Report on

GEN-2017-097
Modification Request Impact Study

Revision R1 **August 15, 2022**

Submitted to
Southwest Power Pool

anedenconsulting.com

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Revision History

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
08/15/2022	Aneden Consulting	Initial Report Issued

Executive Summary

Aneden Consulting (Aneden) was retained by the Southwest Power Pool (SPP) to perform a Modification Request Impact Study (Study) for GEN-2017-097, an active Generation Interconnection Request (GIR) with a point of interconnection (POI) at the Underwood 115 kV Substation.

The GEN-2017-097 project interconnects in the Western Power Administration (WAPA) control area with a capacity of 128 MW as shown in Table ES-1 below. This Study has been requested to evaluate the modification of GEN-2017-097 to change the inverter configuration to 34 x Power Electronics FS4200M 3.78 MWMW for a total capacity of 128.52 MW. This generating capacity for GEN-2017-097 (128.52 MW) exceeds its Generator Interconnection Agreement (GIA) Interconnection Service amount, 128 MW, as listed in Appendix A of the GIA. As a result, the customer must ensure that the amount of power injected at the POI does not exceed the Interconnection Service amount listed in its GIA.

In addition, the modification request included changes to the collection system, generator step-up transformers, generation interconnection line, and main substation transformers. The existing and modified configurations for GEN-2017-097 are shown in Table ES-2.

Table ES-1: GEN-2017-097 Existing Configuration

Request	Point of Interconnection	Existing Generator Configuration	Interconnection Queue Capacity (MW)
GEN-2017-097	Underwood 115 kV (NUNDRWD7 652485)	42 x Power Electronics FS3000CU15 3.048 MW	128

Table ES-2: GEN-2017-097 Modification Request

Facility	DISIS-2017-001 Configuration		Modification Configuration
Point of Interconnection	Underwood 115 kV (NUNDRWD7 652485)		Underwood 115 kV (NUNDRWD7 652485)
Configuration/Capacity	42 x Power Electronics FS3000CU15 3.048 MW = 128 MW		34 x Power Electronics FS4200M 3.78 MW = 128.52 MW PPC to limit POI to 128 MW
Generation Interconnection Line	Length = 0.75 miles R = 0.000900 pu X = 0.005480 pu B = 0.000770 pu Rating MVA = 0 MVA		Length = 0.25 miles R = 0.000190 pu X = 0.001310 pu B = 0.000174 pu Rating MVA = 214 MVA
Main Substation Transformer[1]	X = 9.368%, R = 0.375%, Winding MVA = 100 MVA, Rating MVA = 128 MVA		X = 9.035%, R = 0.143%, Winding MVA = 96 MVA, Rating MVA = 160 MVA
Equivalent GSU Transformer[1]	Gen 1 Equivalent Qty: 21 X = 7.99%, R = 0.399%, Winding MVA = 70 MVA, Rating MVA = 77 MVA	Gen 2 Equivalent Qty: 21 X = 7.99%, R = 0.399%, Winding MVA = 70 MVA, Rating MVA = 77 MVA	Gen 1 Equivalent Qty: 34 X = 8.871%, R = 0.713%, Winding MVA = 143.038 MVA, Rating MVA[2] = 143 MVA
Equivalent Collector Line[3]	R = 0.008850 pu X = 0.008610 pu B = 0.005530 pu	R = 0.009970 pu X = 0.010090 pu B = 0.006590 pu	R = 0.003367 pu X = 0.003544 pu B = 0.021848 pu
Generator Dynamic Model[4] & Power Factor	21 x Power Electronics FS3000CU15 3.2 MVA (PE_GEN_700)[4] ±0.95	21 x Power Electronics FS3000CU15 3.2 MVA (PE_GEN_700)[4] ±0.95	34 x Power Electronics FS4200M 4.2 MVA (REGCAU1)[4] ±0.90

1) X/R based on Winding MVA, 2) Rating rounded in PSS/E, 3) All pu are on 100 MVA Base 4) DYR stability model name

SPP determined that power flow analysis should not be performed based on the POI MW injection increase of 0.62% compared to the DISIS-2017-001 power flow models. However, SPP determined that while the modification used the same inverter manufacturer, Power Electronics, the change in stability model from PE_GEN_700 to REGCAU1 required short circuit and dynamic stability analysis.

The scope of this modification request study included charging current compensation analysis, short circuit analysis, and dynamic stability analysis.

Aneden performed the analyses using the modification request data based on the DISIS 2017-001 stability study models:

1. 2019 Winter Peak (19WP),
2. 2021 Light Load (21LL),
3. 2021 Summer Peak (21SP),
4. 2028 Summer Peak (28SP)

All analyses were performed using the PTI PSS/E version 33 software and the results are summarized below.

The results of the charging current compensation analysis performed using the 2019 Winter Peak, 2021 Light Load, 2021 Summer Peak, and 2028 Summer Peak models showed that the GEN-2017-097 project needed 2.2 MVAr of reactor shunts on the 34.5 kV bus of the project substation with the modifications in place, an increase from the 1.29 MVAr found for the existing GEN-2017-097 configuration in the DISIS-2017-001 study[1]. This is necessary to offset the capacitive effect on the transmission network caused by the project's transmission line and collector system during reduced generation conditions. The information gathered from the charging current compensation analysis is provided as information to the Interconnection Customer and Transmission Owner (TO) and/or Transmission Operator. The applicable reactive power requirements will be further reviewed by the Transmission Owner and/or Transmission Operator.

The results from the short circuit analysis with the updated configuration showed that the maximum GEN-2017-097 contribution to three-phase fault currents in the immediate transmission systems at or near the GEN-2017-097 POI was no greater than 0.63 kA for the 21SP and 28SP models. All three-phase fault current levels within 5 buses of the POI with the GEN-2017-097 generators online were below 21 kA for the 21SP and 28SP models.

The dynamic stability analysis was performed using PTI PSS/E version 33.10 software for the four modified study models, 2019 Winter Peak, 2021 Light Load, 2021 Summer Peak, and 2028 Summer Peak. Up to 108 events were simulated, which included three-phase faults, three-phase faults on prior outage cases, and single-line-to-ground stuck breaker faults.

The results of the dynamic stability analysis showed that there were low voltage conditions leading to the instability of the GEN-2017-097 and GEN-2017-014 generators due to the LVRT in the 19WP case with FLT15-3PH (loss of Philip Tap to OAHE 230kV line). This issue was observed in the DISIS-2017-001-1 report and a 30 MVA SVC at G17-014 bus 588590 was identified as mitigation and alleviated the GEN-2017-097 and GEN-2017-014 LVRT instability. In addition, low final voltage conditions were observed with the P6 Planning Event FLT15-PO1 causing voltages below 0.9 pu to persist after the fault. This voltage criteria violation was observed in the DISIS and modification cases so it was not attributed to the GEN-2017-097 modification.

[1] DISIS-2017-001-1 Restudy of Stability and Short Circuit Analysis, November 3, 2021

There were no other damping or voltage recovery violations attributed to the GEN-2017-097 project 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.

The requested modification has been determined by SPP to not be a Material Modification. The requested modification does not have a material adverse impact on the cost or timing of any other Interconnection Request with a later Queue priority date. As the requested modification places the generating capacity of the Interconnection Request at a higher amount than its Interconnection Service, the customer must install monitoring and control equipment as needed to ensure that the amount of power injected at the POI does not exceed the Interconnection Service amount listed in its GIA.

In accordance with FERC Order No. 827, the generating facility will be required to provide dynamic reactive power within the range of 0.95 leading to 0.95 lagging at the high-side of the generator substation.

It is likely that the customer may be required to reduce its generation output to 0 MW in real-time, 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.

1.0 Scope of Study

Aneden Consulting (Aneden) was retained by the Southwest Power Pool (SPP) to perform a Modification Request Impact Study (Study) for GEN-2017-097. A Modification Request Impact Study is a generation interconnection study performed to evaluate the impacts of modifying the DISIS study assumptions. The determination of the required scope of the study is dependent upon the specific modification requested and how it may impact the results of the DISIS study. Impacting the DISIS results could potentially affect the cost or timing of any Interconnection Request with a later Queue priority date, deeming the requested modification a Material Modification. The criteria sections below include reasoning as to why an analysis was either included or excluded from the scope of study.

