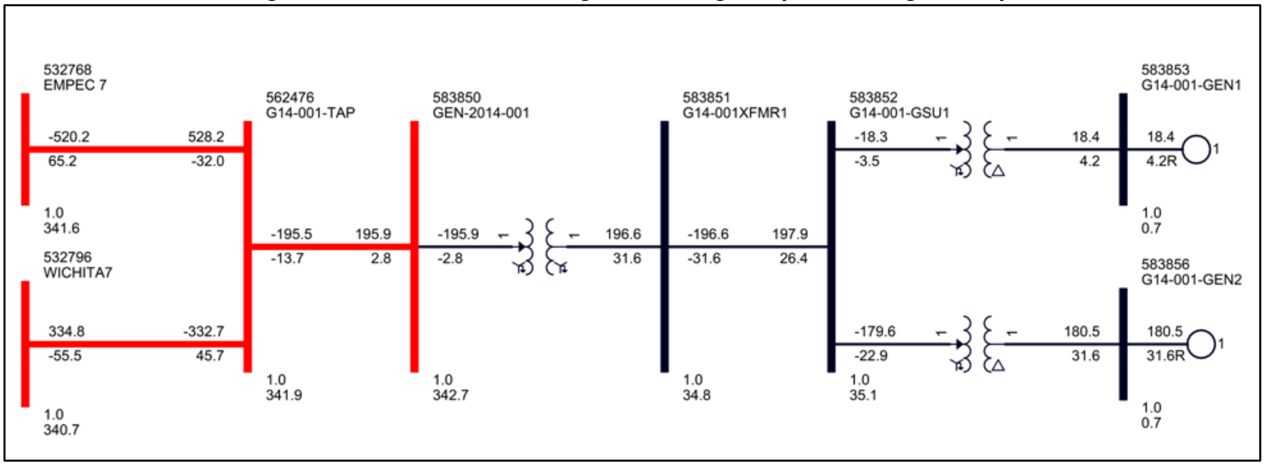


Table 2-1: GEN-2014-001 Modification Request

Facility	Existing		Modification	
Point of Interconnection	Tap on Emporia Energy Center (532768) to Wichita (532796) 345 kV line		Tap on Emporia Energy Center (532768) to Wichita (532796) 345 kV line	
Configuration/Capacity	95 x Gamesa 2.1MW = 199.5 MW		64 x GE 2.82MW + 8 x GE 2.3MW = 198.88 MW	
Generation Interconnection Line	Length = 17.4 miles R = 0.000870 pu X = 0.008530 pu B = 0.144910 pu		Length = 17.4 miles R = 0.000870 pu X = 0.008530 pu B = 0.144910 pu	
Main Substation Transformer	Z = 8.5%, Winding 67 MVA, Rating 112 MVA	Z = 8.5%, Winding 67 MVA, Rating 112 MVA	Z = 10%, Winding 135 MVA, Rating 225 MVA	
GSU Transformer	Gen 1 Equivalent Qty: 48: Z = 11.56%, Rating 112.8 MVA	Gen 2 Equivalent Qty: 47: Z = 11.56%, Rating 110.4 MVA	Gen 1 Equivalent Qty: 8: Z = 5.72%, Rating 26 MVA	Gen 2 Equivalent Qty: 64: Z = 5.72%, Rating 208 MVA
Equivalent Collector Line	R = 0.011070 pu X = 0.009560 pu B = 0.037900 pu	R = 0.022940 pu X = 0.021180 pu B = 0.050170 pu	R = 0.003516 pu X = 0.004349 pu B = 0.067014 pu	

3.0 Reactive Power Analysis

The reactive power analysis, also known as the low-wind/no-wind condition analysis, was performed for GEN-2014-001 to determine the reactive power contribution from the project's interconnection line and collector transformer and cables during low/no wind conditions while the project is still connected to the grid and to size shunt reactors that would reduce the project reactive power contribution to the POI to approximately zero.

3.1 Methodology and Criteria

For the GEN-2014-001 project, the generators were switched out of service while other collector system elements remained in-service. A shunt reactor was tested at the collection substation 345 kV bus to set the MVAr flow into the POI to approximately zero.

