GEN-2016-020

Impact Restudy for Generator Modification

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REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
09/05/2019	SPP	Initial report issued.

CONTENTS

SUMMARY

The GEN-2016-020 Interconnection Customer has requested a modification to its 150 MW Interconnection Request. This system impact restudy was performed to determine the effects of changing wind turbine generators from the previously studied 75 Vestas V110 2 MW wind turbines generators (for a total capacity of 150 MW) to 40 GE 116 2.3 MW and 20 GE 127 2.82 MW wind turbine generators (for a total capacity of 148.4 MW). In addition, the modification request included changes to the generation interconnection line, collection system and the generator substation transformer. The point of interconnection (POI) for GEN-2016-020 remains at the Mooreland 138 kV Substation.

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) in accordance with FERC Order 827. Additionally, the project will be required to install approximately 8 MVArs of reactor shunts on its substation 138 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.

The results of the dynamic stability analysis showed that any fault that trips the Mooreland to Iodine 138 kV line or the Iodine to Fort Supply 138 kV line, caused GEN-2001-014 and GEN-2006-024S to trip offline. The results of the simulations showed that the GEN-2001-014 and GEN-2006-024S tripping during the select faults were not attributed to GEN-2016-020 or the GEN-2016-020 modification request.

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.

Aneden Consulting

Submitted to

Southwest Power Pool

SPP Southwest Power Pool

Report On

GEN-2016-020
Modification Request Impact Study

Revision R1

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anedenconsulting.com

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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-2016-020, an active generation interconnection request with a point of interconnection (POI) at the Mooreland 138 kV Substation.

The GEN-2016-020 project is proposed to interconnect in the Western Farmers Electric Cooperative (WFEC) control area with a capacity of 150 MW as shown in Table ES-1 below. This Study has been requested to evaluate the modification of GEN-2016-020 to change turbine configuration to a total of 40 x GE 116 2.3MW and 20 x GE 127 2.82 MW wind turbines for total capacity of 148.4 MW. In addition, the modification request included changes to the collection system, generation interconnection line and the generator substation transformer. The modification request changes are shown in Table ES-2 below.

Table ES-1: GEN-2016-020 Configuration

Request	Capacity (MW)	Existing Generator Configuration	Point of Interconnection
GEN-2016-020	150	75 x Vestas V110 VCSS 2.0 MW	Mooreland 138 kV Substation (520999)

Table ES-2: GEN-2016-020 Modification Request

Facility	Existing		Modification Request	
Point of Interconnection	Mooreland 138 kV Substation (520999)		Mooreland 138 kV Substation (520999)	
Configuration/Capacity	75 x Vestas V110 VCSS 2.0MW = 150 MW		40 x GE 116 2.3MW + 20 x GE 127 2.82MW = 148.4 MW	
Generation Interconnection Line	Length = 10 miles R = 0.006144 pu X = 0.020951 pu B = 0.004784 pu		Length = 10.5 miles R = 0.006590 pu X = 0.039550 pu B = 0.011960 pu	
Main Substation Transformer	Transformer 1: Z = 9%, Winding 60 MVA, Rating 100 MVA	Transformer 2: Z = 9%, Winding 60 MVA, Rating 100 MVA	Z = 10.5%, Winding 100 MVA, Rating 167 MVA	
GSU Transformer	Equivalent Qty: 75: Z = 8.55%, Rating 157.5 MVA		Gen 1 Equivalent Qty: 40: Z = 5.7%, Rating 100 MVA	Gen 2 Equivalent Qty: 20: Z = 5.7%, Rating 62 MVA
Equivalent Collector Line	R = 0.003759 pu X = 0.003424 pu B = 0.034130 pu		R = 0.007736 pu X = 0.009333 pu B = 0.067341 pu	
Reactive Power Devices	N/A		1 x -10 MVAR 34.5 kV Shunt Reactor + 1 x 5 MVAR 34.5 kV Capacitor Bank	

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 1 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-2016-020.

The results of the reactive power analysis, also known as the low-wind/no-wind condition analysis, performed using the three main models showed that the GEN-2016-020 project may require an 8 MVAr shunt reactor on the 138kV 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-2016-020 was approximately 1.24 kA for the 2018SP and 2026SP cases respectively. All three-phase fault current levels with the GEN-2016-020 generator online were below 23 kA for the 2018SP models and 2026SP models.

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 105 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 any fault involving the loss of the Mooreland to Iodine 138 kV line or Iodine to Fort Supply 138 kV, caused GEN-2001-014 and GEN-2006-024S to trip offline. This was observed before and after the modification requests. The two generators also tripped even with GEN-2016-020 offline and after adjustments to the generators' parameters. The results of the simulations showed that the GEN-2001-014 and GEN-2006-024S tripping were not attributed to GEN-2016-020 or the GEN-2016-020 modification request. As a result, the two projects were GNET in the final simulations for this GEN-2016-020 modification request.

There were no other 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-2016-020 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-2016-020, an active generation interconnection request with point of interconnection (POI) at the Mooreland 138 kV Substation.

The GEN-2016-020 project is proposed to interconnect in the Western Farmers Electric Cooperative (WFEC) control area with a combined capacity of 150 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-2016-020 Configuration

Request	Capacity (MW)	Existing Generator Configuration	Point of Interconnection
GEN-2016-020	150	75 x Vestas V110 VCSS 2.0 MW	Mooreland 138 kV Substation (520999)

1.1 Scope

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

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

The analyses were performed using a set of modified study models developed using the 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.

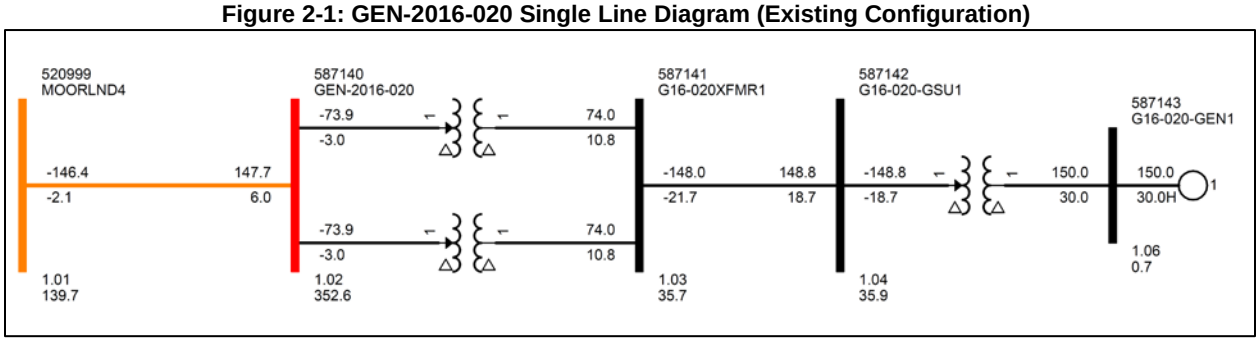
1.2 Study Limitations

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-2016-020 was originally studied as part of Group 1 in the DISIS-2016-001 study. Figure 2-1 shows the power flow model single line diagram for the existing GEN-2016-020 configuration.