All analyses were performed using the PTI PSS/E version 33 software. The results of each analysis are presented in the following sections.

1.1 Power Flow Analysis

To determine whether power flow analysis is required, SPP evaluates the difference in the real power output at the POI between the DISIS-2017-001 power flow configuration and the requested modification. Power flow analysis is performed if the difference in the real power may result in a significant impact on the results of the DISIS power flow analysis.

1.2 Dynamic Stability Analysis, Short Circuit Analysis

To determine whether stability and short circuit analyses are required, SPP evaluates the difference between the stability model parameters and, if needed, the collector system impedance between the existing configuration and the requested modification. Dynamic stability analysis and short circuit analysis would be required if the differences listed above may result in a significant impact on the most recently performed DISIS stability analysis.

1.3 Charging Current Compensation Analysis

SPP requires that a charging current compensation analysis be performed on the requested modification configuration as it is a non-synchronous resource. The charging current compensation analysis determines the capacitive effect at the POI caused by the project's collector system and transmission line's capacitance. A shunt reactor size is determined in order to offset the capacitive effect and maintain zero (0) MVAr flow at the POI while the project's generators and capacitors are offline.

1.4 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

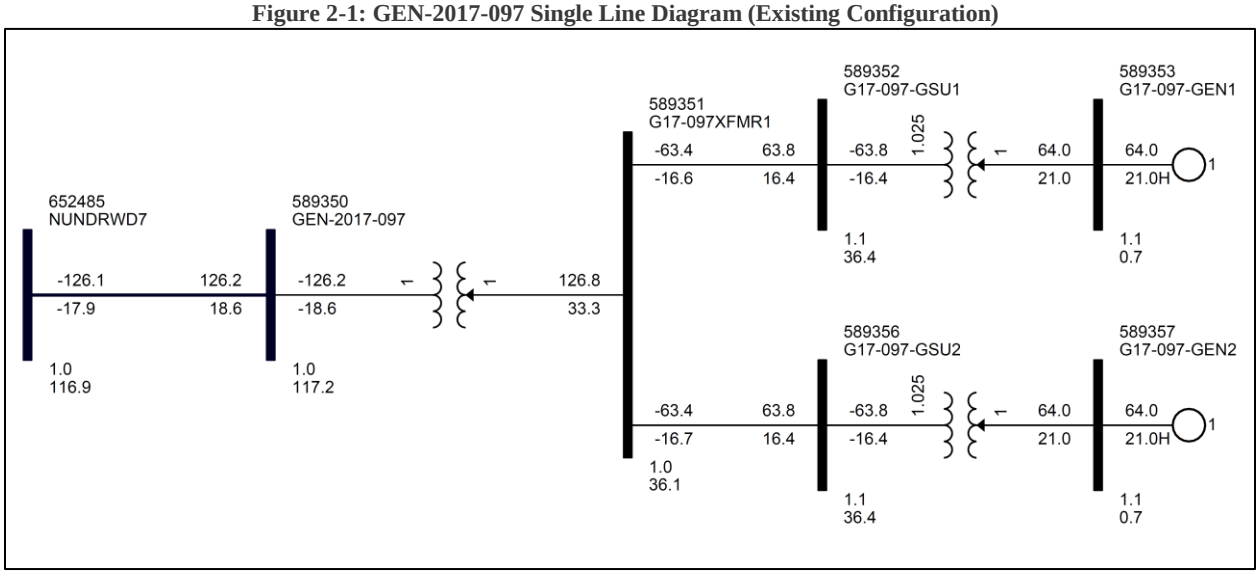
The GEN-2017-097 Interconnection Customer has requested a modification to its Interconnection Request (IR) with a point of interconnection (POI) at the Underwood 115 kV Substation. At the time of the posting of this report, GEN-2017-097 is an active Interconnection Request with queue status of "IA FULLY EXECUTED/ON SCHEDULE." GEN-2017-097 is a solar farm and has a maximum summer and winter queue capacity of 128 MW with Energy Resource Interconnection Service (ERIS).

The GEN-2017-097 project is currently in the DISIS-2017-001 cluster and interconnects in the Western Power Administration (WAPA) control area with a capacity of 128 MW as shown in Table 2-1 below. Figure 2-1 shows the power flow model single line diagram for the existing GEN-2017-097 configuration.

Table 2-1: GEN-2017-097 Existing Configuration

Request	Point of Interconnection	Existing Generator Configuration	Interconnection Queue Capacity (MW)
GEN-2017-097	Underwood 115 kV (NUNDRWD7 652485)	42 x Power Electronics FS3000CU15 3.048 MW	128

Figure 2-1: GEN-2017-097 Single Line Diagram (Existing Configuration)



This Study has been requested by the Interconnection Customer to evaluate the modification of GEN-2017-097 to an inverter configuration of 34 x Power Electronics FS4200M 3.78 MW for a total capacity of 128.52 MW. This combined generating capacity for GEN-2017-097 (128.52 MW) exceeds the total Generator Interconnection Agreement (GIA) Interconnection Service amount, 128 MW, as listed in Appendix A of the GIA. As a result, the customer must ensure that the amount of power injected at the POI does not exceed the Interconnection Service amount listed in its GIA. In addition, the modification request included changes to the collection system, generator step-up transformers, generation interconnection line, and main substation transformers.

Figure 2-2 shows the power flow model single line diagram for the GEN-2017-097 modification. The existing and modified configurations for GEN-2017-097 are shown in Table 2-2.

Figure 2-2: GEN-2017-097 Single Line Diagram (Modification Configuration)

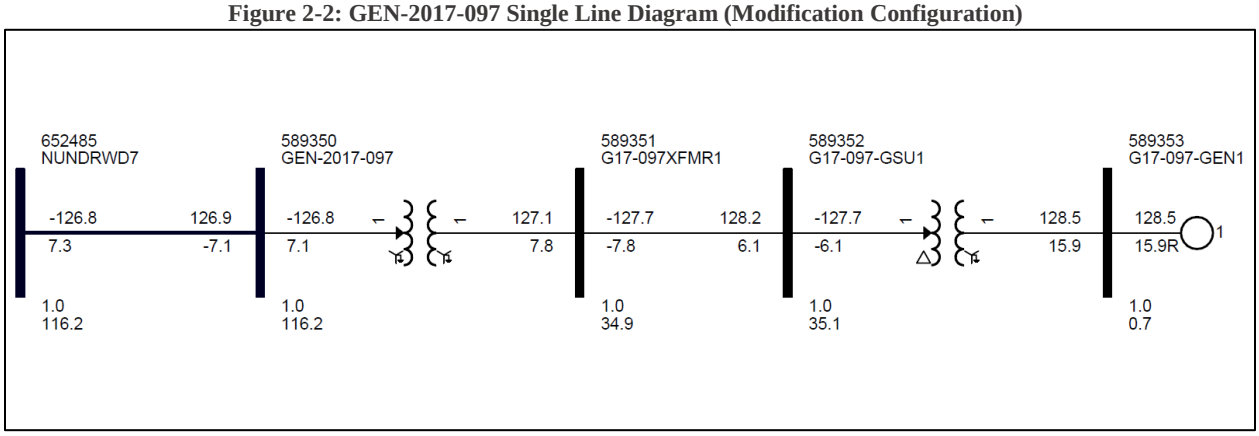


Table 2-2: GEN-2017-097 Modification Request

Facility	DISIS-2017-001 Configuration		Modification Configuration
Point of Interconnection	Underwood 115 kV (NUNDRWD7 652485)		Underwood 115 kV (NUNDRWD7 652485)
Configuration/Capacity	42 x Power Electronics FS3000CU15 3.048 MW = 128 MW		34 x Power Electronics FS4200M 3.78 MW = 128.52 MW PPC to limit POI to 128 MW
Generation Interconnection Line	Length = 0.75 miles R = 0.000900 pu X = 0.005480 pu B = 0.000770 pu Rating MVA = 0 MVA		Length = 0.25 miles R = 0.000190 pu X = 0.001310 pu B = 0.000174 pu Rating MVA = 214 MVA
Main Substation Transformer[1]	X = 9.368%, R = 0.375%, Winding MVA = 100 MVA, Rating MVA = 128 MVA		X = 9.035%, R = 0.143%, Winding MVA = 96 MVA, Rating MVA = 160 MVA
Equivalent GSU Transformer[1]	Gen 1 Equivalent Qty: 21 X = 7.99%, R = 0.399%, Winding MVA = 70 MVA, Rating MVA = 77 MVA	Gen 2 Equivalent Qty: 21 X = 7.99%, R = 0.399%, Winding MVA = 70 MVA, Rating MVA = 77 MVA	Gen 1 Equivalent Qty: 34 X = 8.871%, R = 0.713%, Winding MVA = 143.038 MVA, Rating MVA[2] = 143 MVA
Equivalent Collector Line[3]	R = 0.008850 pu X = 0.008610 pu B = 0.005530 pu	R = 0.009970 pu X = 0.010090 pu B = 0.006590 pu	R = 0.003367 pu X = 0.003544 pu B = 0.021848 pu
Generator Dynamic Model[4] & Power Factor	21 x Power Electronics FS3000CU15 3.2 MVA (PE_GEN_700)[4] ±0.95	21 x Power Electronics FS3000CU15 3.2 MVA (PE_GEN_700)[4] ±0.95	34 x Power Electronics FS4200M 4.2 MVA (REGCAU1)[4] ±0.90

