GEN-2018-003

MODIFICATION REQUEST IMPACT STUDY

By SPP Generator Interconnection

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REVISION HISTORY

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EXECUTIVE SUMMARY

1898 & Co., a part of Burns & McDonnell, was retained by the Southwest Power Pool (SPP) to perform a Modification Request Impact Study (Study) for GEN-2018-003, an active Generation Interconnection Request (GIR) with a Point of Interconnection (POI) at the North New Boston to Bann 138 kV line in American Electric Power (AEP) control area.

The GEN-2018-003 project interconnects in the American Electric Power (AEP) control area with a capacity of 150 MW. This Study has been requested to evaluate the modification of GEN-2018-003 to change the Point of Interconnection (POI) to a different location on the North New Boston to Bann 138 kV line.

SPP determined that steady-state analysis was not required because the results of the previous DISIS analysis analyzed the maximum injection at the POI for GEN-2018-003. However, SPP determined that the change in the POI location required short circuit and dynamic stability analysis.

The scope of this study included reactive power analysis, short circuit analysis, and dynamic stability analysis.

The detailed configuration is captured in Table 1 below.

Table 1: GEN-2018-003 Modification Request

Facility	Existing Configuration	Proposed Modified Configuration
Point of Interconnection	North New Boston (508070) to Bann (508054) 138 kV line	North New Boston (508070) to Bann (508054) 138 kV line
	NWT-BNT4 (508070) to G18-003-TAP (762431) ○ Length = 12.46 mi ○ R = 0.046038 pu ○ X = 0.014207 pu ○ B = 0.01432 pu	NWT-BNT4 (508070) to G18-003-TAP (762431) ○ Length = 9.69 mi ○ R = 0.031438 pu ○ X = 0.009701 pu ○ B = 0.00977 pu
	G18-003-TAP (762431) to NNBOSTON4 (508069) ○ Length = 1.73 mi ○ R = 0.001973 pu ○ X = 0.006392 pu ○ B = 0.001988 pu	G18-003-TAP (762431) to NNBOSTON4 (508069) ○ Length = 4.5 mi ○ R = 0.016572 pu ○ X = 0.010897 pu ○ B = 0.006529 pu
Configuration/Capacity	55 x Power Electronics FS3075K Inverters 3.38 MVA (Solar) = 150 MW	55 x Power Electronics FS3075K Inverters (Solar) = 150 MW
Generation Interconnection Line	Length = 3.25 miles	Length = 3.25 miles
	R = 0.000000 pu	R = 0.000000 pu
	X = 0.000100 pu	X = 0.000100 pu
	B = 0.000000 pu	B = 0.000000 pu

	Rating MVA = N/A MVA	Rating MVA = N/A MVA
Main Substation Transformer[1]	X = 9.9969% R = 0.2499% Voltage = 138/34.5 kV, Winding MVA = 180.0, Winding MVA Base= 108.00 MVA,	X = 9.9969% R = 0.2499% Voltage = 138/34.5 kV, Winding MVA = 180.0, Winding MVA Base= 108.00 MVA,
Equivalent GSU Transformer[1]	X = 5.6996%, R = 0.7599%, Voltage = 34.5/0.63 kV, Winding MVA = 163 MVA, Rating MVA = 163 MVA	X = 5.6996%, R = 0.7599%, Voltage = 34.5/0.63 kV, Winding MVA = 163 MVA, Rating MVA = 163 MVA
Equivalent Collector Line[2]	R = 0.000000 pu	R = 0.000000 pu
	X = 0.000100 pu	X = 0.000100 pu
	B = 0.000100 pu	B = 0.000100 pu
Generator Dynamic Model[3] & Power Factor	55 x Power Electronics FS3075K Inverters 3.38 MVA (Solar) (REGCAU1)[3] Leading: 0.95 Lagging: 0.95	55 x Power Electronics FS3075K Inverters 3.38 MVA (Solar) (REGCAU1)[3] Leading: 0.95 Lagging: 0.95

1.0) X and R based on Winding MVA, 2) All pu are on 100 MVA Base, equivalent based on average derated MVA base provided by IC, 3) DYR stability model name.

1898 & Co. performed the analyses using the study data provided for the SGF and the DISIS-2021-001 study models:

- 2025 Summer Peak (25SP)
- 2025 Winter Peak (25W)

All analyses were performed using the Siemens PTI PSS/E[1] version 34 software and the results are summarized below.

The results of the reactive power analysis using the 25SP model showed that the GEN-2018-003 project did not need a shunt reactor at the project substation with the modification in place, an increase from 0 MVAr found in the DISIS-2021-001-2 study. There was no identified need to offset the capacitive effect on the transmission network caused by the project's transmission line and collector system during reduced generation conditions since there was no observed MVAr absorption by the collection system with the generator offline. The information gathered from the reactive power analysis is provided as information to the Interconnection Customer and Transmission Owner (TO) and/or Transmission Operator (TOP). The applicable reactive power requirements will be further reviewed by the TO and/or TOP.

The short circuit analysis was performed using the 25SP stability model modified for short circuit analysis. The results from the short circuit analysis compared the 25SP model with the new POI. The results from the short circuit analysis with the updated topology showed that the maximum GEN-2018-003 contribution to three-phase fault currents in the immediate transmission systems at or near the GEN-2018-003 POI was 14.1544 kA. The maximum three-phase fault current level within 5 buses of the POI with the new POI location was 32.5535 kA for the 25SP model. There

[1] Power System Simulator for Engineering

were no buses with a maximum three-phase fault current over 40 kA. The maximum contribution to three-phase fault currents due to the POI change was about 6.96% and 2.26 kA. These buses are highlighted in Appendix B.

The dynamic stability analysis was performed using Siemens PTI PSS/E version 34 software for the two modified study models: 25SP and 25WP. 84 fault events were simulated, which included three-phase faults and single-line-to-ground stuck breaker faults.