3.2 Results

The results from the reactive power analysis showed that the GEN-2014-001 project required an approximately 21.2 MVAr shunt reactor at the project substation, to reduce the POI MVAr to zero. Figure 3-1 illustrates the shunt reactor size required to reduce the POI MVAr to approximately zero. Reactive compensation can be provided either by discrete reactive devices or by the generator itself if it possesses that capability.

Figure 3-1: GEN-2014-001 Single Line Diagram (Shunt Reactor)

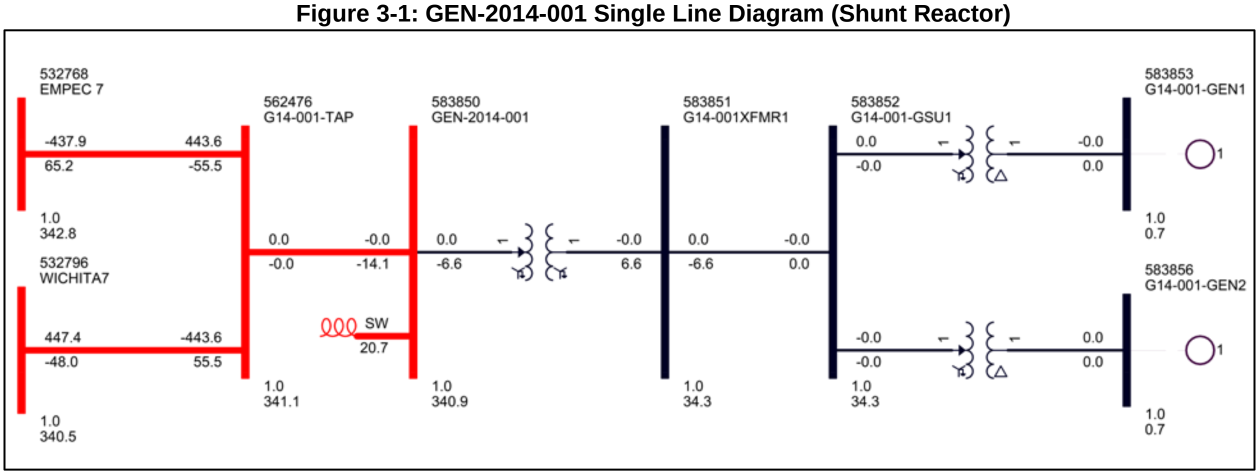


Table 3-1 shows the shunt reactor size determined for the three study models used in the assessment.

Table 3-1: Shunt Reactor Size for Low Wind Study

Machine	POI Bus Number	POI Bus Name	Reactor Size (MVAr)		
			17WP	18SP	26SP
GEN-2014-001	562476	G14-001-TAP	21.2	21.2	21.2

4.0 Short Circuit Analysis

A short-circuit study was performed using the 2018SP and 2026SP models for GEN-2014-001. The detailed results of the short-circuit analysis are provided in Appendix A.

4.1 Methodology

The short-circuit analysis included applying a 3-phase fault on buses up to 5 levels away from the 345 kV POI bus. The PSS/E "Automatic Sequence Fault Calculation (ASCC)" fault analysis module was used to calculate the fault current levels with and without the project online.

4.2 Results

The results of the short circuit analysis for the 2018SP and 2026SP models are summarized in Table 4-1 through Table 4-3. The GEN-2014-001 POI bus fault current magnitudes are provided in Table 4-1 showing a maximum fault current of 11.60 kA.

The maximum fault current calculated within 5 buses with GEN-2014-001 was less than 42 kA for the 2018SP and 2026SP models respectively. The maximum increase in fault current was about 7.7% and 0.82 kA.

The bus locations with fault currents greater than 40 kA are highlighted in Appendix A.