1) X/R based on Winding MVA, 2) Rating rounded in PSS/E, 3) All pu are on 100 MVA Base 4) DYR stability model name

3.0 Existing vs Modification Comparison

To determine which analyses are required for the Study, the differences between the existing configuration and the requested modification were evaluated. Aneden performed this comparison and the resulting analyses using a set of modified study models developed based on the modification request data and the DISIS-2017-001 study models.

The methodology and results of the comparisons are described below. The analysis was completed using PSS/E version 33 software.

3.1 POI Injection Comparison

The real power injection at the POI was determined using PSS/E to compare the DISIS-2017-001 power flow configuration and the requested modification for GEN-2017-097. The percentage change in the POI injection was then evaluated. If the real power (MW) difference was determined to be significant (greater than 10%) power flow analysis would be performed to assess the impact of the modification request.

SPP determined that power flow analysis was not required due to the insignificant change, increase of 0.62%, in the real power output at the POI between the studied DISIS-2017-001 power flow configuration and requested modification shown in Table 3-1.

Table 3-1: GEN-2017-097 POI Injection Comparison

Interconnection Request	Existing POI Injection (MW)	Modification POI Injection (MW)	POI Injection Difference %
GEN-2017-097	126.1	126.8	0.62%

3.2 Stability Model Parameters Comparison

SPP determined that while the modification used the same inverter manufacturer, Power Electronics, the change in stability model from PE_GEN_700 to REGCAU1 required short circuit and dynamic stability analysis. This is because the short circuit contribution and stability responses of the existing configuration and the requested modification's configuration may differ. The generator dynamic model for the modification can be found in Appendix A.

As short circuit and dynamic stability analyses were required, a stability model parameters comparison was not needed for the determination of the scope of the study.

3.3 Equivalent Impedance Comparison Calculation

As the inverter stability model change determined that short circuit and dynamic stability analyses were required, an equivalent impedance comparison was not needed for the determination of the scope of the study.

4.0 Charging Current Compensation Analysis

The charging current compensation analysis was performed for GEN-2017-097 to determine the capacitive charging effects under reduced generation conditions (unsuitable wind speeds, unsuitable solar irradiance, insufficient state of charge, idle conditions, curtailment, etc.) at the generation site and to size shunt reactors that would reduce the project reactive power contribution to the POI to approximately zero.

4.1 Methodology and Criteria

The GEN-2017-097 generators were switched out of service while other collection system elements remained in-service. A shunt reactor was tested at the project's collection substation 34.5 kV bus to offset the MVAr flow into the POI to approximately zero. The size of the shunt reactor is equivalent to the charging current value at unity voltage and the compensation provided is proportional to the voltage effects on the charging current (i.e., for voltages above unity, reactive compensation is greater than the size of the reactor).

Aneden performed the charging current compensation analysis using the modification request data based on the DISIS 2017-001 stability study models:

1. 2019 Winter Peak (19WP),
2. 2021 Light Load (21LL),
3. 2021 Summer Peak (21SP),
4. 2028 Summer Peak (28SP)

4.2 Results

The results from the analysis showed that the GEN-2017-097 project needed approximately 2.2 MVAr of compensation at its collector substation, to reduce the POI MVAr to zero. This is an increase from the 1.29 MVAr found for the existing GEN-2017-097 configuration in the DISIS-2017-001-1 study[2] . The final shunt reactor requirements for GEN-2017-097 are shown in Table 4-1. Figure 4-1 illustrates the shunt reactor size needed to reduce the POI MVAr to approximately zero with the updated configuration.

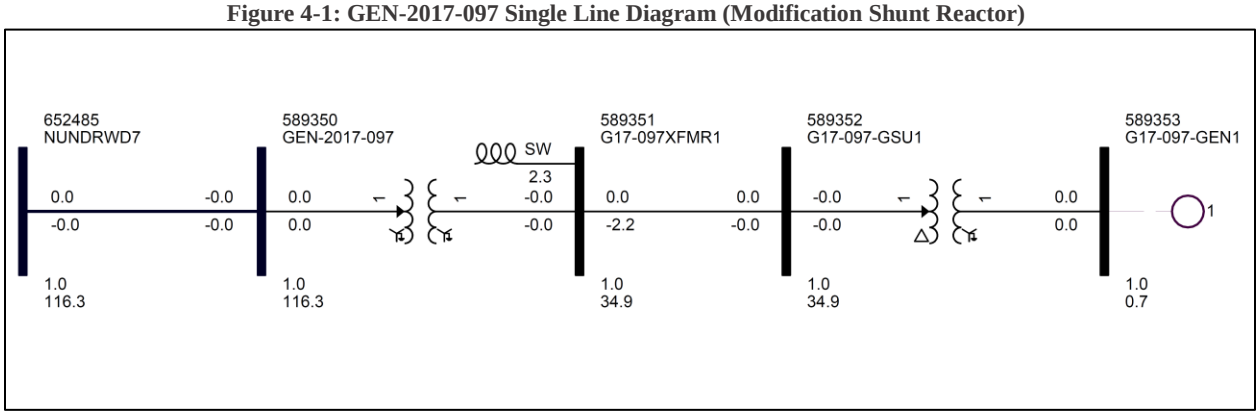
The information gathered from the charging current compensation analysis is provided as information to the Interconnection Customer and Transmission Owner (TO) and/or Transmission Operator. The applicable reactive power requirements will be further reviewed by the Transmission Owner and/or Transmission Operator.

Table 4-1: Shunt Reactor Size for Reduced Generation Study (Modification)

Machine	POI Bus Number	POI Bus Name	Reactor Size (MVAr)			
			19WP	21LL	21SP	28SP
GEN-2017-097	652485	Underwood 115 kV	2.2	2.2	2.2	2.2

[2] DISIS-2017-001-1 Restudy of Stability and Short Circuit Analysis, November 3, 2021

Figure 4-1: GEN-2017-097 Single Line Diagram (Modification Shunt Reactor)



5.0 Short Circuit Analysis

A short circuit study was performed using the 21SP and 28SP model for GEN-2017-097. The detailed results of the short circuit analysis are provided in Appendix B.

5.1 Methodology

The short circuit analysis included applying a 3-phase fault on buses up to 5 levels away from the 115 kV POI bus. The PSS/E "Automatic Sequence Fault Calculation (ASCC)" fault analysis module was used to calculate the fault current levels in the transmission system with and without GEN-2017-097 online.

Aneden performed the short circuit analysis using the modification request data based on the DISIS 2017-001 stability study models:

1. 2021 Summer Peak (21SP),
2. 2028 Summer Peak (28SP)

5.2 Results

The results of the short circuit analysis for the 21SP and 28SP models are summarized in Table 5-1 through Table 5-3 respectively. The GEN-2017-097 POI bus (Underwood 115 kV 652485) fault current magnitudes are provided in Table 5-1 showing a maximum fault current of 7.41 kA with the GEN-2017-097 project online.

The maximum fault current calculated within 5 buses of the GEN-2017-097 POI was less than 21 kA for the 21SP and 28SP models respectively. The maximum GEN-2017-097 contribution to three-phase fault current was about 9.3% and 0.63 kA.