The results of the dynamic stability analysis showed several existing base case issues that were found in both the original DISIS-2021-001 models and in the models with the GEN-2018-003 modification included. These issues were not attributed to the GEN-2018-003 modification request and are detailed in Appendix C.

There were no damping or voltage recovery violations attributed to the GEN-2018-003 modification request observed during simulated faults. A few faults showed other generator tripping issues which were also observed in the base cases. 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.

Based on the results of the study, SPP determined that the requested modification is **not 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 or negatively impact the reliability of the Transmission System. There were no additional Interconnection Facilities or Network Upgrades identified by the analyses.

In accordance with FERC Order No. 827, both SGF and EGF 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.

SCOPE OF STUDY

1898 & Co., a part of Burns & McDonnell, was retained by the Southwest Power Pool (SPP) to conduct a Modification Request Impact Study (Study) for GEN-2018-003. 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 Siemens PTI PSS/E version 34 software. The results of each analysis are presented in the following sections.

REACTIVE POWER ANALYSIS

SPP requires that a reactive power analysis be performed on the requested configuration if it is a non-synchronous resource. The reactive power analysis determines the added capacitive effect at the POI caused by the project's collection system and transmission line's capacitance. A shunt reactor size was determined to offset the capacitive effect and maintain zero (0) MVAr injection at the POI while the plant's generators and capacitors were offline.

SHORT CIRCUIT ANALYSIS & STABILITY ANALYSIS

To determine whether stability and short circuit analyses are required, SPP evaluates the difference between the stability models, the stability model parameters and, if needed, the equivalent 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 were determined to have a significant impact on the most recently performed DISIS stability analysis.

STEADY-STATE ANALYSIS

Steady-state analysis is performed if SPP deems it necessary based on the nature of the requested change. SPP determined that steady-state analysis was not required because the results of the previous DISIS analysis analyzed the maximum injection at the POI for GEN-2018-003.

STUDY LIMITATIONS

The assessments and conclusions provided in this report are based on assumptions and information provided to1898 & Co., a part of Burns & McDonnell, by others. While the assumptions and information provided may be appropriate for the purposes of this report, 1898 & Co. does not guarantee that those conditions assumed will occur. In addition, 1898 & Co. 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.

PROJECT AND MODIFICATION REQUEST

The GEN-2018-003 Interconnection Customer requested a modification to its Generation Interconnection Request (GIR) with a Point of Interconnection (POI) at the North New Boston to Bann 138 kV line in the American Electric Power (AEP) control area.

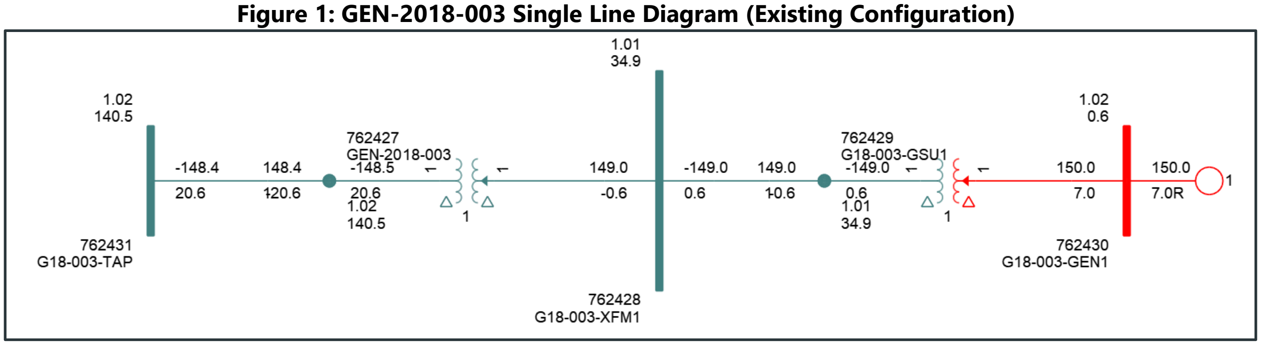
At the time of report posting, GEN-2018-003 is an active Interconnection Request with a queue status of "IA FULLY EXECUTED/ON SCHEDULE." GEN-2018-003 is a solar facility with a maximum summer and winter queue capacity of 150 MW with Network Resource Interconnection Service (NRIS)/Energy Resource Interconnection Service (ERIS).

The GEN-2018-003 project is currently in the DISIS-2018-001 cluster. Figure 2-1 shows the power flow model single line diagram for the existing modeled GEN-2018-003 configuration using the DISIS-2021-001 25SP stability model.

This Study has been requested to evaluate the modification of GEN-2018-003 to change the Point of Interconnection (POI) on the North New Boston to Bann 138 kV line. The existing POI location is 1.78 miles from the North New Boston 138 kV substation towards the Bann 138 kV substation. The new location of the POI will also be on the North New Boston to Bann 138 kV line, with a modified location of 4.5 miles from North New Boston 138 kV substation towards Bann 138 kV substation. All other specifications of the GEN-2018-003 facility, including the collection system, inverter count, impedance values, etc., are to remain the same as the existing facility in provided DISIS-2021-001 25 SP stability model. The injection amount must be limited to 150 MW at the POI as listed in Appendix A of the GIA. As a result, the customer must make sure that the amount of power injected at the POI does not exceed the Interconnection Service amount listed in its GIA.

Figure 1-1 shows the power flow model single line diagram for the GEN-2018-003 facility. The impedance modifications to model the change in POI location from the DISIS-2021-001 models are shown in Table 2-1 and Table 3-1 below.