Figure 2-1: GEN-2016-020 Single Line Diagram (Existing Configuration)



The GEN-2016-020 Modification Request included a turbine configuration change to a total of 40 x GE 116 2.3MW and 20 x GE 127 2.82 MW wind turbines for a total capacity of 148.4 MW. In addition, the modification request also included changes to the collection system 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-2016-020 Single Line Diagram (New Configuration)

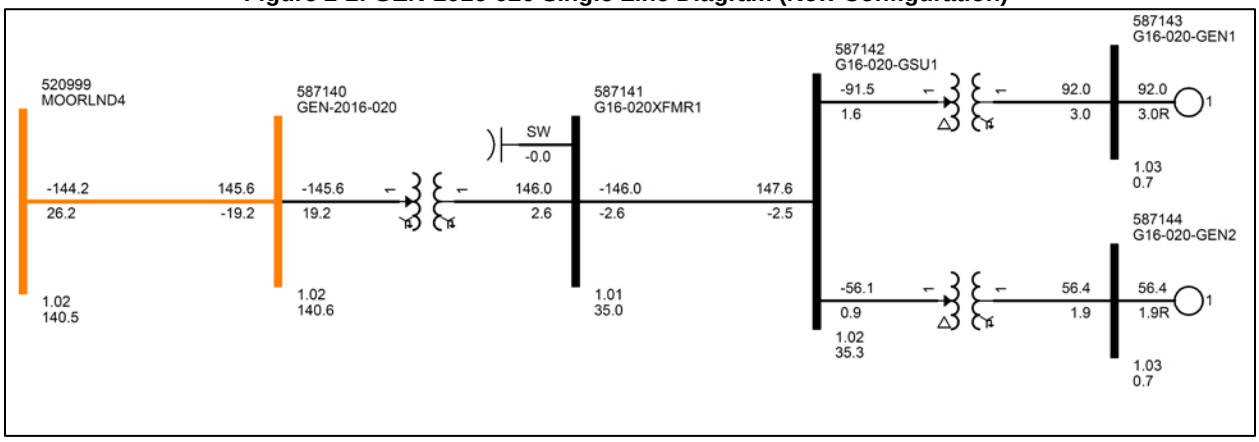


Table 2-1: GEN-2016-020 Modification Request

Facility	Existing		Modification Request	
Point of Interconnection	Mooreland 138 kV Substation (520999)		Mooreland 138 kV Substation (520999)	
Configuration/Capacity	75 x Vestas V110 VCSS 2.0MW = 150 MW		40 x GE 116 2.3MW + 20 x GE 127 2.82MW = 148.4 MW	
Generation Interconnection Line	Length = 10 miles R = 0.006144 pu X = 0.020951 pu B = 0.004784 pu		Length = 10.5 miles R = 0.006590 pu X = 0.039550 pu B = 0.011960 pu	
Main Substation Transformer	Transformer 1: Z = 9%, Winding 60 MVA, Rating 100 MVA	Transformer 2: Z = 9%, Winding 60 MVA, Rating 100 MVA	Z = 10.5%, Winding 100 MVA, Rating 167 MVA	
GSU Transformer	Equivalent Qty: 75: Z = 8.55%, Rating 157.5 MVA		Gen 1 Equivalent Qty: 40: Z = 5.7%, Rating 100 MVA	Gen 2 Equivalent Qty: 20: Z = 5.7%, Rating 62 MVA
Equivalent Collector Line	R = 0.003759 pu X = 0.003424 pu B = 0.034130 pu		R = 0.007736 pu X = 0.009333 pu B = 0.067341 pu	
Reactive Power Devices	N/A		1 x -10 MVAR 34.5 kV Shunt Reactor + 1 x 5 MVAR 34.5 kV Capacitor Bank	

3.0 Reactive Power Analysis

The reactive power analysis, also known as the low-wind/no-wind condition analysis, was performed for GEN-2016-020 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-2016-020 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 138 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-2016-020 project required approximately an 8 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-2016-020 Single Line Diagram (Shunt Reactor)

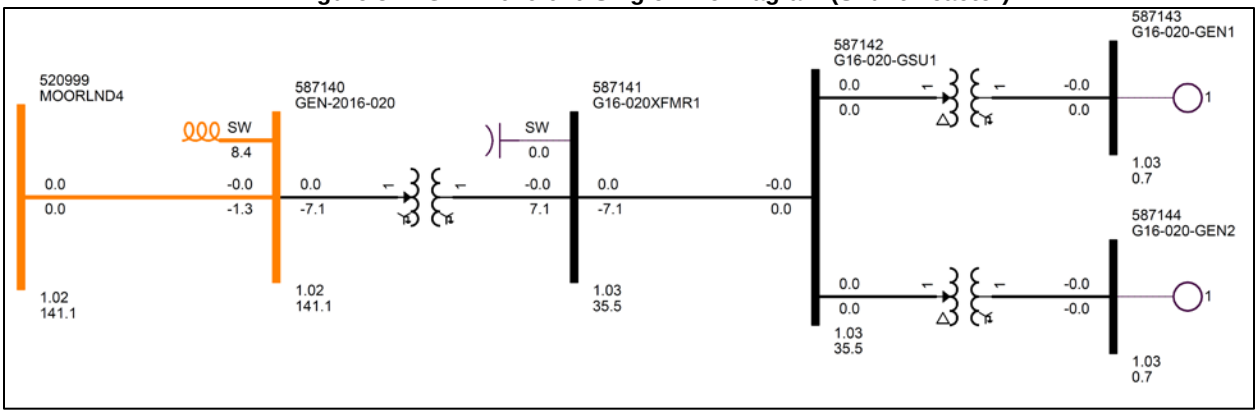


Table 3-1 shows the shunt reactor size determined for the three study models used in the assessment.

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

Machine	POI Bus Number	POI Bus Name	Reactor Size (MVAr)		
			17WP	18SP	26SP
GEN-2016-020	520999	Mooreland 138 kV Substation	8	8	8

4.0 Short Circuit Analysis

A short-circuit study was performed using the 2018SP and 2026SP models for GEN-2016-020. The detail 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 138 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 and Table 4-2 respectively. The maximum increase in fault current was about 6.9%, 1.24 kA. The maximum fault current calculated within 5 buses with GEN-2016-020 was less than 23 kA for the 2018SP and 2026SP models respectively.