Table 5-1: POI Short Circuit Results

Case	GEN-OFF Current (kA)	GEN-ON Current (kA)	Max kA Change	Max %Change
21SP	6.78	7.41	0.63	9.3%
28SP	6.82	7.40	0.58	8.5%

Table 5-2: 21SP Short Circuit Results

Voltage (kV)	Max. Current (kA)	Max kA Change	Max %Change
69	4.3	0.05	1.5%
115	11.5	0.63	9.3%
230	20.0	0.29	7.4%
345	8.8	-0.01	-0.1%
Max	**20.0**	**0.63**	**9.3%**

Table 5-3: 28SP Short Circuit Results

Voltage (kV)	Max. Current (kA)	Max kA Change	Max %Change
69	4.3	0.02	0.6%
115	11.5	0.58	8.5%
230	20.2	0.27	6.8%
345	8.9	0.00	0.0%
Max	**20.2**	**0.58**	**8.5%**

6.0 Dynamic Stability Analysis

Aneden performed a dynamic stability analysis to identify the impact of the inverter configuration change and other modifications to the GEN-2017-097 project. The analysis was performed according to SPP's Disturbance Performance Requirements shown in Appendix C. The modification details are described in Section 2.0 above and the dynamic modeling data is provided in Appendix A. The simulation plots can be found in Appendix D.

6.1 Methodology and Criteria

The dynamic stability analysis was performed using models developed with the requested GEN-2017-097 configuration of 34 x Power Electronics FS4200M 3.78 MW (REGCAU1). This stability analysis was performed using PTI's PSS/E version 33.10 software.

The modifications requested for the GEN-2017-097 project were used to create modified stability models for this impact study based on the DISIS 2017-001 stability study models:

1. 2019 Winter Peak (19WP),
2. 2021 Light Load (21LL),
3. 2021 Summer Peak (21SP),
4. 2028 Summer Peak (28SP)

The modified dynamic model data for the GEN-2017-097 project is provided in Appendix A. 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-2017-097 and other equally and prior queued projects in the cluster group[3]. In addition, voltages of five (5) buses away from the POI of GEN-2017-097 were monitored and plotted. The machine rotor angle for synchronous machines and speed for asynchronous machines within this study area including 534 (SUNC), 536 (WERE), 540 (GMO), 541 (KCPL), 635 (MEC), 640 (NPPD), 645 (OPPD), 650 (LES), 652 (WAPA) were monitored. In addition, the voltages of all 100 kV and above buses within the study area were monitored.

6.2 Fault Definitions

Aneden simulated the faults previously simulated for GEN-2017-097 and developed additional fault events 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 stuck breaker faults. The simulated faults are listed and described in Table 6-1 below. These contingencies were applied to the modified 2019 Winter Peak, 2021 Light Load, 2021 Summer Peak, and the 2028 Summer Peak models.

[3] Based on the DISIS-2017-001 Cluster Groups

Table 6-1: Fault Definitions

Fault ID	Planning Event	Fault Descriptions
FLT01-3PH	P1	3 phase fault on the PHILIP_T-BE4 (659188) to NUNDRWD4 (652484) 230 kV line CKT 1, near PHILIP_T-BE4. a. Apply fault at the PHILIP_T-BE4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT03-3PH	P1	3 phase fault on the G17-064-TAP (589024) to WAYSIDE4 (640404) 230 kV line CKT 1, near G17-064-TAP. a. Apply fault at the G17-064-TAP 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT05-3PH	P1	3 phase fault on the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT06-3PH	P1	3 phase fault on the NUNDRWD7 (652485) to ELSWRTH7 (652477) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT07-3PH	P1	3 phase fault on the NUNDRWD7 (652485) to WICKSVL7 (652493) to Wall 7 (652492) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT08-3PH	P1	3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652266) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT09-3PH	P1	3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT11-3PH	P1	3 phase fault on the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT12-3PH	P1	3 phase fault on the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT13-3PH	P1	3 phase fault on the NUNDRWD-LXN3 (652884) to MAURINE4 (652497) 230 kV line CKT 1, near NUNDRWD-LXN3. a. Apply fault at the NUNDRWD-LXN3 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT14-3PH	P1	3 phase fault on the PHILIP_T-BE4 (659188) to PHILIP 4 (652486) 230 kV line CKT 1, near PHILIP_T-BE4. a. Apply fault at the PHILIP_T-BE4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.

Table 6-1 Continued

Fault ID	Planning Event	Fault Descriptions
FLT15-3PH	P1	3 phase fault on the PHILIP_T-BE4 (659188) to OAHE 4 (652519) 230 kV line CKT 1, near PHILIP_T-BE4. a. Apply fault at the PHILIP_T-BE4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT16-3PH	P1	3 phase fault on the WAYSIDE4 (640404) to STEGALL-LNX3 (652873) 230 kV line CKT 1, near WAYSIDE4. a. Apply fault at the WAYSIDE4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT17-3PH	P1	3 phase fault on the WAYSIDE T1 230 kV (640404)/ 115 kV (640405) / 13.8 kV (640406) transformer CKT 1, near WAYSIDE4 230 kV. a. Apply fault at the WAYSIDE4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT18-3PH	P1	3 phase fault on the RAPIDCY7 (652490) to DRYCREEK-BE7 (659377) 115 kV line CKT 1, near RAPIDCY7. a. Apply fault at the RAPIDCY7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT19-3PH	P1	3 phase fault on the RAPIDCY7 (652490) to ELKCRK 7 (652473) to NEWELL 7 (652483) 115 kV line CKT 1, near RAPIDCY7. a. Apply fault at the RAPIDCY7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT20-3PH	P1	3 phase fault on the PHILIP9 (652487) to MIDLAND7 (652481) to IRVSIMM7 (652491) 115 kV line CKT 1, near PHILIP9. a. Apply fault at the PHILIP9 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT21-3PH	P1	3 phase fault on the PHILIP9 (652487) to WANBLEE 7 (652579) to MARTIN 7 (652479) 115 kV line CKT 1, near PHILIP9. a. Apply fault at the PHILIP9 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT22-3PH	P1	3 phase fault on the PL KV1A 3 115 kV (652487) / 230 kV (652486) /13.2 kV (652498) XFMR transformer 1, near PHILIP 7 115 kV. a. Apply fault at the PHILIP 7 115 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT23-3PH	P1	3 phase fault on the OAHE 4 (652519) to G16-094-TAP (587764) 230 kV line CKT 1, near OAHE 4. a. Apply fault at the OAHE 4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT24-3PH	P1	3 phase fault on the OAHE 4 (652519) to FTTHOMP4 (652507) 230 kV line CKT 1, near OAHE 4. a. Apply fault at the OAHE 4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT25-3PH	P1	3 phase fault on the OAHE 4 (652519) to SULLYBT-ER4 (655487) 230 kV line CKT 1, near OAHE 4. a. Apply fault at the OAHE 4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.

Table 6-1 Continued

Fault ID	Planning Event	Fault Descriptions
FLT26-3PH	P1	3 phase fault on the MAURINE4 (652497) to BISON (659351) 230 kV line CKT 1, near MAURINE4. a. Apply fault at the MAURINE4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT27-3PH	P1	3 phase fault on the MA KV1A 3 230 kV (652497) / 115 kV (652480) /13.8 kV (652247) transformer CKT 1, near MAURINE4 230 kV. a. Apply fault at the MAURINE4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT29-3PH	P1	3 phase fault on the STEGALL-LNX3 (652873) to STEGALL4 (652573) 230 kV line CKT Z, near STEGALL-LNX3. a. Apply fault at the STEGALL-LNX3 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT31-3PH	P1	3 phase fault on the DRYCREEK-BE4 (659376) to RCDC.E_BE4 (659271) 230 kV line CKT Z, near DRYCREEK-BE4. a. Apply fault at the DRYCREEK-BE4 230 kV bus. b. Clear fault after 7 cycles by tripping the faulted line. **Trip generator RAPID_DC-BED (659304)** c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 7 cycles, then trip the line in (b) and remove fault.
FLT32-3PH	P1	3 phase fault on the KV1A DRY 230 kV (659376) / 115 kV (659377) /13.8 kV (659378) transformer CKT 1, near DRYCREEK-BE4 230 kV. a. Apply fault at the DRYCREEK-BE4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT33-3PH	P1	3 phase fault on the G14_001IST (654490) to MAURINE7 (652480) 115 kV line CKT 1, near G14_001IST. a. Apply fault at the G14_001IST 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT36-3PH	P1	3 phase fault on the IRVSIMM7 (652491) to OAHE (652520) 115 kV line CKT 1, near IRVSIMM7. a. Apply fault at the IRVSIMM7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT37-3PH	P1	3 phase fault on the IRVSIMM7 (652491) to PIERRE7 (652489) 115 kV line CKT 1, near IRVSIMM7. a. Apply fault at the IRVSIMM7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT70-3PH	P1	3 phase fault on the NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT15-PO1	P6	**PRIOR OUTAGE of NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1;** 3 phase fault on the PHILIP_T-BE4 (659188) to OAHE 4 (652519) 230 kV line CKT 1, near PHILIP_T-BE4. a. Apply fault at the PHILIP_T-BE4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.