Figure 1: GEN-2018-003 Single Line Diagram (Existing Configuration)



*based on the DISIS-2021-001 25SP stability models

Table 2: GEN-2018-003 Modification Request

Facility	Existing DISIS Configuration	Modification Configuration
Point of Interconnection	North New Boston (508070) to Bann (508054) 138 kV line	North New Boston (508070) to Bann (508054) 138 kV line
	NWT-BNT4 (508070) to G18-003-TAP (762431) o Length = 12.46 mi o R = 0.046038 pu o X = 0.014207 pu o B = 0.01432 pu	NWT-BNT4 (508070) to G18-003-TAP (762431) o Length = 9.69 mi o R = 0.031438 pu o X = 0.009701 pu o B = 0.00977 pu
	G18-003-TAP (762431) to NNBOSTON4 (508069) o Length = 1.73 mi o R = 0.001973 pu o X = 0.006392 pu o B = 0.001988 pu	G18-003-TAP (762431) to NNBOSTON4 (508069) o Length = 4.5 mi o R = 0.016572 pu o X = 0.010897 pu o B = 0.006529 pu
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	X = 0.000100 pu	X = 0.000100 pu
	B = 0.000000 pu	B = 0.000000 pu
	Rating MVA = N/A MVA	Rating MVA = N/A MVA
Main Substation Transformer[1]	X = 9.9969% R = 0.2499% Voltage = 138/34.5 kV, Winding MVA = 180.0, Winding MVA Base= 108.00 MVA,	X = 9.9969% R = 0.2499% Voltage = 138/34.5 kV, Winding MVA = 180.0, Winding MVA Base= 108.00 MVA,
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1) X and R based on Winding MVA, 2) All pu are on 100 MVA Base, equivalent based on average derated MVA base provided by IC, 3) DYR stability model name.

EXISTING VS MODIFICATION COMPARISON

To determine which analyses are required for the Study, the differences between the existing configuration from the DISIS-2021-001 models and the requested modification were evaluated. 1898 & Co. performed this comparison and the resulting analyses using a set of modified study models developed based on the modification request data and the DISIS-2021-001 study models. The analysis was completed using PSS/E version 34 software.

The methodology and results of the comparisons are described below.

STABILITY MODEL PARAMETER COMPARISON

SPP determined that short circuit and dynamic stability analyses were required because of the POI change within the North New Boston to Bann 138 kV line. This is because the short circuit contribution and stability responses of the existing POI location and the requested modification's POI location may differ due to the impedance changes on the North New Boston to Bann 138 kV line. The generator dynamic model for the modification can be found in Appendix A.

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

EQUIVALENT IMPEDANCE COMPARISON CALCULATION

As the POI location 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.

REACTIVE POWER ANALYSIS

The reactive power analysis was performed for GEN-2018-003 to determine the capacitive charging effects during 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.

METHODOLOGY AND CRITERIA

GEN-2018-003 generator was switched out of service while other system elements remained in-service. A shunt reactor was tested at the project's collection substation 34.5 kV bus to reduce the MVAr injection at the POI to 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).

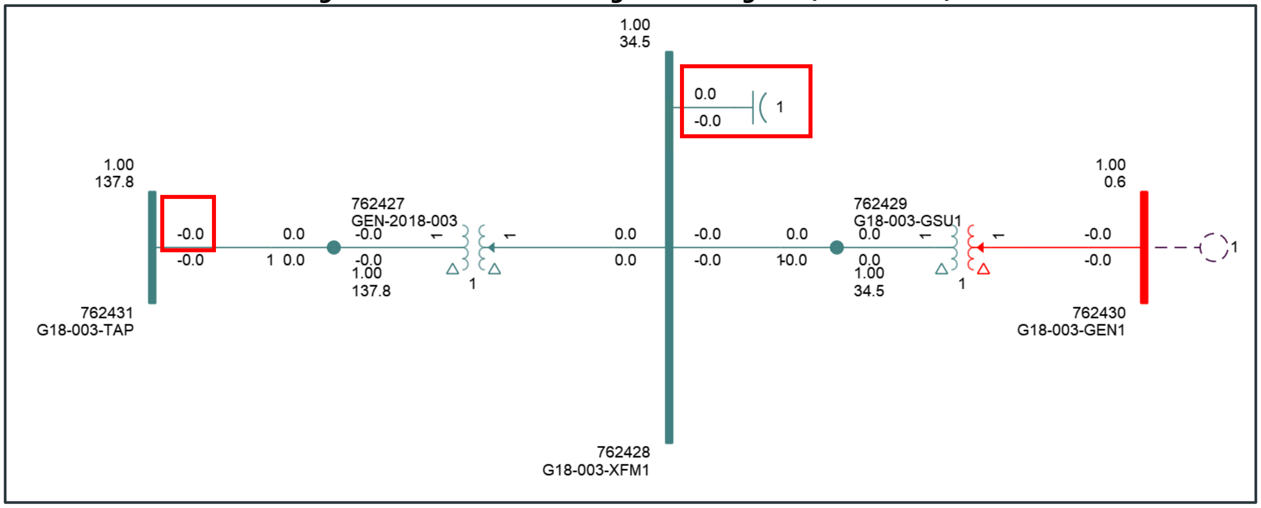
1898 & Co. performed the reactive power analysis using the modification request data based on the 25SP DISIS 2021-001 stability study model.

RESULTS

The results from the analysis showed that the GEN-2018-003 project did not require any MVAr compensation at its collector substation to reduce the MVAr injection at the POI to zero. The MVAr injection at the POI with the GEN-2018-003 unit offline remained at zero. Figure 4-1 illustrates the GEN-2018-003 facility offline with zero MVAr at the POI.

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

Figure 2: GEN-2018-003 Single Line Diagram (Shunt Sizes)



SHORT CIRCUIT ANALYSIS

1898 & CO. performed a short circuit study using the 25SP model for GEN-2018-003 to determine the maximum fault current requiring interruption by protective equipment for each bus in the relevant subsystem. The detailed results of the short circuit analysis are provided in Appendix B.

METHODOLOGY

The short circuit analysis included applying a 3-phase fault on buses up to 5 levels away from the 138 kV POI bus. The PSS/E "Automatic Sequence Fault Calculation (ASCC)" fault analysis module was used to calculate the fault current levels in the transmission system, comparing the fault current levels between the existing POI location versus the new POI location.