Table 4-1: POI Short Circuit Results

Case	MRIS Current (kA)	Existing Current (kA)	Max kA Change	Max %Change
2018SP	11.56	10.73	0.82	7.7%
2026SP	11.60	10.78	0.82	7.7%

Table 4-2: 2018SP Short Circuit Results

Voltage (kV)	Max. Current (kA)	Max kA Change	Max %Change
69	33.3	0.04	0.1%
115	27.8	0.02	0.1%
138	40.9	0.16	0.4%
161	40.6	-0.01	-0.1%
230	25.1	0.00	0.0%
345	28.6	0.82	7.7%
Max	**40.9**	**0.82**	**7.7%**

Table 4-3: 2026SP Short Circuit Results

Voltage (kV)	Max. Current (kA)	Max kA Change	Max %Change
69	33.3	0.04	0.1%
115	27.7	0.02	0.1%
138	41.1	0.15	0.4%
161	41.1	-0.02	-0.1%
230	25.2	0.00	0.0%
345	28.6	0.82	7.7%
Max	**41.1**	**0.82**	**7.7%**

5.0 Dynamic Stability Analysis

Aneden performed a dynamic stability analysis to identify the impact of the turbine configuration change and other modifications to the GEN-2014-001 project. The analysis was performed according to SPP's Disturbance Performance Requirements shown in Appendix B. The modification details are described in Section 2.0 above and the dynamic modeling data is provided in Appendix C. The simulation plots can be found in Appendix D.

5.1 Methodology and Criteria

The dynamic stability analysis was performed using models developed with the requested 64 x GE 2.82MW turbines and 8 x GE 2.3MW turbine configuration for the GEN-2014-001 generating facilities. This stability analysis was performed using PTI's PSS/E version 33.7 software.

The stability models were developed using the models from DISIS-2016-002 for Group 8. The modifications requested to project GEN-2014-001 were used to create modified stability models for this impact study.

The modified dynamics model data for the DISIS-2016-002-1 Group 8 request, GEN-2014-001 is provided in Appendix C. The modified power flow models and associated dynamics database were initialized (no-fault test) to confirm that there were no errors in the initial conditions of the system and the dynamic data.

During the fault simulations, the active power (PELEC), reactive power (QELEC), and terminal voltage (ETERM) were monitored for GEN-2014-001 and other equally and prior queued projects in Group 8. In addition, voltages of five (5) buses away from the POI of GEN-2014-001 were monitored and plotted. The machine rotor angle for synchronous machines and speed for asynchronous machines within this study area including 520 (AEPW), 524 (OKGE), 525 (WFEC), 526 (SPS), 531 (MIDW), 534 (SUNC), 536 (WERE), 540(GMO), 541 (KCPL) were monitored. In addition, the voltages of all 100 kV and above buses within the study area were monitored.

5.2 Fault Definitions

Aneden simulated the faults previously simulated for GEN-2014-001 and selected additional fault events for GEN-2014-001 as required. The new set of faults were simulated using the modified study models. The fault events included three-phase faults, three-phase faults on prior outage cases, and single-line-to-ground faults with stuck breakers. The simulated faults are listed and described in Table 5-1 below. These contingencies were applied to the modified 2017 Winter Peak, 2018 Summer Peak, and the 2026 Summer Peak models.

Table 5-1: Fault Definitions

Fault ID	Fault Descriptions
FLT01-3PH	3 phase fault on the GEN-2014-001 (562476) to Wichita (532796) 345kV line ckt 1, near GEN-2014-001. a. Apply fault at the GEN-2014-001 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT02-3PH	3 phase fault on the GEN-2014-001 (562476) to EMPEC (532768) 345kV line ckt 1, near GEN-2014-001. a. Apply fault at the GEN-2014-001 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT03-3PH	3 phase fault on the Wichita (532796) to Reno (532771) 345kV line ckt 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT04-3PH	3 phase fault on the Wichita (532796) to Benton (532791) 345kV line ckt 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT05-3PH	3 phase fault on the Wichita (532796) to Viola (532798) 345kV line ckt 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT07-3PH	3 phase fault on the Lang (532769) to EMPEC (532768) 345kV line ckt 1, near Lang. a. Apply fault at the Lang 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT08-3PH	3 phase fault on the Morris (532770) to EMPEC (532768) 345kV line ckt 1, near Morris. a. Apply fault at the Morris 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT09-3PH	3 phase fault on the Swissvale (532774) to EMPEC (532768) 345kV line ckt 1, near Swissvale. a. Apply fault at the Swissvale 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT10-3PH	3 phase fault on the Wichita (532796) to GEN-2014-001 (562476)345kV line ckt 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT11-3PH	3 phase fault on the Lang (533304) to East St (533301) 115kV line ckt 1, near Lang. a. Apply fault at the Lang 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT12-3PH	3 phase fault on the Lang (533304) to Reading (533306) 115kV line ckt 1, near Lang. a. Apply fault at the Lang 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT13-3PH	3 phase fault on the Lang (533304) to Prairie (533307) 115kV line ckt 1, near Lang. a. Apply fault at the Lang 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table 5-1 continued