Table 4-1: 2018SP Short Circuit Results

Voltage (kV)	Max. Current (kA)	Max kA Change	Max %Change
69	10.8	0.06	0.7%
138	22.6	1.24	6.9%
345	18.8	-0.01	-0.1%
Max	**22.6**	**1.24**	**6.9%**

Table 4-2: 2026SP Short Circuit Results

Voltage (kV)	Max. Current (kA)	Max kA Change	Max %Change
69	10.9	0.05	0.6%
138	22.7	1.24	6.5%
345	18.8	-0.01	-0.1%
Max	**22.7**	**1.24**	**6.5%**

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-2016-020 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 40 x GE 116 2.3MW + 20 x GE 127 2.82MW turbines configuration for the GEN-2016-020 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 1. The modifications requested to project GEN-2016-020 were used to create modified stability models for this impact study.

The modified dynamics model data for the DISIS-2016-002-1 Group 1 request, GEN-2016-020 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-2016-020 and other equally and prior queued projects in Group 1. In addition, voltages of five (5) buses away from the POI of GEN-2016-020 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) 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 by WFEC for GEN-2016-020 and selected additional fault events for GEN-2016-020 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
FLT23-3PH	3 phase fault on G15-095T 138 kV (560066) to ROSE_VALLEY 138 kV (520207), near G15-095T. a. Apply fault at the G15-095T 138 kV bus. b. Clear fault after 5 cycles and trip 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 G15-095T 138 kV (560066) to MOORLND4 138 kV (520999), near G15-095T. a. Apply fault at the G15-095T 138 kV bus. b. Clear fault after 5 cycles and trip 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 ROSE_VALLEY 138 kV (520207) to NOEL_SW 138 kV (520201), near ROSE_VALLEY. a. Apply fault at the ROSE_VALLEY 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT27-3PH	3 phase fault on MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR, near MOORLND4 138 kV. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer.
FLT28-3PH	3 phase fault on MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT29-3PH	3 phase fault on MOORLND4 138 kV (520999) to BEARCAT 138 kV (520500), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT30-3PH	3 phase fault on MOORLND4 138 kV (520999) to PIC4 138 kV (520425), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT31-3PH	3 phase fault on MOORLND4 138 kV (520999) to IODINE 4 138 kV (520957), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT32-3PH	3 phase fault on MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT33-3PH	3 phase fault on MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT35-SB	**Stuck Breaker at MOORLND4 (520999)** a. Apply single phase fault at MOORLND4. b. Clear fault after 16 cycles and trip the following elements c. MOORLND4 (520999) - BEARCAT (520500) d. MOORLND4 (520999) - PIC4 (520425)
FLT53-3PH	3 phase fault on MOORLND2 69 kV (520995) to CRTSJCT2 69 kV (521197), near MOORLND2. a. Apply fault at the MOORLND2 69 kV bus. b. Clear fault after 5 cycles and trip 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
FLT54-3PH	3 phase fault on WINDFRM4 138 kV (515785) to WOODWRD4 138 kV (514785), near WINDFRM4. a. Apply fault at the WINDFRM4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT55-3PH	3 phase fault on BEARCAT 138 kV (520500) to NINMILE 4 138 kV (521128), near BEARCAT. a. Apply fault at the BEARCAT 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT56-3PH	3 phase fault on PIC4 138 kV (520425) to CEDRDAL4 138 kV (520848), near PIC4. a. Apply fault at the PIC4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT57-3PH	3 phase fault on IODINE 4 138 kV (520957) to FTSUPLY4 138 kV (520920), near IODINE 4. a. Apply fault at the IODINE 4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT58-3PH	3 phase fault on GLASMTN4 138 kV (514788) to CLEOCOR4 138 kV (514778), near GLASMTN4. a. Apply fault at the GLASMTN4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT59-3PH	3 phase fault on TALOGA 4 138 kV (521065) to DEWEY 4 138 kV (514787), near TALOGA 4. a. Apply fault at the TALOGA 4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT60-3PH	3 phase fault on TALOGA 4 138 kV (521065) to TALOGA 2 69 kV (521064) to TLGTERT 13.8 kV (521178) XFMR, near TALOGA 4 138 kV. a. Apply fault at the TALOGA 4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer.
FLT62-SB	**Stuck Breaker at MOORLND4 (520999)** a. Apply single phase fault at MOORLND4. b. Clear fault after 16 cycles and trip the following elements c. MOORLND4 (520999) - IODINE 4 (520957) d. MOORLND4 (520999) - GLASMTN4 (514788)
FLT9001-3PH	3 phase fault on MOORLND4 138 kV (520999) to G15-095T 138 kV (560066), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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 MOORLND4 138 kV (520999) to MORLND1 13.8 kV (520996) XFMR, near MOORLND4 138 kV. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer and generator
FLT9003-3PH	3 phase fault on MOORLND4 138 kV (520999) to MORLND2 13.8 kV (520997) XFMR, near MOORLND4 138 kV. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer and generator