1898 & Co. created a short circuit model using the 25SP DISIS-2021-001 stability study model by adjusting the SGF short circuit parameters consistent with the submitted data. The adjusted parameters used in the short circuit analysis are shown in Table 3 below. No other changes were made to the model.

Table 3: Short Circuit Model Parameters*

Parameter	Value by Generator Bus#
	762430 (PV)
Machine MVA Base	170
R (pu)	0.000
X'' (pu)	0.800

*pu values based on Machine MVA Base

RESULTS

The results of the short circuit analysis for the 25SP model are summarized in Table 4 and Table 5. The GEN-2018-003 POI bus (G18-003-TAP 138 kV) fault current magnitudes for the comparison cases are provided in Table 5 showing a fault current of 11.8899 kA with the GEN-2018-003 project existing POI location and 14.1544 kA with the GEN-2018-003 proposed modified POI location. Table 6 shows the maximum fault current magnitudes and fault current increases with the GEN-2018-003 comparison cases.

The maximum fault current calculated within 5 buses of the POI was 19.4 kA for the 25SP model. The maximum GEN-2017-010 contribution to three-phase fault currents was about 32.9% and 1.25 kA.

Table 4: POI Short Circuit Comparison Results

Case	Existing POI (kA)	Proposed Modified POI (kA)	kA Change	%Change
25SP	11.8899	14.1544	2.2645	19.05%

Table 5: 25SP Short Circuit Comparison Results

Voltage (kV)	Max. Current (Existing & Proposed POI Modification) (kA)	Max kA Change	Max %Change
69	20.2902	0.0064	0.032%
115	18.0042	0.0019	0.011%
138	32.5535	2.2645	6.956%
230	N/A	N/A	N/A
345	22.287	0.0195	0.087%
Max	**32.5535**	**2.2645**	**6.956%**

DYNAMIC STABILITY ANALYSIS

1898 & CO. performed a dynamic stability analysis to identify the impact of the modifications to GEN-2018-003. The analysis was performed according to SPP's Disturbance Performance Requirements. The modification details are described in Section 2.0 above and the dynamic modeling data is provided in Appendix A. The existing base case issues and simulation plots can be found in Appendix C.

METHODOLOGY AND CRITERIA

The dynamic stability analysis was performed using models developed with the requested GEN-2018-003 POI change of 1.73 miles from North New Boston 138 kV substation towards Bann 138 kV substation to 4.5 miles from North New Boston 138 kV substation towards Bann 138 kV substation. This stability analysis was performed using Siemens PTI's PSS/E version 34.9.6 software.

The modifications requested for GEN-2018-003 project were used to create modified stability models for this impact study based on the DISIS-2021-001 stability study models:

- 2025 Summer Peak (25SP),
- 2025 Winter Peak (25W)

The dynamic model data for the GEN-2018-003 project is provided in Appendix A. The power flow models and associated dynamic database were initialized (no-fault test) to confirm that there were no errors in the initial conditions of the system and the dynamic data.

The following system adjustments were made to address existing base case issues that are not attributed to the modification request:

- The PSSE dynamic simulation iterations and acceleration factor were adjusted as needed to resolve PSSE dynamic simulation crashes.

During the fault simulations, the active power (PELEC), reactive power (QELEC), and terminal voltage (ETERM) were monitored for GEN-2018-003 and other current and prior queued projects in Group 4[2]. In addition, voltages of five (5) buses away from the POI of the GEN-2018-003 were monitored and plotted.

[2] Based on the DISIS-2021-001 Cluster Groups

FAULT DEFINITIONS

1898 & Co. developed fault events as required to study the modification. The fault events included three-phase faults and single-line-to-ground stuck breaker faults. Single-line-to-ground faults are approximated by applying a fault impedance to bring the faulted bus positive sequence voltage to 0.6 p.u.. 84 faults were simulated for the Study and are listed and described in Table 6 below. These contingencies were applied to the modified 25SP and 25 WP models.

Table 6: Fault Definitions

Fault ID	Planning Event	Fault Description
P1_504029_SFOREMAN-507431_PATTERS4_Ckt1	P1	3 Phase fault on SFOREMAN (504029) 138.0 kV a. Apply fault on SFOREMAN (504029) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from SFOREMAN (504029) 138.0 kV bus to PATTERS4 (507431) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from SFOREMAN (504029) 138.0 kV bus to PATTERS4 (507431) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from SFOREMAN (504029) 138.0 kV bus to PATTERS4 (507431) 138.0 kV bus CKT 1
P1_507431_PATTERS4-507434_SNASHVL4_Ckt1	P1	3 Phase fault on PATTERS4 (507431) 138.0 kV a. Apply fault on PATTERS4 (507431) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Drop load from bus SNASHVL4 (507434) 138.0 kV bus b. 2. Trip branch from PATTERS4 (507431) 138.0 bus to SNASHVL4 (507434) 138.0 bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from PATTERS4 (507431) 138.0 bus to SNASHVL4 (507434) 138.0 bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from PATTERS4 (507431) 138.0 bus to SNASHVL4 (507434) 138.0 bus CKT 1
P1_507431_PATTERS4-765641_G21-036-TAP_Ckt1	P1	3 Phase fault on PATTERS4 (507431) 138.0 kV a. Apply fault on PATTERS4 (507431) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from PATTERS4 (507431) 138.0 kV bus to G21-036-TAP (765641) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from PATTERS4 (507431) 138.0 kV bus to G21-036-TAP (765641) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from PATTERS4 (507431) 138.0 kV bus to G21-036-TAP (765641) 138.0 kV bus CKT 1
P1_507455_TURK-507454_TURK_3Winding	P1	3 Phase fault on TURK (507455) 345.0 kV a. Apply fault on TURK (507455) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Disconnect bus at TURK (507457) to trip transformer at TURK 1 13.800 (507457) 13.8000001907 kV bus
P1_507455_TURK-510911_VALIANT7_Ckt1	P1	3 Phase fault on TURK (507455) 345.0 kV a. Apply fault on TURK (507455) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Trip branch from TURK (507455) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from TURK (507455) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 d. Leave fault on for 6 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from TURK (507455) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1