Fault ID	Fault Descriptions
FLT14-3PH	3 phase fault on the Morris (532770) to JEC (532766) 345kV line ckt 1, near Morris. a. Apply fault at the Morris 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT15-3PH	3 phase fault on the Morris (532863) to Swissvale (532856) 230kV line ckt 1, near Morris. a. Apply fault at the Morris 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT18-3PH	3 phase fault on the Swissvale (532774) to W. Gardner (542965) 345kV line ckt 1, near Swissvale. a. Apply fault at the Swissvale 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT19-3PH	3 phase fault on the Swissvale (532856) to Auburn (532851) 230kV line ckt 1, near Swissvale. a. Apply fault at the Swissvale 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT20-3PH	3 phase fault on the Swissvale (532856) to Lawhill (532853) 230kV line ckt 1, near Swissvale. a. Apply fault at the Swissvale 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT21-3PH	3 phase fault on the Swissvale (532856) to Techill (532857) 230kV line ckt 1, near Swissvale. a. Apply fault at the Swissvale 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT22-3PH	3 phase fault on the Benton (532791) to Rosehill (532794) 345kV line ckt 1, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT23-3PH	3 phase fault on the Benton (532791) to Wolfcreek (532797) 345kV line ckt 1, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT24-3PH	3 phase fault on the Benton (532986) to Midian (532990) 138kV line ckt 1, near Benton. a. Apply fault at the Benton 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT25-3PH	3 phase fault on the Benton (532986) to 29th (533024) 138kV line ckt 1, near Benton. a. Apply fault at the Benton 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT26-3PH	3 phase fault on the Benton (532986) to Chisholm (533035) 138kV line ckt 1, near Benton. a. Apply fault at the Benton 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table 5-1 continued

Fault ID	Fault Descriptions
FLT33-3PH	3 phase fault on the Lang (533304) 115kV to Lang (532769) 345kV/(532808) 14.4kV transformer at the 115kV bus. a. Apply fault at the Lang 115kV bus. b. Clear fault after 5 cycles by tripping the transformer
FLT34-3PH	3 phase fault on the Wichita (532796) 345kV to Evans (533040) 138kV/(532830) 13.8kV transformer at the 345kV bus. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the transformer
FLT35-3PH	3 phase fault on the Morris (532770) 345kV to Morris (532863) 230kV/(532809) 14.4kV transformer at the 345kV bus. a. Apply fault at the Morris 345kV bus. b. Clear fault after 5 cycles by tripping the transformer
FLT37-3PH	3 phase fault on the Swissvale (532856) 230kV to Swissvale (532774) 345kV/(532815) 14.4kV transformer at the 230kV bus. a. Apply fault at the Swissvale 230kV bus. b. Clear fault after 5 cycles by tripping the transformer
FLT38-3PH	3 phase fault on the Benton (532791) 345kV to Benton (532986) 138kV/(532821) 13.8kV transformer at the Benton 345kV bus. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the transformer
FLT40-3PH	3 phase fault on the Reno (532771) 345kV to Reno (533416) 115kV/(532810) 13.8kV transformer at the Reno 345kV bus. a. Apply fault at the Reno 345kV bus. b. Clear fault after 5 cycles by tripping the transformer
FLT44-SB	**Wichita (532796) 345kV Stuck Breaker Scenario 1** a. Apply single phase fault at the Wichita (532796) 345kV bus. b. Wait 16 cycles and remove fault. c. Drop Wichita (532796)-Reno (532771) 345kV, ckt 1 line. d. Drop Wichita –Evans Transformer (532796,533040, 532830,"1").
FLT45-SB	**Wichita (532796) 345kV Stuck Breaker Scenario 2** a. Apply single phase fault at the Wichita (532796) 345kV bus. b. Wait 16 cycles and remove fault. c. Drop Wichita (532796)-Benton (532791) 345kV, ckt 1 line. d. Drop Wichita –Evans Transformer (532796,533040,532830,"1").
FLT46-SB	**Wichita (532796) 345kV Stuck Breaker Scenario 3** a. Apply single phase fault at the Wichita (532796) 345kV bus. b. Wait 16 cycles and remove fault. c. Drop Wichita (532796)-Viola (532798) 345kV, ckt 1 line. d. Drop Wichita –Evans Transformer (532796,533040,532830,"1").
FLT48-SB	**EMPEC (532768) 345kV Stuck Breaker Scenario 1** a. Apply single phase fault at the EMPEC (532768) 345kV bus. b. Wait 16 cycles and remove fault. c. Drop EMPEC (532768)-Lang (532769) 345kV, ckt 1 line. d. Drop EMPEC121 generation (532740).
FLT49-SB	**EMPEC (532768) 345kV Stuck Breaker Scenario 2** a. Apply single phase fault at the EMPEC (532768) 345kV bus. b. Wait 16 cycles and remove fault. c. Drop EMPEC (532768)-Morris (532770) 345kV, ckt 1 line. d. Drop EMPEC121 generation (532740).