Table 5-1 continued

Fault ID	Fault Descriptions
FLT9004-3PH	3 phase fault on MOORLND4 138 kV (520999) to MORLND3 13.8 kV (520998) XFMR, near MOORLND4 138 kV. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer and generator
FLT9005-3PH	3 phase fault on FTSUPLY4 138 kV (520920) to SLEEPING 138 kV (520922), near FTSUPLY4. a. Apply fault at the FTSUPLY4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line, trip generator. 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 FTSUPLY4 138 kV (520920) to FTSUPLY2 69 kV (520919) to FTSUPTERT 13.8kV (521170) XFMR, near FTSUPLY4 138 kV. a. Apply fault at the FTSUPLY4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer and generator
FLT9007-3PH	3 phase fault on NINMILE 4 138 kV (521128) to MORWODS4 138 kV (521001), near NINMILE 4. a. Apply fault at the NINMILE 4 138 kV bus. b. Clear fault after 5 cycles and trip 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	3 phase fault on DEWEY 4 138 kV (514787) to SOUTHRD4 138 kV (514822), near DEWEY 4. a. Apply fault at the DEWEY 4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT9009-3PH	3 phase fault on DEWEY 4 138 kV (514787) to TLGAWND4 138 kV (515390), near DEWEY 4. a. Apply fault at the DEWEY 4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line and generator. 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 DEWEY 4 138 kV (514787) to IODINE-4 138 kV (514796), near DEWEY 4. a. Apply fault at the DEWEY 4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT9011-3PH	3 phase fault on WOODWRD4 138 kV (514785) to CENT 4 138 kV (515363), near WOODWRD4. a. Apply fault at the WOODWRD4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line and generator. 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 WOODWRD4 138 kV (514785) to WODWRD 2 69 kV (514782) to WOODWR21 13.2kV (515771) XFMR, near WOODWRD4 138 kV. a. Apply fault at the WOODWRD4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer
FLT9013-3PH	3 phase fault on WOODWRD4 138 kV (514785) to WWDPST 4 138 kV (515425) PST XFMR, near WOODWRD4 138 kV. a. Apply fault at the WOODWRD4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer
FLT9014-3PH	3 phase fault on CEDRDAL4 138 kV (520848) to OKEENE 4 138kV (521016), near CEDRDAL4. a. Apply fault at the CEDRDAL4 138 kV bus. b. Clear fault after 5 cycles and trip 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
FLT9015-3PH	3 phase fault on CLEOCOR4 138 kV (514778) to GEN-2015-048 138 kV (584890), near CLEOCOR4. a. Apply fault at the CLEOCOR4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line and generator. 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 CLEOCOR4 138 kV (514778) to CLEOCOR2 69 kV (514777) to CLEOCOR1 13.8kV (515716) XFMR, near CLEOCOR4 138 kV. a. Apply fault at the CLEOCOR4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer
FLT9017-3PH	3 phase fault on CLEOCOR4 138 kV (514778) to CLEOPLT4 138 kV (515562), near CLEOCOR4. a. Apply fault at the CLEOCOR4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT9018-3PH	3 phase fault on G15-095T 138 kV (560066) to GEN-2015-095 138 kV (585300), near G15-095T. a. Apply fault at the G15-095T 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line and trip generator. 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.
FLT1001-SB	**Stuck Breaker at IODINE 4 (520957)** a. Apply single phase fault at faulted bus. b. Clear fault after 16 cycles and trip the following elements c. IODINE 4 138kV bus
FLT1002-SB	**Stuck Breaker at BEARCAT (520500)** a. Apply single phase fault at faulted bus. b. Clear fault after 16 cycles and trip the following elements c. BEARCAT 138kV bus
FLT1003-SB	**Stuck Breaker at TALOGA 4 (521065)** a. Apply single phase fault at faulted bus. b. Clear fault after 16 cycles and trip the following elements c. TALOGA 4 138kV bus
FLT1004-SB	**Stuck Breaker at MOORLND2 (520995)** a. Apply single phase fault at faulted bus. b. Clear fault after 16 cycles and trip the following elements c. MOORLND2 69kV bus
FLT1005-SB	**Stuck Breaker at WINDFRM4 (515785)** a. Apply single phase fault at faulted bus. b. Clear fault after 16 cycles and trip the following elements c. WINDFRM4 138kV bus, trip generator
FLT1006-SB	**Stuck Breaker at PIC4 (520425)** a. Apply single phase fault at faulted bus. b. Clear fault after 16 cycles and trip the following elements c. PIC4 138kV bus
FLT1007-SB	**Stuck Breaker at GLASMTN4 (514788)** a. Apply single phase fault at faulted bus. b. Clear fault after 16 cycles and trip the following elements c. GLASMTN4 138kV bus