Table 6-1 Continued

Fault ID	Planning Event	Fault Descriptions
FLT11-PO2	P6	**PRIOR OUTAGE of the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT70-PO2	P6	**PRIOR OUTAGE of the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT07-PO6	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to WICKSVL7 (652493) to PHILIP 7 (652487) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT09-PO6	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) 115 kV line CKT 1;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT07-PO7	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to ELSWRTH7 (652477) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to WICKSVL7 (652493) to PHILIP 7 (652487) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT09-PO7	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to ELSWRTH7 (652477) 115 kV line CKT 1;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT05-PO8	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to WICKSVL7 (652493) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT06-PO8	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to WICKSVL7 (652493) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to ELSWRTH7 (652477) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT09-PO8	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to WICKSVL7 (652493) 115 kV line CKT 1;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.

Table 6-1 Continued

Fault ID	Planning Event	Fault Descriptions
FLT9001-3PH	P1	3 phase fault on the ELSWRTH7 (652477) to RAPIDCY7 (652490) 115 kV line CKT 1, near ELSWRTH7. a. Apply fault at the ELSWRTH7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT9002-3PH	P1	3 phase fault on the WICKSVL7 (652493) to WALL 7 (652492) 115 kV line CKT 1, near WICKSVL7. a. Apply fault at the WICKSVL7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT9003-3PH	P1	3 phase fault on the WALL 7 (652492) to PHILIP 7 (652487)115 kV line CKT 1, near WALL 7. a. Apply fault at the WALL 7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT9004-3PH	P1	3 phase fault on the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT9005-3PH	P1	3 phase fault on the PHILIP_T-BE4 (659188) to GEN-2017-014 (588590) 230 kV line CKT 1, near PHILIP_T-BE4. a. Apply fault at the PHILIP_T-BE4 230 kV bus. b. Clear fault after 7 cycles by tripping the faulted line. **Trip generator G17-014-GEN2 (588597)** **Trip generator G17-014-GEN1 (588593)** c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 7 cycles, then trip the line in (b) and remove fault.
FLT9006-3PH	P1	3 phase fault on the OA NO.5 230 kV (652519)/ 115 kV (652520) / 13.8 kV (652589) transformer CKT 1, near OAHE 4 230 kV. a. Apply fault at the OAHE 4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT9007-3PH	P1	3 phase fault on the G17-064-TAP (589024) to GEN-2017-064 (589020) 230 kV line CKT 1, near G17-064-TAP. a. Apply fault at the G17-064-TAP 230 kV bus. b. Clear fault after 6 cycles by tripping the faulted line. **Trip generator G17-064-GEN2 (589027)** **Trip generator G17-064-GEN1 (589023)** c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 6 cycles, then trip the line in (b) and remove fault.
FLT9008-3PH	P1	3 phase fault on the OA NO.2 230 kV (652519)/ 13.8 kV (652556) transformer CKT 1, near OAHE 4 230 kV. a. Apply fault at the OAHE 4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer. **Trip generator OAHE2-3G (652556)**
FLT05-PO1	P6	**PRIOR OUTAGE of NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT06-PO1	P6	**PRIOR OUTAGE of NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to ELSWRTH7 (652477) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.

Table 6-1 Continued

Fault ID	Planning Event	Fault Descriptions
FLT07-PO1	P6	PRIOR OUTAGE of NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1; 3 phase fault on the NUNDRWD7 (652485) to WICKSVL7 (652493) to PHILIP 7 (652487) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT08-PO1	P6	**PRIOR OUTAGE of NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652266) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT09-PO1	P6	**PRIOR OUTAGE of NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT11-PO1	P6	**PRIOR OUTAGE of NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT12-PO1	P6	**PRIOR OUTAGE of NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT9004-PO1	P6	**PRIOR OUTAGE of NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT05-PO2	P6	**PRIOR OUTAGE of the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT06-PO2	P6	**PRIOR OUTAGE of the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to ELSWRTH7 (652477) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT07-PO2	P6	PRIOR OUTAGE of the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1; 3 phase fault on the NUNDRWD7 (652485) to WICKSVL7 (652493) to PHILIP 7 (652487) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.

Table 6-1 Continued

Fault ID	Planning Event	Fault Descriptions
FLT08-PO2	P6	**PRIOR OUTAGE of the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652266) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT12-PO2	P6	**PRIOR OUTAGE of the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT9004-PO2	P6	**PRIOR OUTAGE of the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT05-PO3	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT06-PO3	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to ELSWRTH7 (652477) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT07-PO3	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to WICKSVL7 (652493) to PHILIP 7 (652487) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT08-PO3	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652266) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT09-PO3	P6	**PRIOR OUTAGE of NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.

Table 6-1 Continued

Fault ID	Planning Event	Fault Descriptions
FLT70-PO3	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT9004-PO3	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT11-PO3	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT05-PO4	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT06-PO4	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to ELSWRTH7 (652477) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT07-PO4	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to WICKSVL7 (652493) to PHILIP 7 (652487) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT08-PO4	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652266) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT09-PO4	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.

Table 6-1 Continued

Fault ID	Planning Event	Fault Descriptions
FLT12-PO4	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT70-PO4	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT9004-PO4	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT05-PO5	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z;** 3 phase fault on the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT06-PO5	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z;** 3 phase fault on the NUNDRWD7 (652485) to ELSWRTH7 (652477) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT07-PO5	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z;** 3 phase fault on the NUNDRWD7 (652485) to WICKSVL7 (652493) to PHILIP 7 (652487) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT08-PO5	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652266) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT09-PO5	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.

Table 6-1 Continued

Fault ID	Planning Event	Fault Descriptions
FLT12-PO4	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT70-PO4	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT9004-PO4	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT05-PO5	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z;** 3 phase fault on the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT06-PO5	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z;** 3 phase fault on the NUNDRWD7 (652485) to ELSWRTH7 (652477) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT07-PO5	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z;** 3 phase fault on the NUNDRWD7 (652485) to WICKSVL7 (652493) to PHILIP 7 (652487) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT08-PO5	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652266) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT09-PO5	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.

Table 6-1 Continued

Fault ID	Planning Event	Fault Descriptions
FLT11-PO5	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z;** 3 phase fault on the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT12-PO5	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z;** 3 phase fault on the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT70-PO5	P6	**PRIOR OUTAGE of the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z;** 3 phase fault on the NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT06-PO6	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to ELSWRTH7 (652477) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT08-PO6	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) 115 kV line CKT 1;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652266) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT11-PO6	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT12-PO6	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT70-PO6	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.

Table 6-1 Continued

Fault ID	Planning Event	Fault Descriptions
FLT9004-PO6	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT05-PO7	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to ELSWRTH7 (652477) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) to RAPIDCY7 (652490) 115 kV line CKT 1, near NUNDRWD7. a. Apply fault at the NUNDRWD7 115 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT08-PO7	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to ELSWRTH7 (652477) 115 kV line CKT 1;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652266) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT11-PO7	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to ELSWRTH7 (652477) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT12-PO7	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to ELSWRTH7 (652477) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT70-PO7	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to ELSWRTH7 (652477) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT9004-PO7	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to ELSWRTH7 (652477) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT08-PO8	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to WICKSVL7 (652493) 115 kV line CKT 1;** 3 phase fault on the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652266) transformer CKT 1, near NUNDRWD4 230 kV. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 cycles and trip the faulted transformer.
FLT11-PO8	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to WICKSVL7 (652493) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.