Fault ID	Planning Event	Fault Description
P1_508050_ANDRSNC4-508064_MUNZCTY4_Ckt1	P1	3 Phase fault on ANDRSNC4 (508050) 138.0 kV a. Apply fault on ANDRSNC4 (508050) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from ANDRSNC4 (508050) 138.0 bus to BRYANML4 (508056) 138.0 bus CKT 1 b. 2. Drop load from bus BRYANML4 (508056) 138.0 kV bus b. 3. Trip branch from BRYANML4 (508056) 138.0 bus to MUNZCTY4 (508064) 138.0 bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from ANDRSNC4 (508050) 138.0 bus to BRYANML4 (508056) 138.0 bus CKT 1 c. 2. Reclose branch from BRYANML4 (508056) 138.0 bus to MUNZCTY4 (508064) 138.0 bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from ANDRSNC4 (508050) 138.0 bus to BRYANML4 (508056) 138.0 bus CKT 1 d. 2. Trip branch from BRYANML4 (508056) 138.0 bus to MUNZCTY4 (508064) 138.0 bus CKT 1
P1_508050_ANDRSNC4-508069_NNBOSTN4_Ckt1	P1	3 Phase fault on ANDRSNC4 (508050) 138.0 kV a. Apply fault on ANDRSNC4 (508050) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from ANDRSNC4 (508050) 138.0 bus to RIFFIN (508104) 138.0 bus CKT 1 b. 2. Drop load from bus RIFFIN (508104) 138.0 kV bus b. 3. Trip branch from RIFFIN (508104) 138.0 bus to NNBOSTN4 (508069) 138.0 bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from ANDRSNC4 (508050) 138.0 bus to RIFFIN (508104) 138.0 bus CKT 1 c. 2. Reclose branch from RIFFIN (508104) 138.0 bus to NNBOSTN4 (508069) 138.0 bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from ANDRSNC4 (508050) 138.0 bus to RIFFIN (508104) 138.0 bus CKT 1 d. 2. Trip branch from RIFFIN (508104) 138.0 bus to NNBOSTN4 (508069) 138.0 bus CKT 1
P1_508053_BANN-508054_BANN_3Winding	P1	3 Phase fault on BANN (508053) 69.0 kV a. Apply fault on BANN (508053) 69.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Disconnect bus at BANN1-1 (508097) to trip transformer at BANN1-1 13.800 (508097) 13.8000001907 kV bus
P1_508054_BANN-508049_NASH_Ckt1	P1	3 Phase fault on BANN (508054) 138.0 kV a. Apply fault on BANN (508054) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from BANN (508054) 138.0 kV bus to NASH (508049) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from BANN (508054) 138.0 kV bus to NASH (508049) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from BANN (508054) 138.0 kV bus to NASH (508049) 138.0 kV bus CKT 1
P1_508054_BANN-508053_BANN_3Winding	P1	3 Phase fault on BANN (508054) 138.0 kV a. Apply fault on BANN (508054) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Disconnect bus at BANN1-1 (508097) to trip transformer at BANN1-1 13.800 (508097) 13.8000001907 kV bus
P1_508054_BANN-508075_REDSPRG4_Ckt1	P1	3 Phase fault on BANN (508054) 138.0 kV a. Apply fault on BANN (508054) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from BANN (508054) 138.0 kV bus to REDSPRG4 (508075) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault:

Fault ID	Planning Event	Fault Description
		c. 1. Reclose branch from BANN (508054) 138.0 kV bus to REDSPRG4 (508075) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from BANN (508054) 138.0 kV bus to REDSPRG4 (508075) 138.0 kV bus CKT 1
P1_508054_BANN-508078_SETEXAR4_Ckt1	P1	3 Phase fault on BANN (508054) 138.0 kV a. Apply fault on BANN (508054) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from BANN (508054) 138.0 kV bus to SETEXAR4 (508078) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from BANN (508054) 138.0 kV bus to SETEXAR4 (508078) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from BANN (508054) 138.0 kV bus to SETEXAR4 (508078) 138.0 kV bus CKT 1
P1_508064_MUNZCTY4-508050_ANDRSNC4_Ckt1	P1	3 Phase fault on MUNZCTY4 (508064) 138.0 kV a. Apply fault on MUNZCTY4 (508064) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from MUNZCTY4 (508064) 138.0 bus to BRYANML4 (508056) 138.0 bus CKT 1 b. 2. Drop load from bus BRYANML4 (508056) 138.0 kV bus b. 3. Trip branch from BRYANML4 (508056) 138.0 bus to ANDRSNC4 (508050) 138.0 bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from MUNZCTY4 (508064) 138.0 bus to BRYANML4 (508056) 138.0 bus CKT 1 c. 2. Reclose branch from BRYANML4 (508056) 138.0 bus to ANDRSNC4 (508050) 138.0 bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from MUNZCTY4 (508064) 138.0 bus to BRYANML4 (508056) 138.0 bus CKT 1 d. 2. Trip branch from BRYANML4 (508056) 138.0 bus to ANDRSNC4 (508050) 138.0 bus CKT 1
P1_508064_MUNZCTY4-508840_WILKES_Ckt1	P1	3 Phase fault on MUNZCTY4 (508064) 138.0 kV a. Apply fault on MUNZCTY4 (508064) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from MUNZCTY4 (508064) 138.0 kV bus to WILKES (508840) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from MUNZCTY4 (508064) 138.0 kV bus to WILKES (508840) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from MUNZCTY4 (508064) 138.0 kV bus to WILKES (508840) 138.0 kV bus CKT 1
P1_508064_MUNZCTY4-509645_DUGLASV2_Ckt1	P1	3 Phase fault on MUNZCTY4 (508064) 138.0 kV a. Apply fault on MUNZCTY4 (508064) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from MUNZCTY4 (508064) 138.0 bus to DUGLASV4 (509666) 138.0 bus CKT 1 b. 2. Trip branch from DUGLASV4 (509666) 138.0 bus to DUGLASV2 (509645) 138.0 bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from MUNZCTY4 (508064) 138.0 bus to DUGLASV4 (509666) 138.0 bus CKT 1 c. 2. Reclose branch from DUGLASV4 (509666) 138.0 bus to DUGLASV2 (509645) 138.0 bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from MUNZCTY4 (508064) 138.0 bus to DUGLASV4 (509666) 138.0 bus CKT 1 d. 2. Trip branch from DUGLASV4 (509666) 138.0 bus to DUGLASV2 (509645) 138.0 bus CKT 1