Table 5-1 continued

Fault ID	Fault Descriptions
FLT1008-SB	**Stuck Breaker at G15-095T (560066)** a. Apply single phase fault at faulted bus. b. Clear fault after 16 cycles and trip the following elements c. G15-095T 138kV bus, trip generator
FLT1009-SB	**Stuck Breaker at MOORLND4 (520999)** a. Apply single phase fault at MOORLND4. b. Clear fault after 16 cycles and trip the following elements c. MOORLND4 (520999) - IODINE 4 (520957) - Ft Supply (520920) line d. MOORLND4 (520999) - G15-095 (560066) line e. MOORLND4 (520999) - WINDFRM4 (515785) line f. MOORLND4 (520999) - MOORLAND2 (520995) - MLNDTERT (521180) XFMR g. MOORLND4 (520999) - GLASMTN4 (514788) line h. MORLND1 (520996) Generator
FLT1010-SB	**Stuck Breaker at MOORLND4 (520999)** a. Apply single phase fault at MOORLND4. b. Clear fault after 16 cycles and trip the following elements c. MOORLND4 (520999) - BEARCAT (520500) - NINMILE4 (521128) - MORWODS4 (521001) line d. MOORLND4 (520999) - PIC4 (520425) - CEDRDAL4 (520848) - OKEENE 4 (521016) line e. MOORLND4 (520999) - TALOGA 4 (521065) line f. MORLND2 (520997) Generator g. MORLND3 (520998) Generator
FLT31-PO1	**Prior Outage of MOORLND4 (520999) to BEARCAT (520500) line;** 3 phase fault on MOORLND4 138 kV (520999) to IODINE 4 138 kV (520957), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT33-PO1	**Prior Outage of MOORLND4 (520999) to BEARCAT (520500) line;** 3 phase fault on MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT27-PO1	**Prior Outage of MOORLND4 (520999) to BEARCAT (520500) line;** 3 phase fault on MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR, near MOORLND4 138 kV. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer.
FLT28-PO1	**Prior Outage of MOORLND4 (520999) to BEARCAT (520500) line;** 3 phase fault on MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT30-PO1	**Prior Outage of MOORLND4 (520999) to BEARCAT (520500) line;** 3 phase fault on MOORLND4 138 kV (520999) to PIC4 138 kV (520425), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT32-PO1	**Prior Outage of MOORLND4 (520999) to BEARCAT (520500) line;** 3 phase fault on MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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-PO1	**Prior Outage of MOORLND4 (520999) to BEARCAT (520500) line;** 3 phase fault on MOORLND4 138 kV (520999) to G15-095T 138 kV (560066), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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
FLT29-PO2	**Prior Outage of MOORLND4 (520999) to IODINE 4 (520957) line;** 3 phase fault on MOORLND4 138 kV (520999) to BEARCAT 138 kV (520500), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT33-PO2	**Prior Outage of MOORLND4 (520999) to IODINE 4 (520957) line;** 3 phase fault on MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT27-PO2	**Prior Outage of MOORLND4 (520999) to IODINE 4 (520957) line;** 3 phase fault on MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR, near MOORLND4 138 kV. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer.
FLT28-PO2	**Prior Outage of MOORLND4 (520999) to IODINE 4 (520957) line;** 3 phase fault on MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT30-PO2	**Prior Outage of MOORLND4 (520999) to IODINE 4 (520957) line;** 3 phase fault on MOORLND4 138 kV (520999) to PIC4 138 kV (520425), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT32-PO2	**Prior Outage of MOORLND4 (520999) to IODINE 4 (520957) line;** 3 phase fault on MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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-PO2	**Prior Outage of MOORLND4 (520999) to IODINE 4 (520957) line;** 3 phase fault on MOORLND4 138 kV (520999) to G15-095T 138 kV (560066), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT27-PO3	**Prior Outage of MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065) line;** 3 phase fault on MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR, near MOORLND4 138 kV. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer.
FLT28-PO3	**Prior Outage of MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065) line;** 3 phase fault on MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT29-PO3	**Prior Outage of MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065) line;** 3 phase fault on MOORLND4 138 kV (520999) to BEARCAT 138 kV (520500), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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
FLT30-PO3	**Prior Outage of MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065) line;** 3 phase fault on MOORLND4 138 kV (520999) to PIC4 138 kV (520425), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT31-PO3	**Prior Outage of MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065) line;** 3 phase fault on MOORLND4 138 kV (520999) to IODINE 4 138 kV (520957), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT32-PO3	**Prior Outage of MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065) line;** 3 phase fault on MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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-PO3	**Prior Outage of MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065) line;** 3 phase fault on MOORLND4 138 kV (520999) to G15-095T 138 kV (560066), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT27-PO4	**Prior Outage of MOORLND4 138 kV (520999) to G15-095T 138 kV (560066) line;** 3 phase fault on MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR, near MOORLND4 138 kV. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer.
FLT28-PO4	**Prior Outage of MOORLND4 138 kV (520999) to G15-095T 138 kV (560066) line;** 3 phase fault on MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT29-PO4	**Prior Outage of MOORLND4 138 kV (520999) to G15-095T 138 kV (560066) line;** 3 phase fault on MOORLND4 138 kV (520999) to BEARCAT 138 kV (520500), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT30-PO4	**Prior Outage of MOORLND4 138 kV (520999) to G15-095T 138 kV (560066) line;** 3 phase fault on MOORLND4 138 kV (520999) to PIC4 138 kV (520425), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT31-PO4	**Prior Outage of MOORLND4 138 kV (520999) to G15-095T 138 kV (560066) line;** 3 phase fault on MOORLND4 138 kV (520999) to IODINE 4 138 kV (520957), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT32-PO4	**Prior Outage of MOORLND4 138 kV (520999) to G15-095T 138 kV (560066) line;** 3 phase fault on MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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-PO4	**Prior Outage of MOORLND4 138 kV (520999) to G15-095T 138 kV (560066) line;** 3 phase fault on MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT27-PO5	**Prior Outage of MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788) line;** 3 phase fault on MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR, near MOORLND4 138 kV. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer.
FLT28-PO5	**Prior Outage of MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788) line;** 3 phase fault on MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT29-PO5	**Prior Outage of MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788) line;** 3 phase fault on MOORLND4 138 kV (520999) to BEARCAT 138 kV (520500), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT30-PO5	**Prior Outage of MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788) line;** 3 phase fault on MOORLND4 138 kV (520999) to PIC4 138 kV (520425), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT31-PO5	**Prior Outage of MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788) line;** 3 phase fault on MOORLND4 138 kV (520999) to IODINE 4 138 kV (520957), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT33-PO5	**Prior Outage of MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788) line;** 3 phase fault on MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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-PO5	**Prior Outage of MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788) line;** 3 phase fault on MOORLND4 138 kV (520999) to G15-095T 138 kV (560066), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT27-PO6	**Prior Outage of MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785) line;** 3 phase fault on MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR, near MOORLND4 138 kV. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer.
FLT29-PO6	**Prior Outage of MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785) line;** 3 phase fault on MOORLND4 138 kV (520999) to BEARCAT 138 kV (520500), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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
FLT30-PO6	**Prior Outage of MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785) line;** 3 phase fault on MOORLND4 138 kV (520999) to PIC4 138 kV (520425), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT31-PO6	**Prior Outage of MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785) line;** 3 phase fault on MOORLND4 138 kV (520999) to IODINE 4 138 kV (520957), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT32-PO6	**Prior Outage of MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785) line;** 3 phase fault on MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT33-PO6	**Prior Outage of MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785) line;** 3 phase fault on MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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-PO6	**Prior Outage of MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785) line;** 3 phase fault on MOORLND4 138 kV (520999) to G15-095T 138 kV (560066), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT27-PO7	**Prior Outage of MOORLND4 138 kV (520999) to PIC4 138 kV (520425) line;** 3 phase fault on MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR, near MOORLND4 138 kV. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted transformer.
FLT28-PO7	**Prior Outage of MOORLND4 138 kV (520999) to PIC4 138 kV (520425) line;** 3 phase fault on MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT29-PO7	**Prior Outage of MOORLND4 138 kV (520999) to PIC4 138 kV (520425) line;** 3 phase fault on MOORLND4 138 kV (520999) to BEARCAT 138 kV (520500), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT31-PO7	**Prior Outage of MOORLND4 138 kV (520999) to PIC4 138 kV (520425) line;** 3 phase fault on MOORLND4 138 kV (520999) to IODINE 4 138 kV (520957), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT32-PO7	**Prior Outage of MOORLND4 138 kV (520999) to PIC4 138 kV (520425) line;** 3 phase fault on MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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-PO7	**Prior Outage of MOORLND4 138 kV (520999) to PIC4 138 kV (520425) line;** 3 phase fault on MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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-PO7	**Prior Outage of MOORLND4 138 kV (520999) to PIC4 138 kV (520425) line;** 3 phase fault on MOORLND4 138 kV (520999) to G15-095T 138 kV (560066), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT28-PO8	**Prior Outage of MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR** 3 phase fault on MOORLND4 138 kV (520999) to WINDFRM4 138 kV (515785), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT29-PO8	**Prior Outage of MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR** 3 phase fault on MOORLND4 138 kV (520999) to BEARCAT 138 kV (520500), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT30-PO8	**Prior Outage of MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR** 3 phase fault on MOORLND4 138 kV (520999) to PIC4 138 kV (520425), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT31-PO8	**Prior Outage of MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR** 3 phase fault on MOORLND4 138 kV (520999) to IODINE 4 138 kV (520957), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT32-PO8	**Prior Outage of MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR** 3 phase fault on MOORLND4 138 kV (520999) to GLASMTN4 138 kV (514788),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.
FLT33-PO8	**Prior Outage of MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR** 3 phase fault on MOORLND4 138 kV (520999) to TALOGA 4 138 kV (521065),near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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-PO8	**Prior Outage of MOORLND4 138 kV (520999) to MOORLND2 69 kV (520995) to LNDTERT 13.8 kV (521180) XFMR** 3 phase fault on MOORLND4 138 kV (520999) to G15-095T 138 kV (560066), near MOORLND4. a. Apply fault at the MOORLND4 138 kV bus. b. Clear fault after 5 cycles and trip 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.

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.