Table 6-1 Continued

Fault ID	Planning Event	Fault Descriptions
FLT12-PO8	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to WICKSVL7 (652493) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT70-PO8	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to WICKSVL7 (652493) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT9004-PO8	P6	**PRIOR OUTAGE of the NUNDRWD7 (652485) to WICKSVL7 (652493) 115 kV line CKT 1;** 3 phase fault on the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z, near NUNDRWD4. a. Apply fault at the NUNDRWD4 230 kV bus. b. Clear fault after 7 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 7 cycles, then trip the line in (b) and remove fault.
FLT1001-SB	P4	**Stuck Breaker on at NUNDRWD4 (652484) at 230kV bus** a. Apply single-phase fault at NUNDRWD4 (652484) on the 230kV bus. b. After 16 cycles, trip the following elements c. Trip the NUNDRWD4 (652484) to G17-064-TAP (589024) 230 kV line CKT 1. d. Trip the NUNDRWD4 (652484) to DRYCREEK-BE4 (659376) 230 kV line CKT 1. e. Trip the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652266) transformer CKT 1.
FLT1002-SB	P4	**Stuck Breaker on at NUNDRWD4 (652484) at 230kV bus** a. Apply single-phase fault at NUNDRWD4 (652484) on the 230kV bus. b. After 16 cycles, trip the following elements c. Trip the NUNDRWD4 (652484) to NUNDRWD-LXN3 (652884) 230 kV line CKT Z. d. Trip the NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line CKT 1. e. Trip the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1.
FLT1003-SB	P4	**Stuck Breaker on at NUNDRWD7 (652485) at 115kV bus** a. Apply single-phase fault at NUNDRWD7 (652485) on the 230kV bus. b. After 16 cycles, trip the following elements c. Trip the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652267) transformer CKT 1. d. Trip the NUNDRWD7 (652485) to ELSWRTH7 (652477) 115 kV line CKT 1. e. Trip the NUNDRWD7 (652485) to WICKSVL7 (652493) 115 kV line CKT 1.
FLT1004-SB	P4	**Stuck Breaker on at NUNDRWD7 (652485) at 115kV bus** a. Apply single-phase fault at NUNDRWD7 (652485) on the 230kV bus. b. After 16 cycles, trip the following elements c. Trip the NU KV2A 230 kV (652484)/ 115 kV (652485) / 13.8 kV (652266) transformer CKT 1. d. Trip the NUNDRWD7 (652485) to RUSHMORE-RM7 (655763) 115 kV line CKT 1.

6.3 Results

Table 6-2 shows the results of the fault events simulated for each of the four modified cases. The associated stability plots are provided in Appendix D.

Table 6-2: GEN-2017-097 Dynamic Stability Results

Fault ID	19WP			21LL			21SP			28SP		
	Volt Violation	Volt Recovery	Stable	Volt Violation	Volt Recovery	Stable	Volt Violation	Volt Recovery	Stable	Volt Violation	Volt Recovery	Stable
FLT01-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT03-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT05-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT06-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT07-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT08-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT09-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT11-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT12-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT13-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT14-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT15-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT16-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT17-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT18-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT19-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT20-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT21-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT22-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT23-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT24-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT25-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT26-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT27-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT29-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT31-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT32-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT33-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable

Table 6-2 continued

Fault ID	19WP			21LL			21SP			28SP		
	Volt Violation	Volt Recovery	Stable	Volt Violation	Volt Recovery	Stable	Volt Violation	Volt Recovery	Stable	Volt Violation	Volt Recovery	Stable
FLT36-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT37-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT70-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT15-PO1	Fail (1)	Pass	Stable	Fail (1)	Pass	Stable	Fail (1)	Pass	Stable	Fail (1)	Pass	Stable
FLT11-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT70-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT07-PO6	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT09-PO6	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT07-PO7	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT09-PO7	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT05-PO8	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT06-PO8	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT09-PO8	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9001-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9002-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9003-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9004-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9005-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9006-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9007-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9008-3PH	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT05-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT06-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT07-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT08-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT09-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT11-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT12-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9004-PO1	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT05-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT06-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable

Table 6-2 continued

Fault ID	19WP			21LL			21SP			28SP		
	Volt Violation	Volt Recovery	Stable	Volt Violation	Volt Recovery	Stable	Volt Violation	Volt Recovery	Stable	Volt Violation	Volt Recovery	Stable
FLT07-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT08-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT12-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9004-PO2	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT05-PO3	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT06-PO3	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT07-PO3	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT08-PO3	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT09-PO3	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT70-PO3	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9004-PO3	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT11-PO3	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT05-PO4	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT06-PO4	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT07-PO4	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT08-PO4	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT09-PO4	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT12-PO4	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT70-PO4	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9004-PO4	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT05-PO5	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT06-PO5	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT07-PO5	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT08-PO5	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT09-PO5	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT11-PO5	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT12-PO5	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT70-PO5	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT06-PO6	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT08-PO6	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT11-PO6	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable

Table 6-2 continued

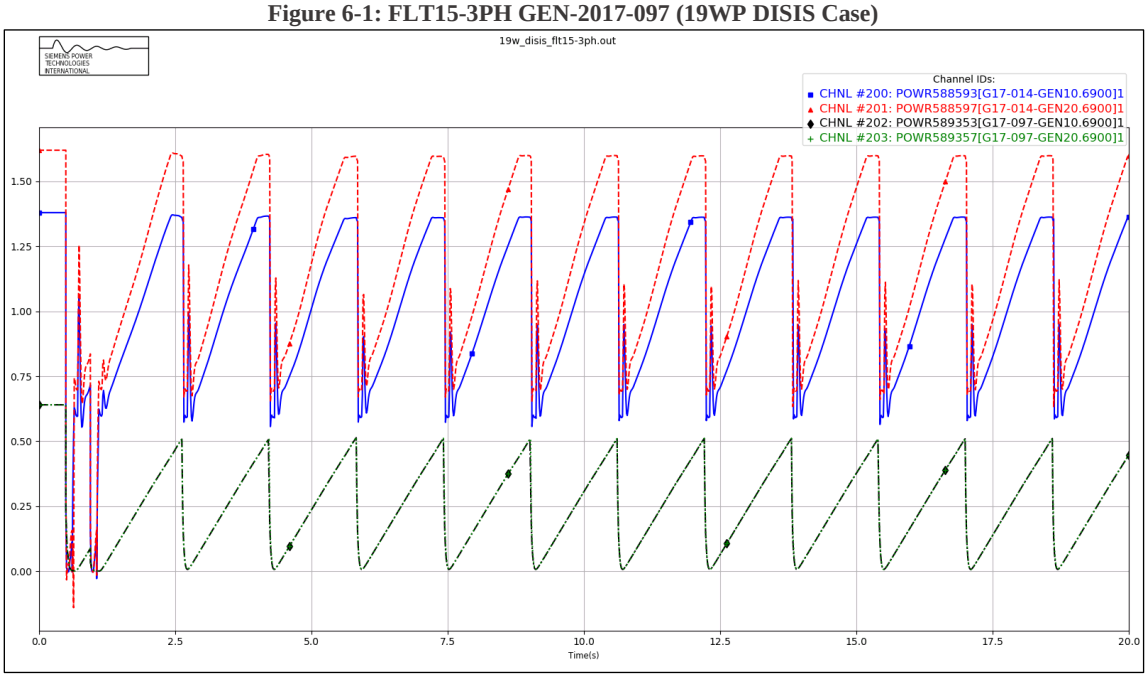
Fault ID	19WP			21LL			21SP			28SP		
	Volt Violation	Volt Recovery	Stable	Volt Violation	Volt Recovery	Stable	Volt Violation	Volt Recovery	Stable	Volt Violation	Volt Recovery	Stable
FLT12-PO6	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT70-PO6	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9004-PO6	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT05-PO7	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT08-PO7	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT11-PO7	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT12-PO7	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT70-PO7	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9004-PO7	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT08-PO8	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT11-PO8	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT12-PO8	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT70-PO8	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT9004-PO8	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT1001-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT1002-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT1003-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable
FLT1004-SB	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable	Pass	Pass	Stable

(1) Final voltage dips below 0.9 pu for several buses in both the DISIS-2017-001 case and MRIS case (base case issue)

The results of the stability analysis showed that the GEN-2017-097 and GEN-2017-014 generators were unstable with FLT15-3PH (loss of Philip Tap to OAHE 230 kV line) for the 19WP scenario in the DISIS-2017-001 base case as shown in Figure 6-1 below. The stability results of the DISIS-2017-001-1 study[4] concluded that insufficient reactive power in the area after losing the 230 kV connection to OHAE caused voltage drops below 0.9 pu that triggered the low voltage ride through (LVRT) setting of both GEN-2017-014 and GEN-2017-097.