Table 5-1 continued

Fault ID	Fault Descriptions
FLT50-SB	**EMPEC (532768) 345kV Stuck Breaker Scenario 3** a. Apply single phase fault at the EMPEC (532768) 345kV bus. b. Wait 16 cycles and remove fault. c. Drop EMPEC (532768)-Swissvale (532774) 345kV, ckt 1 line. d. Drop EMPEC121 generation (532740).
FLT51-SB	**EMPEC (532768) 345kV Stuck Breaker Scenario 1** a. Apply single phase fault at the EMPEC (532768) 345kV bus. b. Wait 16 cycles and remove fault. c. Drop EMPEC (532768)-Lang (532769) 345kV, ckt 1 line. d. Drop EMPEC51 generation (532742).
FLT52-SB	**EMPEC (532768) 345kV Stuck Breaker Scenario 2** a. Apply single phase fault at the EMPEC (532768) 345kV bus. b. Wait 16 cycles and remove fault. c. Drop EMPEC (532768)-Morris (532770) 345kV, ckt 1 line. d. Drop EMPEC51 generation (532742).
FLT53-SB	**EMPEC (532768) 345kV Stuck Breaker Scenario 3** a. Apply single phase fault at the EMPEC (532768) 345kV bus. b. Wait 16 cycles and remove fault. c. Drop EMPEC (532768)-Swissvale (532774) 345kV, ckt 1 line. d. Drop EMPEC51 generation (532742).
FLT55-3PH	3 phase fault on the Benton (532986) to Belaire (532988) 138kV line ckt 1, near Benton. a. Apply fault at the Benton 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9001-3PH	3 phase fault on the Wichita (532796) to Buffalo7 (532782) 345kV line ckt 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9002-3PH	3 phase fault on the Buffalo7 (532782) to Thistle7 (539801) 345kV line ckt 1, near Buffalo7. a. Apply fault at the Buffalo7 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9003-3PH	3 phase fault on the Buffalo7 (532782) to GEN-2016-073 (587500) 345kV line ckt 1, near Buffalo7. a. Apply fault at the Buffalo7 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. Trip the generator G16-073-GEN1 (587503). c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9004-3PH	3 phase fault on the Buffalo7 (532782) to Kingman7 (532783) 345kV line ckt 1, near Buffalo7. a. Apply fault at the Buffalo7 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. Trip generators c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9005-3PH	3 phase fault on the Reno (532771) to G16-111-TAP (587884) 345kV line ckt 1, near Reno. a. Apply fault at the Reno 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9006-3PH	3 phase fault on the Viola (532798) to G16-153-TAP (588364) 345kV line ckt 1, near Viola. a. Apply fault at the Viola 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. Trip generators c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table 5-1 continued