Table 5-2: GEN-2016-020 Dynamic Stability Results

Fault ID	17W			18S			26S		
	Volt. Recovery	Volt. Violation	Stable	Volt. Recovery	Volt. Violation	Stable	Volt. Recovery	Volt. Violation	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
FLT27-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT28-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT29-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT30-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT31-3PH	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT32-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT33-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT34-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT35-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT53-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT54-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT55-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT56-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT57-3PH	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT58-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT59-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT60-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT62-SB	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
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	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

Table 5-2 continued

Fault ID	17W			18S			26S		
	Volt. Recovery	Volt. Violation	Stable	Volt. Recovery	Volt. Violation	Stable	Volt. Recovery	Volt. Violation	Stable
FLT9017-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9018-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT1001-SB	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT1002-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT1003-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT1004-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT1005-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT1006-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT1007-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT1008-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT1009-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT1010-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT31-PO1	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT33-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT27-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT28-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT30-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT32-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9001-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT29-PO2	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT33-PO2	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT27-PO2	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT28-PO2	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT30-PO2	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT32-PO2	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT9001-PO2	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT27-PO3	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT28-PO3	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT29-PO3	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT30-PO3	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT31-PO3	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT32-PO3	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9001-PO3	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT27-PO4	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT28-PO4	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT29-PO4	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT30-PO4	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT31-PO4	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT32-PO4	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT33-PO4	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT27-PO5	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT28-PO5	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT29-PO5	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT30-PO5	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT31-PO5	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip

Table 5-2 continued

Fault ID	17W			18S			26S		
	Volt. Recovery	Volt. Violation	Stable	Volt. Recovery	Volt. Violation	Stable	Volt. Recovery	Volt. Violation	Stable
FLT33-PO5	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9001-PO5	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT27-PO6	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT29-PO6	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT30-PO6	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT31-PO6	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT32-PO6	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT33-PO6	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9001-PO6	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT27-PO7	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT28-PO7	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT29-PO7	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT31-PO7	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT32-PO7	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT33-PO7	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9001-PO7	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT28-PO8	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT29-PO8	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT30-PO8	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT31-PO8	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip	Pass	Pass	GEN Trip
FLT32-PO8	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT33-PO8	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9001-PO8	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable

The results of the stability simulations showed that any faults which would trip the Mooreland to Iodine 138 kV or Iodine and Fort Supply 138 kV lines, such as FLT31 and FLT57, would cause the Suzlon S88 2.1MW wind turbine generators, modeled as Type 2 generic wind turbine generators, connected to the Fort Supply 69 kV, GEN-2001-014 and GEN-2006-024S, to trip offline while the rest of the system remained stable. This generation trip was observed before and after the changes requested in this modification request study. The plots showing the generation trips before and after the modification request changes during FLT31 are shown in Figure 5-1 and Figure 5-2 respectively.

Additional sensitivity analyses were performed to further investigate the GEN-2001-014 and GEN-2006-024S generator trips for FLT31as follows. All simulations were performed using the base models before the GEN-2016-020 modifications:

1. **Scenario 2**: With GEN-2016-020 online, the GEN-2001-014 and GEN-2006-024S tripping relays were disabled. The results showed that both units were unstable.
2. **Scenario 3**: With GEN-2016-020 offline, GEN-2001-014 and GEN-2006-024S still tripped offline with the base case tripping relays left as-is.
3. **Scenario 4**: With GEN-2016-020 online, updated parameters were used for GEN-2001-014 and GEN-2006-024S but the units still tripped offline.

The power plots for the three scenarios are shown in Figure 5-3 through Figure 5-5 respectively.

Figure 5-1: FLT31 Base Case (Before Modification)