[4] DISIS-2017-001-1 Restudy of Stability and Short Circuit Analysis, November 3, 2021

Figure 6-1: FLT15-3PH GEN-2017-097 (19WP DISIS Case)

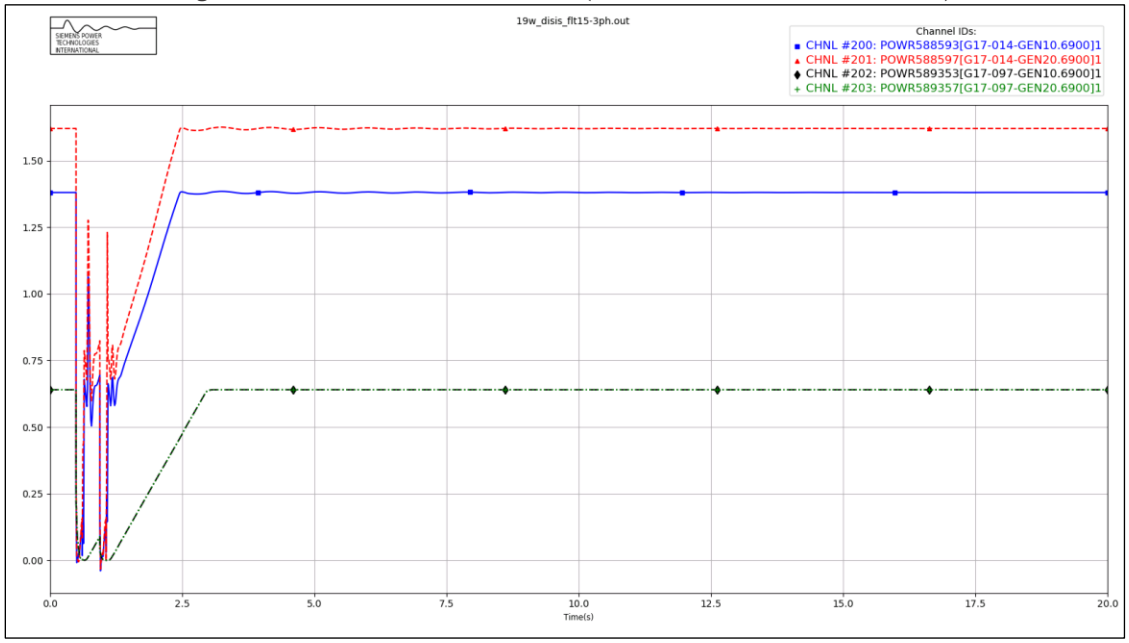


The DISIS-2017-001-1 report recommended two mitigation options to resolve the low voltage issues in the area:

1. Primary Mitigation: Build 2nd circuit from Philip Tap to OHAE
2. Alternate Mitigation: Add 30 MVA Static VAR Compensator (SVC) at G17-014 (bus 588590)

SPP provided the modeling information for the alternate mitigation, 30 MVA SVC at G17-014 bus 588590. With this alternate mitigation in place, the instability of the generators with FLT15-3PH was resolved as shown in Figure 6-2 below.

Figure 6-2: FLT15-3PH GEN-2017-097 (19WP DISIS Case + 30 MVA SVC)



Subsequent to the addition of the 30 MVA SVC, with the prior outage of the NUNDRWD4 (652484) to PHILIP_T-BE4 (659188) 230 kV line followed by FLT15-3PH (defined as FLT15-PO1 in Table 6-1 above), the final voltage criteria was not met for all study scenarios (19WP, 21LL, 21SP, and 28SP) as the final voltage at several buses dipped below 0.9 pu. Figure 6-3 shows the voltages below the criteria in the 19WP case with the GEN-2017-097 modification and 30 MVA SVC in place. Similar voltage criteria violations were observed for the same fault scenario in the original DISIS base case with the 30 MVA SVC in place as shown in Figure 6-4. Therefore, this issue was categorized as an existing issue not attributed to the GEN-2017-097 Modification Request.

Figure 6-3: FLT15-PO1 Final Voltage Criteria Violation (19WP Modification Case + 30 MVA SVC)

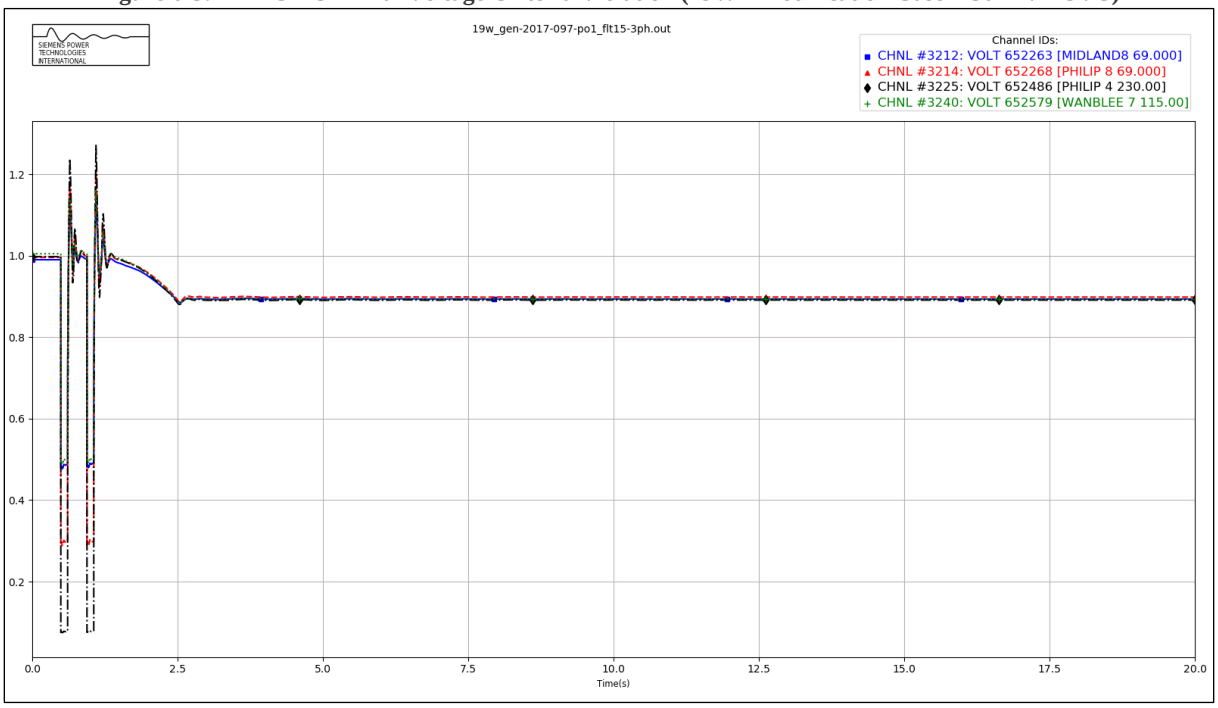
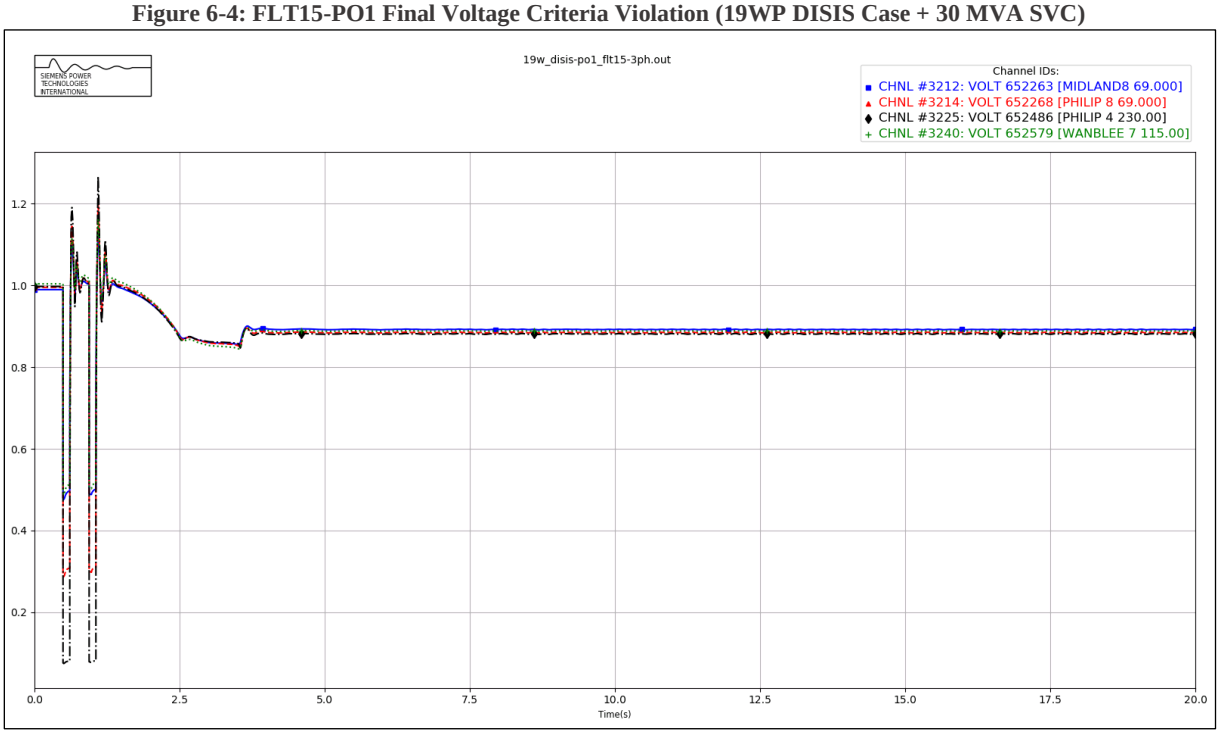