Fault ID	Fault Descriptions
FLT9007-3PH	3 phase fault on the Viola (532798) to Renfrow 7 (515543) 345kV line ckt 1, near Viola. a. Apply fault at the Viola 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9008-3PH (18S and 26S only)	3 phase fault on the Viola (532798) 345kV to Viola (533075) 138kV/(532832) 13.8kV transformer at the 345kV bus. a. Apply fault at the Viola 345kV bus. b. Clear fault after 5 cycles by tripping the transformer
FLT9009-3PH	3 phase fault on the Benton (532791) to GEN-2016-162 (588320) 345kV line ckt 1, near Benton. a. Apply fault at the Benton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. Trip the generators G16-163-GEN1 (588333) and G16-162-GEN1 (588323) c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9010-3PH	3 phase fault on the EMPEC (532768) to GEN-2015-073 (585100) 345kV line ckt 1, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. Trip the generators G15-073-GEN2 (585106) and G15-073-GEN1 (585103) . c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9011-3PH	3 phase fault on the EMPEC (532768) to Lang (532769) 345kV line ckt 1, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9012-3PH	3 phase fault on the EMPEC (532768) to Swissvale (532774) 345kV line ckt 1, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9013-3PH	3 phase fault on the EMPEC (532768) to Morris (532770) 345kV line ckt 1, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9014-3PH	3 phase fault on the EMPEC (532768) to Wolfcrk7 (532797) 345kV line ckt 1, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9015-3PH	3 phase fault on the Wolfcrk7 (532797) to Rosehill (532794) 345kV line ckt 1, near Wolfcrk7. a. Apply fault at the Wolfcrk7 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9016-3PH	3 phase fault on the Lang (532769) 345kV to Lang (533304) 115kV/(532808) 14.4kV transformer at the 345kV bus. a. Apply fault at the Lang 345kV bus. b. Clear fault after 5 cycles by tripping the transformer
FLT9017-3PH	3 phase fault on the Swisval7 (532774) 345kV to Swisval (532856) 230kV/(532815) 14.4kV transformer at the 345kV bus. a. Apply fault at the Swisval7 345kV bus. b. Clear fault after 5 cycles by tripping the transformer

Table 5-1 continued

Fault ID	Fault Descriptions
FLT9018-3PH	3 phase fault on the EMPEC (532768) 345kV to EMPEC (532741) 13.8kV transformer at the 345kV bus. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the transformer EMPEC (532741).
FLT9019-3PH	3 phase fault on the EMPEC (532768) 345kV to EMPEC (532742) 18kV transformer at the 345kV bus. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the transformer EMPEC (532742).
FLT9020-3PH	3 phase fault on the Swissvale (532856) to Morris (532863) 230kV line ckt 1, near Swissvale. a. Apply fault at the Swissvale 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT03-PO1	**Prior Outage of GEN-2014-001 (562476) to EMPEC (532768) 345kV line** 3 phase fault on the Wichita (532796) to Reno (532771) 345kV line ckt 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT04-PO1	**Prior Outage of GEN-2014-001 (562476) to EMPEC (532768) 345kV line** 3 phase fault on the Wichita (532796) to Benton (532791) 345kV line ckt 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT05-PO1	**Prior Outage of GEN-2014-001 (562476) to EMPEC (532768) 345kV line** 3 phase fault on the Wichita (532796) to Viola (532798) 345kV line ckt 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT34-PO1	**Prior Outage of GEN-2014-001 (562476) to EMPEC (532768) 345kV line** 3 phase fault on the Wichita (532796) 345kV to Evans (533040) 138kV/(532830) 13.8kV transformer at the 345kV bus. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the transformer
FLT9001-PO1	**Prior Outage of GEN-2014-001 (562476) to EMPEC (532768) 345kV line** 3 phase fault on the Wichita (532796) to Buffalo7 (532782) 345kV line ckt 1, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9010-PO2	**Prior Outage of GEN-2014-001 (562476) to Wichita (532796) 345kV line** 3 phase fault on the EMPEC (532768) to GEN-2015-073 (585100) 345kV line ckt 1, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. Trip the generators G15-073-GEN2 (585106) and G15-073-GEN1 (585103) . c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9011-PO2	**Prior Outage of GEN-2014-001 (562476) to Wichita (532796) 345kV line** 3 phase fault on the EMPEC (532768) to Lang (532769) 345kV line ckt 1, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9012-PO2	**Prior Outage of GEN-2014-001 (562476) to Wichita (532796) 345kV line** 3 phase fault on the EMPEC (532768) to Swissvale (532774) 345kV line ckt 1, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Table 5-1 continued