Fault ID	Planning Event	Fault Description
P1_508067_NEWBOST2-508063_LSORDTP2_Ckt1	P1	3 Phase fault on NEWBOST2 (508067) 69.0 kV a. Apply fault on NEWBOST2 (508067) 69.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from NEWBOST2 (508067) 69.0 bus to REDRVR-2 (508074) 69.0 bus CKT 1 b. 2. Drop load from bus REDRVR-2 (508074) 69.0 kV bus b. 3. Trip branch from REDRVR-2 (508074) 69.0 bus to HOOKS (508057) 69.0 bus CKT 1 b. 4. Drop load from bus HOOKS (508057) 69.0 kV bus b. 5. Drop load from bus HOOKS (508057) 69.0 kV bus b. 6. Trip branch from HOOKS (508057) 69.0 bus to LSORDTP2 (508063) 69.0 bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NEWBOST2 (508067) 69.0 bus to REDRVR-2 (508074) 69.0 bus CKT 1 c. 2. Reclose branch from REDRVR-2 (508074) 69.0 bus to HOOKS (508057) 69.0 bus CKT 1 c. 3. Reclose branch from HOOKS (508057) 69.0 bus to LSORDTP2 (508063) 69.0 bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NEWBOST2 (508067) 69.0 bus to REDRVR-2 (508074) 69.0 bus CKT 1 d. 2. Trip branch from REDRVR-2 (508074) 69.0 bus to HOOKS (508057) 69.0 bus CKT 1 d. 3. Trip branch from HOOKS (508057) 69.0 bus to LSORDTP2 (508063) 69.0 bus CKT 1
P1_508067_NEWBOST2-508069_NNBOSTN4_3Winding	P1	3 Phase fault on NEWBOST2 (508067) 69.0 kV a. Apply fault on NEWBOST2 (508067) 69.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from NEWBOST2 (508067) 69.0 bus to NNBOSTN2 (508068) 69.0 bus CKT 1 b. 2. Disconnect bus at NNBT2-1 (508099) to trip transformer at NNBT2-1 13.200 (508099) 13.1999998093 kV bus b. 3. Drop load from bus NEWBOST2 (508067) 69.0 kV bus b. 4. Drop load from bus NEWBOST2 (508067) 69.0 kV bus c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NEWBOST2 (508067) 69.0 bus to NNBOSTN2 (508068) 69.0 bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NEWBOST2 (508067) 69.0 bus to NNBOSTN2 (508068) 69.0 bus CKT 1
P1_508067_NEWBOST2-508287_BUFORDR2_Ckt1	P1	3 Phase fault on NEWBOST2 (508067) 69.0 kV a. Apply fault on NEWBOST2 (508067) 69.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from NEWBOST2 (508067) 69.0 bus to DEKALB (508289) 69.0 bus CKT 1 b. 2. Drop load from bus DEKALB (508289) 69.0 kV bus b. 3. Drop load from bus DEKALB (508289) 69.0 kV bus b. 4. Trip branch from DEKALB (508289) 69.0 bus to BUFORDR2 (508287) 69.0 bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NEWBOST2 (508067) 69.0 bus to DEKALB (508289) 69.0 bus CKT 1 c. 2. Reclose branch from DEKALB (508289) 69.0 bus to BUFORDR2 (508287) 69.0 bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NEWBOST2 (508067) 69.0 bus to DEKALB (508289) 69.0 bus CKT 1 d. 2. Trip branch from DEKALB (508289) 69.0 bus to BUFORDR2 (508287) 69.0 bus CKT 1
P1_508069_NNBOSTN4-504029_SFOREMAN_Ckt1	P1	3 Phase fault on NNBOSTN4 (508069) 138.0 kV a. Apply fault on NNBOSTN4 (508069) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from NNBOSTN4 (508069) 138.0 kV bus to SFOREMAN (504029)