Figure 6-4: FLT15-PO1 Final Voltage Criteria Violation (19WP DISIS Case + 30 MVA SVC)



There were no other damping or voltage recovery violations attributed to the GEN-2017-097 project 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.

7.0 Modified Capacity Exceeds GIA Capacity

Under FERC Order 845, Interconnection Customers are allowed to request Interconnection Service that is lower than the full generating capacity of their planned generating facilities. The Interconnection Customers must install acceptable control and protection devices that prevent the injection above their requested Interconnection Service amount measured at the POI.

As such, Interconnection Customers are allowed to increase the generating capacity of a generating facility without increasing its Interconnection Service amount stated in its GIA. This is allowable as long as they install the proper control and protection devices, and the requested modification is not determined to be a Material Modification.

7.1 Results

The modified generating capacity of GEN-2017-097 (128.52 MW) exceeds the GIA Interconnection Service amount, 128 MW, as listed in Appendix A of the GIA.

The customer must install monitoring and control equipment as needed to ensure that the amount of power injected at the POI does not exceed the Interconnection Service amount listed in its GIA.

8.0 Material Modification Determination

In accordance with Attachment V of SPP's Open Access Transmission Tariff, for modifications other than those specifically permitted by Attachment V, SPP shall evaluate the proposed modifications prior to them being implemented and inform the Interconnection Customer in writing of whether the modifications would constitute a Material Modification. Material Modification shall mean (1) modification to an Interconnection Request in the queue that has a material adverse impact on the cost or timing of any other Interconnection Request with a later Queue priority date; or (2) planned modification to an Existing Generating Facility that is undergoing evaluation for a Generating Facility Modification or Generating Facility Replacement, and has a material adverse impact on the Transmission System with respect to: i) steady-state thermal or voltage limits, ii) dynamic system stability and response, or iii) short-circuit capability limit; compared to the impacts of the Existing Generating Facility prior to the modification or replacement.

8.1 Results

SPP determined the requested modification is not a Material Modification based on the results of this Modification Request Impact Study performed by Aneden. Aneden evaluated the impact of the requested modification on the prior study results. Aneden determined that the requested modification did not negatively impact the prior study dynamic stability and short circuit results, and the modifications to the project were not significant enough to change the previously studied power flow conclusions.

This determination implies that any network upgrades already required by GEN-2017-097 would not be negatively impacted and that no new upgrades are required due to the requested modification, thus not resulting in a material adverse impact on the cost or timing of any other Interconnection Request with a later Queue priority date.

9.0 Conclusions

The Interconnection Customer for GEN-2017-097 requested a Modification Request Impact Study to assess the impact of the inverter and facility change to 34 x Power Electronics FS4200M 3.78 MW for a total capacity of 128.52 MW. The combined generating capacity of GEN-2017-097 (128.52 MW) exceeds its Generator Interconnection Agreement (GIA) Interconnection Service amount, 128 MW, as listed in Appendix A of the GIA. As a result, the customer must ensure that the amount of power injected at the POI does not exceed the Interconnection Service amount listed in its GIA.

In addition, the modification request included changes to the collection system, generator step-up transformers, generation interconnection line, and main substation transformers.

SPP determined that power flow should not be performed based on the POI MW injection increase of 0.62% compared to the DISIS-2017-001 power flow models. However, SPP determined that while the modification used the same inverter manufacturer, Power Electronics, the change in stability model from PE_GEN_700 to REGCAU1 required short circuit and dynamic stability analysis.

All analyses were performed using the PTI PSS/E version 33 software and the results are summarized below.

The results of the charging current compensation analysis performed using the 2019 Winter Peak, 2021 Light Load, 2021 Summer Peak, and 2028 Summer Peak models showed that the GEN-2017-097 project needed 2.2 MVAr of reactor shunts on the 34.5 kV bus of the project substation with the modifications in place, an increase from the 1.29 MVAr found for the existing GEN-2017-097 configuration in the DISIS-2017-001 study[5]. This is necessary to offset the capacitive effect on the transmission network caused by the project's transmission line and collector system during reduced generation conditions. The information gathered from the charging current compensation analysis is provided as information to the Interconnection Customer and Transmission Owner (TO) and/or Transmission Operator. The applicable reactive power requirements will be further reviewed by the Transmission Owner and/or Transmission Operator.

The results from the short circuit analysis with the updated configuration showed that the maximum GEN-2017-097 contribution to three-phase fault currents in the immediate transmission systems at or near the GEN-2017-097 POI was not greater than 0.63 kA for the 21SP and 28SP models. All three-phase fault current levels within 5 buses of the POI with the GEN-2017-097 generators online were below 21 kA for the 21SP and 28SP models.

The dynamic stability analysis was performed using PTI PSS/E version 33.10 software for the four modified study models, 2019 Winter Peak, 2021 Light Load, 2021 Summer Peak, and 2028 Summer Peak. Up to 108 events were simulated, which included three-phase faults, three-phase faults on prior outage cases, and single-line-to-ground stuck breaker faults.

The results of the dynamic stability analysis showed that there were low voltage conditions leading to the instability of the GEN-2017-097 and GEN-2017-014 generators due to the LVRT in the 19WP case with FLT15-3PH (loss of Philip Tap to OAHE 230kV line). This issue was observed in the DISIS-2017-001-1 report and a 30 MVA SVC at G17-014 bus 588590 was identified as mitigation and alleviated the GEN-2017-097 and GEN-2017-014 instability. In addition, low final voltage conditions were observed with the P6 Planning Event FLT15-PO1 causing voltages below 0.9 pu to persist after the fault. This voltage criteria

[5] DISIS-2017-001-1 Restudy of Stability and Short Circuit Analysis, November 3, 2021

violation was observed in the DISIS and modification cases so it was not attributed to the GEN-2017-097 modification.

There were no other damping or voltage recovery violations attributed to the GEN-2017-097 project 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.

The requested modification has been determined by SPP to not be a Material Modification. The requested modification does not have a material adverse impact on the cost or timing of any other Interconnection Request with a later Queue priority date. As the requested modification places the generating capacity of the Interconnection Request at a higher amount than its Interconnection Service, the customer must install monitoring and control equipment as needed to ensure that the amount of power injected at the POI does not exceed the Interconnection Service amount listed in its GIA.

In accordance with FERC Order No. 827, the generating facility will be required to provide dynamic reactive power within the range of 0.95 leading to 0.95 lagging at the high-side of the generator substation.

It is likely that the customer may be required to reduce its generation output to 0 MW in real-time, 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.