Fault ID	Fault Descriptions
FLT9013-PO2	**Prior Outage of GEN-2014-001 (562476) to Wichita (532796) 345kV line** 3 phase fault on the EMPEC (532768) to Morris (532770) 345kV line ckt 1, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9014-PO2	**Prior Outage of GEN-2014-001 (562476) to Wichita (532796) 345kV line** 3 phase fault on the EMPEC (532768) to Wolfcrk7 (532797) 345kV line ckt 1, near EMPEC. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
FLT9018-PO2	**Prior Outage of GEN-2014-001 (562476) to Wichita (532796) 345kV line** 3 phase fault on the EMPEC (532768) 345kV to EMPEC (532741) 13.8kV transformer at the 345kV bus. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the transformer EMPEC (532741).
FLT9019-PO2	**Prior Outage of GEN-2014-001 (562476) to Wichita (532796) 345kV line** 3 phase fault on the EMPEC (532768) 345kV to EMPEC (532742) 18kV transformer at the 345kV bus. a. Apply fault at the EMPEC 345kV bus. b. Clear fault after 5 cycles by tripping the transformer EMPEC (532742).

5.3 Results

Table 5-2 shows the results of the fault events simulated for each of the models. The associated stability plots are provided in Appendix D.

There were no damping or voltage recovery violations observed during the simulated faults. Additionally, the project 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.

Table 5-2: GEN-2014-001 Dynamic Stability Results

Fault ID	17W			18S			26S		
	Volt. Recovery	Volt. Violation	Stable	Volt. Recovery	Volt. Violation	Stable	Volt. Recovery	Volt. Violation	Stable
FLT01-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT02-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT03-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT04-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT05-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT07-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT08-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT09-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT10-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT11-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT12-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT13-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT14-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT15-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT18-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT19-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT20-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT21-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT22-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT23-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT24-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT25-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT26-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT33-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT34-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT35-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT37-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT38-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT40-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT44-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT45-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable

Table 5-2 continued

Fault ID	17W			18S			26S		
	Volt. Recovery	Volt. Violation	Stable	Volt. Recovery	Volt. Violation	Stable	Volt. Recovery	Volt. Violation	Stable
FLT46-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT48-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT49-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT50-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT51-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT52-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT53-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT55-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9001-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9002-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9003-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9004-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9005-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9006-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9007-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9008-3PH				Pass	Pass	Stable	Pass	Pass	Stable
FLT9009-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9010-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9011-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9012-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9013-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9014-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9015-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9016-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9017-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9018-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9019-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9020-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT03-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT04-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT05-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT34-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9001-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9010-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9011-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9012-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9013-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9014-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9018-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9019-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable

6.0 Conclusions

The Interconnection Customer for GEN-2014-001 requested a Modification Request Impact Study to assess the impact of the turbine and facility changes to a configuration with a total of 64 x GE 2.82MW + 8 x GE 2.3MW wind turbines for total capacity of 198.88 MW. In addition, the modification request included changes to the collection system and the generator substation transformer.

A power factor analysis was not performed as there was no change in the point of interconnection for GEN-2014-001.

The results of the reactive power analysis, also known as the low-wind/no-wind condition analysis, performed using all three models showed that the GEN-2014-001 project may require a 21.2 MVAr shunt reactor on the 345 kV bus of the project substation. The shunt reactor is needed to reduce the reactive power transfer at the POI to approximately zero during low/no wind conditions while the generation interconnection project remains connected to the grid.

The results from the short circuit analysis showed that the maximum change in the fault currents in the immediate systems at or near GEN-2014-001 was approximately 0.82 kA for the 2018SP and 2026SP cases. All three-phase fault current levels with the GEN-2014-001 generator online were below 42 kA for the 2018SP models and 2026SP models. The GEN-2014-001 POI bus had a maximum fault current of 11.60 kA.

The results of the dynamic stability analysis showed that there were no machine rotor angle damping or transient voltage recovery violations observed in the simulated fault events associated with this modification request study. Additionally, the project wind farm was found to stay connected during the other contingencies that were studied and, therefore, will meet the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

The results of this Study show that the GEN-2014-001 Modification Request does not constitute a material modification.