Fault ID	Planning Event	Fault Description
		138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NNBOSTN4 (508069) 138.0 kV bus to SFOREMAN (504029) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NNBOSTN4 (508069) 138.0 kV bus to SFOREMAN (504029) 138.0 kV bus CKT 1
P1_508069_NNBOSTN4-508050_ANDRSNC4_Ckt1	P1	3 Phase fault on NNBOSTN4 (508069) 138.0 kV a. Apply fault on NNBOSTN4 (508069) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from NNBOSTN4 (508069) 138.0 bus to RIFFIN (508104) 138.0 bus CKT 1 b. 2. Drop load from bus RIFFIN (508104) 138.0 kV bus b. 3. Trip branch from RIFFIN (508104) 138.0 bus to ANDRSNC4 (508050) 138.0 bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NNBOSTN4 (508069) 138.0 bus to RIFFIN (508104) 138.0 bus CKT 1 c. 2. Reclose branch from RIFFIN (508104) 138.0 bus to ANDRSNC4 (508050) 138.0 bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NNBOSTN4 (508069) 138.0 bus to RIFFIN (508104) 138.0 bus CKT 1 d. 2. Trip branch from RIFFIN (508104) 138.0 bus to ANDRSNC4 (508050) 138.0 bus CKT 1
P1_508069_NNBOSTN4-508067_NEWBOST2_3Winding	P1	3 Phase fault on NNBOSTN4 (508069) 138.0 kV a. Apply fault on NNBOSTN4 (508069) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Disconnect bus at NNBT2-1 (508099) to trip transformer at NNBT2-1 13.200 (508099) 13.1999998093 kV bus b. 2. Trip branch from NNBOSTN2 (508068) 69.0 bus to NEWBOST2 (508067) 69.0 bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NNBOSTN2 (508068) 69.0 bus to NEWBOST2 (508067) 69.0 bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NNBOSTN2 (508068) 69.0 bus to NEWBOST2 (508067) 69.0 bus CKT 1
P1_508070_NWT-BNT4-508054_BANN_Ckt1	P1	3 Phase fault on NWT-BNT4 (508070) 138.0 kV a. Apply fault on NWT-BNT4 (508070) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from NWT-BNT4 (508070) 138.0 kV bus to BANN (508054) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NWT-BNT4 (508070) 138.0 kV bus to BANN (508054) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NWT-BNT4 (508070) 138.0 kV bus to BANN (508054) 138.0 kV bus CKT 1
P1_508070_NWT-BNT4-508071_NWTXARK4_Ckt1	P1	3 Phase fault on NWT-BNT4 (508070) 138.0 kV a. Apply fault on NWT-BNT4 (508070) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from NWT-BNT4 (508070) 138.0 kV bus to NWTXARK4 (508071) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NWT-BNT4 (508070) 138.0 kV bus to NWTXARK4 (508071) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NWT-BNT4 (508070) 138.0 kV bus to NWTXARK4 (508071) 138.0 kV bus CKT 1
P1_508071_NWTXARK4-507431_PATTERS4_Ckt1	P1	3 Phase fault on NWTXARK4 (508071) 138.0 kV a. Apply fault on NWTXARK4 (508071) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements:

Fault ID	Planning Event	Fault Description
		b. 1. Trip branch from NWTXARK4 (508071) 138.0 kV bus to PATTERS4 (507431) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NWTXARK4 (508071) 138.0 kV bus to PATTERS4 (507431) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NWTXARK4 (508071) 138.0 kV bus to PATTERS4 (507431) 138.0 kV bus CKT 1
P1_508071_NWTXARK4-508049_NASH_Ckt1	P1	3 Phase fault on NWTXARK4 (508071) 138.0 kV a. Apply fault on NWTXARK4 (508071) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from NWTXARK4 (508071) 138.0 kV bus to NASH (508049) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NWTXARK4 (508071) 138.0 kV bus to NASH (508049) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NWTXARK4 (508071) 138.0 kV bus to NASH (508049) 138.0 kV bus CKT 1
P1_508071_NWTXARK4-508072_NWTXARK7_3Winding	P1	3 Phase fault on NWTXARK4 (508071) 138.0 kV a. Apply fault on NWTXARK4 (508071) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Disconnect bus at NWTEX2-1 (508101) to trip transformer at NWTEX2-1 13.800 (508101) 13.8000001907 kV bus
P1_508071_NWTXARK4-508080_SUGARHL4_Ckt1	P1	3 Phase fault on NWTXARK4 (508071) 138.0 kV a. Apply fault on NWTXARK4 (508071) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from NWTXARK4 (508071) 138.0 kV bus to SUGARHL4 (508080) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NWTXARK4 (508071) 138.0 kV bus to SUGARHL4 (508080) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NWTXARK4 (508071) 138.0 kV bus to SUGARHL4 (508080) 138.0 kV bus CKT 1
P1_508072_NWTXARK7-507455_TURK_Ckt1	P1	3 Phase fault on NWTXARK7 (508072) 345.0 kV a. Apply fault on NWTXARK7 (508072) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Trip branch from NWTXARK7 (508072) 345.0 kV bus to TURK (507455) 345.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NWTXARK7 (508072) 345.0 kV bus to TURK (507455) 345.0 kV bus CKT 1 d. Leave fault on for 6 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NWTXARK7 (508072) 345.0 kV bus to TURK (507455) 345.0 kV bus CKT 1
P1_508072_NWTXARK7-508071_NWTXARK4_3Winding	P1	3 Phase fault on NWTXARK7 (508072) 345.0 kV a. Apply fault on NWTXARK7 (508072) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Disconnect bus at NWTEX2-1 (508101) to trip transformer at NWTEX2-1 13.800 (508101) 13.8000001907 kV bus
P1_508072_NWTXARK7-508298_LYDIA_Ckt1	P1	3 Phase fault on NWTXARK7 (508072) 345.0 kV a. Apply fault on NWTXARK7 (508072) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Trip branch from NWTXARK7 (508072) 345.0 kV bus to LYDIA (508298) 345.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NWTXARK7 (508072) 345.0 kV bus to LYDIA (508298) 345.0 kV bus CKT 1 d. Leave fault on for 6 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NWTXARK7 (508072) 345.0 kV bus to LYDIA (508298) 345.0 kV bus CKT 1