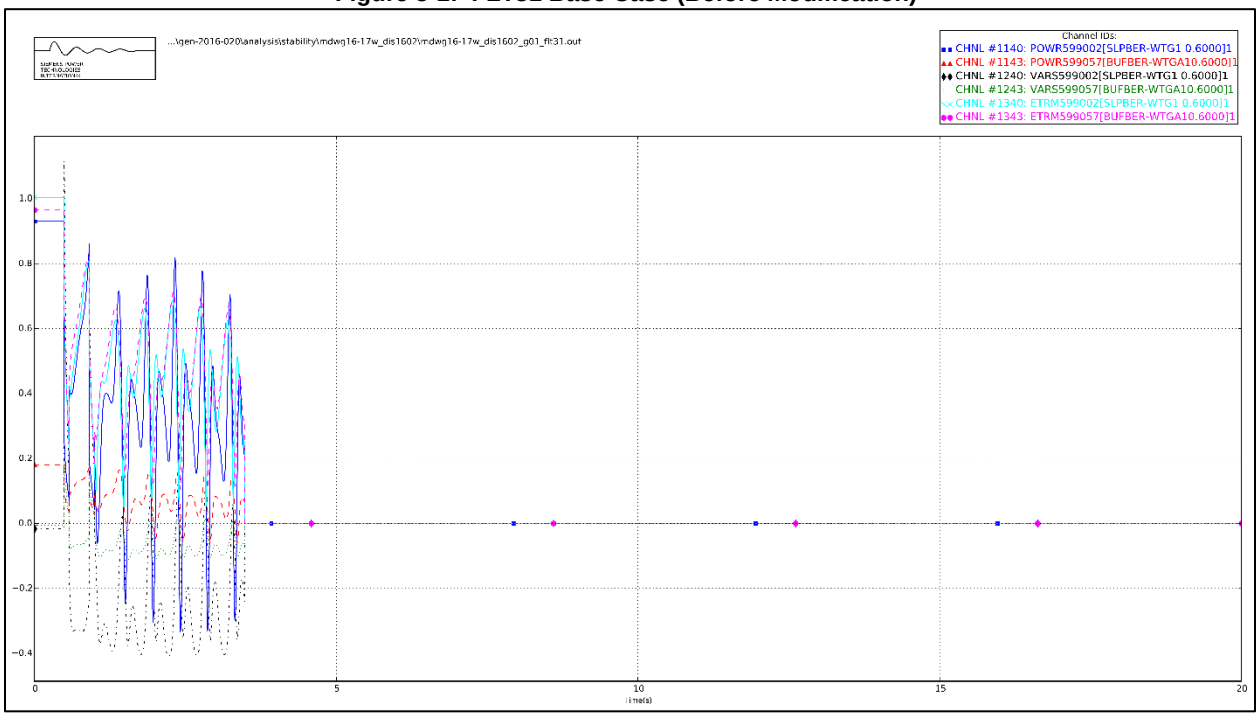


Figure 5-2: FLT31 Modification Case

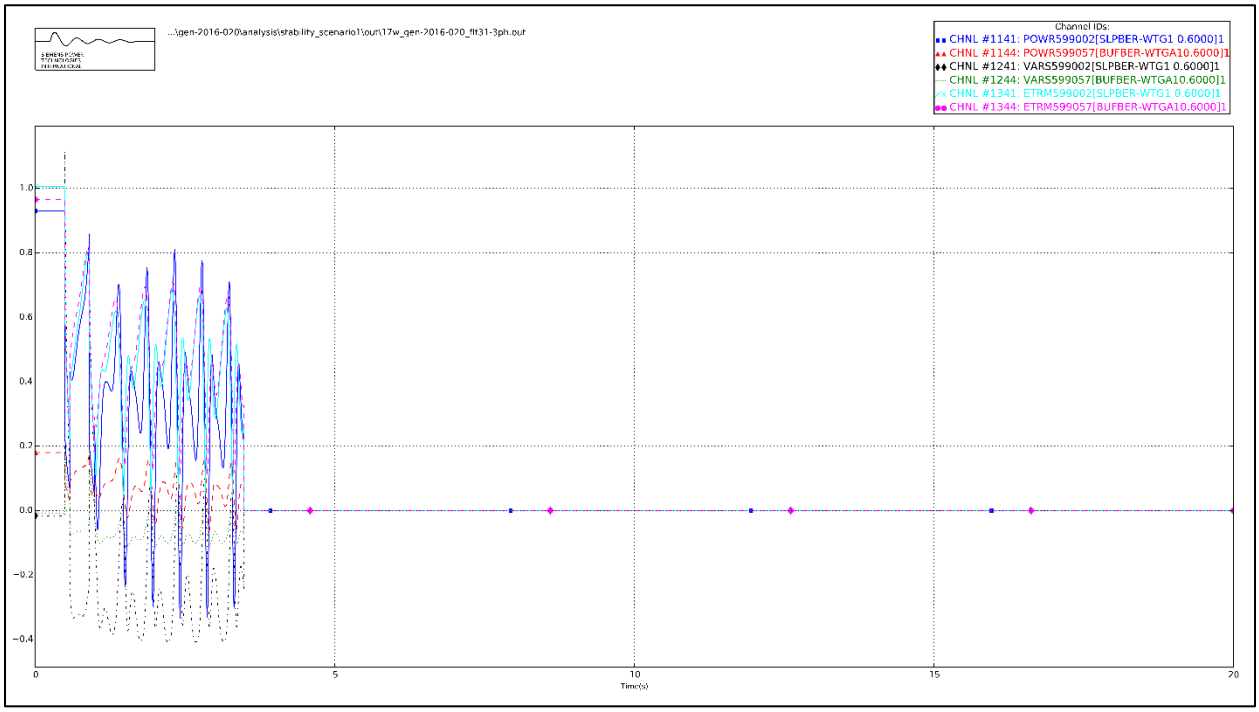


Figure 5-3: FLT31 Base Case – Scenario 2

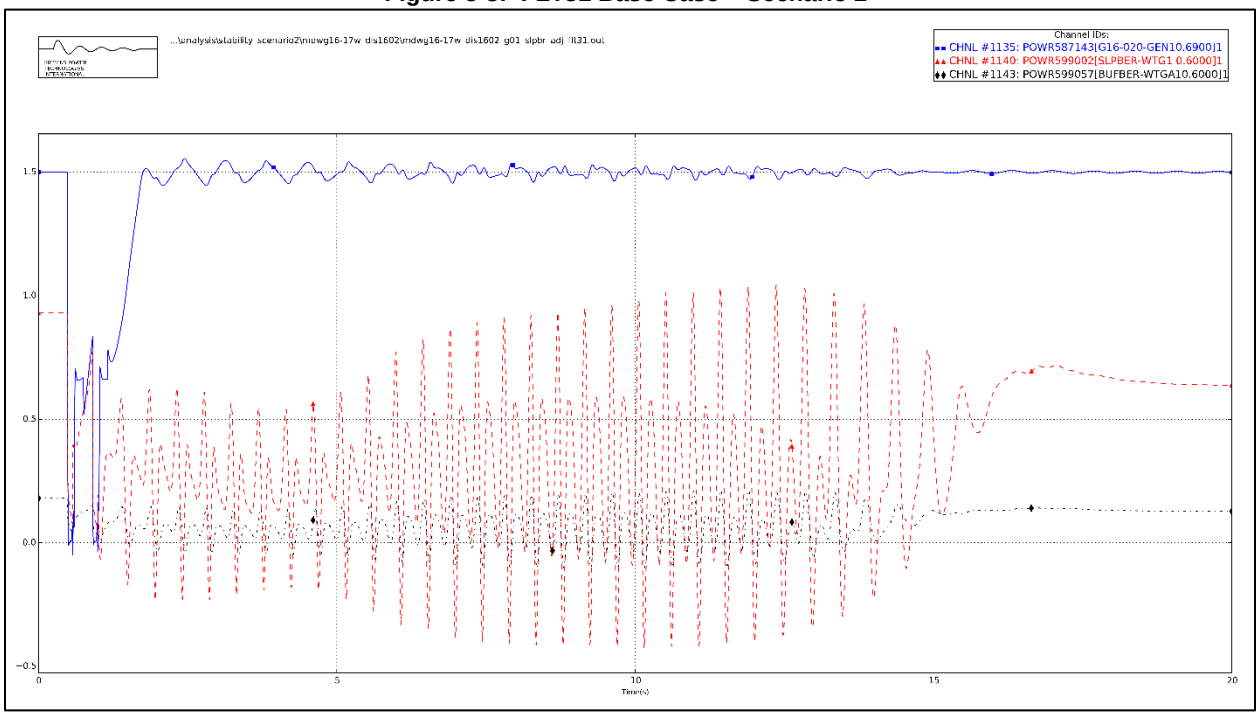


Figure 5-4: FLT31 Base Case – Scenario 3

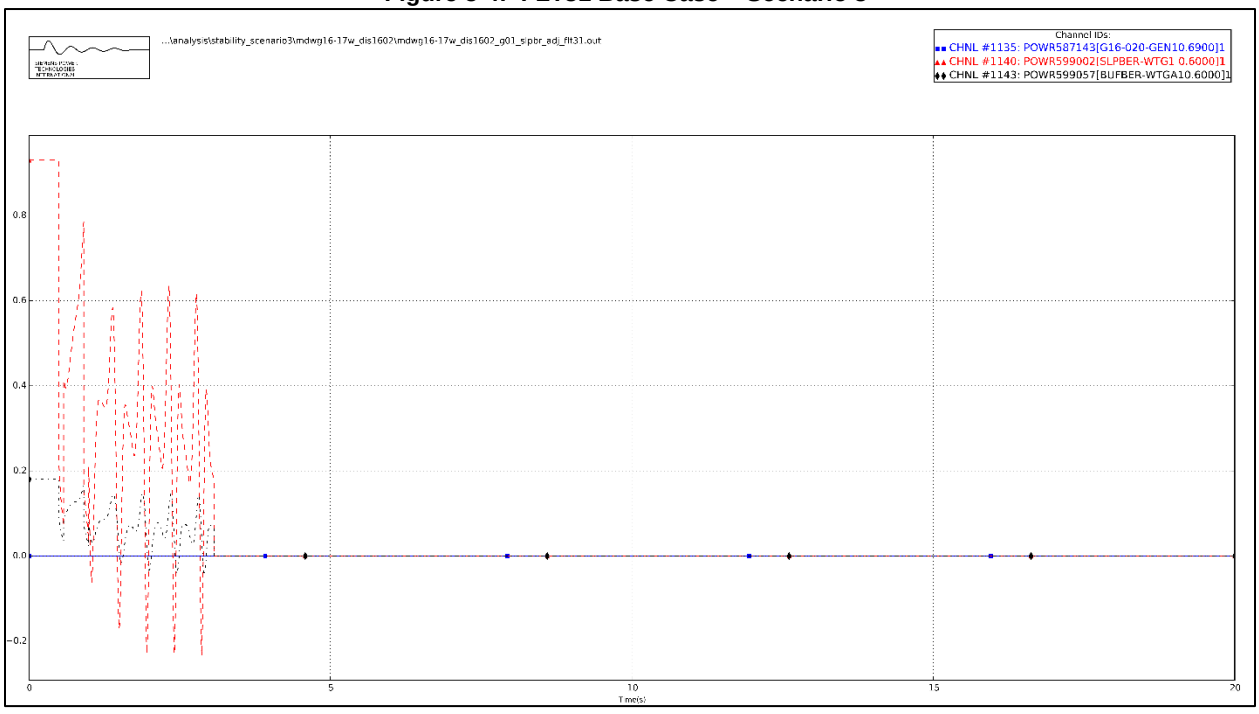
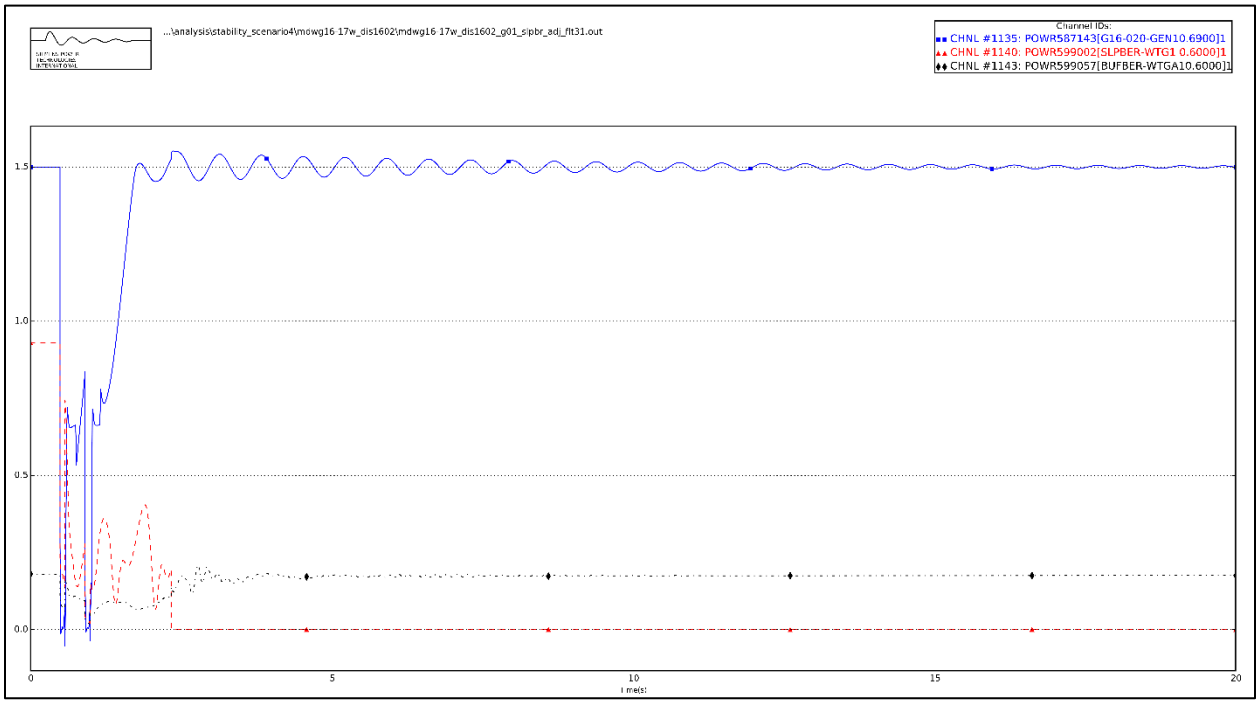


Figure 5-5: FLT31 Base Case – Scenario 4



Based on the results of the sensitivity analyses, it can be concluded that the GEN-2001-014 and GEN-2006-024S trips during the faults identified in Table 5-2 above are not associated with GEN-2016-020 or the GEN-2016-020 modification request. GEN-2001-014 and GEN-2006-024S were represented as GNET in the cases in the final simulations and all the simulations were observed to be stable and within system performance requirements.

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.

6.0 Conclusions

The Interconnection Customer for GEN-2016-020 requested a Modification Request Impact Study to assess the impact of the turbine and facility changes to a configuration with a total of 40 x GE 116 2.3MW + 20 x GE 127 2.82MW wind turbines for a total capacity of 148.4 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-2016-020.

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 combined GEN-2016-043 project may require an 8 MVAr shunt reactor on the 138kV 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-2016-020 was approximately 1.24 kA for the 2018SP and 2026SP cases respectively. All three-phase fault current levels with the GEN-2016-020 generator online were below 23 kA for the 2018SP models and 2026SP models.

The results of the dynamic stability analysis showed that any fault that trips the Mooreland to Iodine 138 kV line or the Iodine to Fort Supply 138 kV line, caused GEN-2001-014 and GEN-2006-024S to trip offline. This was observed before and after the modification requests. The two generators also tripped with GEN-2016-020 offline and after adjustments to the generators' parameters. The results of the simulations showed that the GEN-2001-014 and GEN-2006-024S tripping during the select faults were not attributed to GEN-2016-020 or the GEN-2016-020 modification request. When the two projects were GNET in the final simulations for this GEN-2016-020 modification request, there were no violations observed.

There were no other 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-2016-020 Modification Request does not constitute a material modification.