Fault ID	Planning Event	Fault Description
P1_508072_NWTXARK7-508359_WELSH_Ckt1	P1	3 Phase fault on NWTXARK7 (508072) 345.0 kV a. Apply fault on NWTXARK7 (508072) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Trip branch from NWTXARK7 (508072) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NWTXARK7 (508072) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 d. Leave fault on for 6 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NWTXARK7 (508072) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1
P1_508072_NWTXARK7-508841_WILKES_Ckt1	P1	3 Phase fault on NWTXARK7 (508072) 345.0 kV a. Apply fault on NWTXARK7 (508072) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Trip branch from NWTXARK7 (508072) 345.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NWTXARK7 (508072) 345.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1 d. Leave fault on for 6 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NWTXARK7 (508072) 345.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1
P1_508072_NWTXARK7-764520_G20-020-TAP_Ckt1	P1	3 Phase fault on NWTXARK7 (508072) 345.0 kV a. Apply fault on NWTXARK7 (508072) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Trip branch from NWTXARK7 (508072) 345.0 kV bus to G20-020-TAP (764520) 345.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from NWTXARK7 (508072) 345.0 kV bus to G20-020-TAP (764520) 345.0 kV bus CKT 1 d. Leave fault on for 6 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from NWTXARK7 (508072) 345.0 kV bus to G20-020-TAP (764520) 345.0 kV bus CKT 1
P1_508075_REDSPRG4-508059_IPC_Ckt1	P1	3 Phase fault on REDSPRG4 (508075) 138.0 kV a. Apply fault on REDSPRG4 (508075) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from REDSPRG4 (508075) 138.0 bus to IPC-DOM4 (508060) 138.0 bus CKT 1 b. 2. Drop load from bus IPC-DOM4 (508060) 138.0 kV bus b. 3. Trip branch from IPC-DOM4 (508060) 138.0 bus to IPC (508059) 138.0 bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from REDSPRG4 (508075) 138.0 bus to IPC-DOM4 (508060) 138.0 bus CKT 1 c. 2. Reclose branch from IPC-DOM4 (508060) 138.0 bus to IPC (508059) 138.0 bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from REDSPRG4 (508075) 138.0 bus to IPC-DOM4 (508060) 138.0 bus CKT 1 d. 2. Trip branch from IPC-DOM4 (508060) 138.0 bus to IPC (508059) 138.0 bus CKT 1
P1_508078_SETEXAR4-508077_SETEXAR2_3Winding	P1	3 Phase fault on SETEXAR4 (508078) 138.0 kV a. Apply fault on SETEXAR4 (508078) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Disconnect bus at SETEX1-1 (508102) to trip transformer at SETEX1-1 13.200 (508102) 13.1999998093 kV bus
P1_508078_SETEXAR4-508105_MANDEVILTP4_Ckt1	P1	3 Phase fault on SETEXAR4 (508078) 138.0 kV a. Apply fault on SETEXAR4 (508078) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from SETEXAR4 (508078) 138.0 kV bus to MANDEVILTP4 (508105) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from SETEXAR4 (508078) 138.0 kV bus to MANDEVILTP4

Fault ID	Planning Event	Fault Description
		(508105) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from SETEXAR4 (508078) 138.0 kV bus to MANDEVILTP4 (508105) 138.0 kV bus CKT 1
P1_508080_SUGARHL4-507454_TURK_Ckt1	P1	3 Phase fault on SUGARHL4 (508080) 138.0 kV a. Apply fault on SUGARHL4 (508080) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from SUGARHL4 (508080) 138.0 kV bus to TURK (507454) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from SUGARHL4 (508080) 138.0 kV bus to TURK (507454) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from SUGARHL4 (508080) 138.0 kV bus to TURK (507454) 138.0 kV bus CKT 1
P1_508080_SUGARHL4-508079_SUGARHL2_3Winding	P1	3 Phase fault on SUGARHL4 (508080) 138.0 kV a. Apply fault on SUGARHL4 (508080) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Disconnect bus at SHILL1-1 (508103) to trip transformer at SHILL1-1 12.470 (508103) 12.470000267 kV bus
P1_508298_LYDIA-508359_WELSH_Ckt1	P1	3 Phase fault on LYDIA (508298) 345.0 kV a. Apply fault on LYDIA (508298) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Trip branch from LYDIA (508298) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from LYDIA (508298) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 d. Leave fault on for 6 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from LYDIA (508298) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1
P1_508298_LYDIA-510911_VALIANT7_Ckt1	P1	3 Phase fault on LYDIA (508298) 345.0 kV a. Apply fault on LYDIA (508298) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Trip branch from LYDIA (508298) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from LYDIA (508298) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 d. Leave fault on for 6 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from LYDIA (508298) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1
P1_508359_WELSH-508832_DIANA_Ckt1	P1	3 Phase fault on WELSH (508359) 345.0 kV a. Apply fault on WELSH (508359) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Trip branch from WELSH (508359) 345.0 kV bus to DIANA (508832) 345.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from WELSH (508359) 345.0 kV bus to DIANA (508832) 345.0 kV bus CKT 1 d. Leave fault on for 6 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from WELSH (508359) 345.0 kV bus to DIANA (508832) 345.0 kV bus CKT 1
P1_508359_WELSH-508832_DIANA_Ckt2	P1	3 Phase fault on WELSH (508359) 345.0 kV a. Apply fault on WELSH (508359) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Trip branch from WELSH (508359) 345.0 kV bus to DIANA (508832) 345.0 kV bus CKT 2 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from WELSH (508359) 345.0 kV bus to DIANA (508832) 345.0 kV bus CKT 2 d. Leave fault on for 6 cycles, then trip the faulted elements in (b) and clear the fault:

Fault ID	Planning Event	Fault Description
		d. 1. Trip branch from WELSH (508359) 345.0 kV bus to DIANA (508832) 345.0 kV bus CKT 2
P1_508841_WILKES-508359_WELSH_Ckt1	P1	3 Phase fault on WILKES (508841) 345.0 kV a. Apply fault on WILKES (508841) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Trip branch from WILKES (508841) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from WILKES (508841) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 d. Leave fault on for 6 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from WILKES (508841) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1
P1_508841_WILKES-508809_LONGWD_Ckt1	P1	3 Phase fault on WILKES (508841) 345.0 kV a. Apply fault on WILKES (508841) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Trip branch from WILKES (508841) 345.0 kV bus to LONGWD (508809) 345.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from WILKES (508841) 345.0 kV bus to LONGWD (508809) 345.0 kV bus CKT 1 d. Leave fault on for 6 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from WILKES (508841) 345.0 kV bus to LONGWD (508809) 345.0 kV bus CKT 1
P1_762431_G18-003-TAP-508069_NNBOSTN4_Ckt1	P1	3 Phase fault on G18-003-TAP (762431) 138.0 kV a. Apply fault on G18-003-TAP (762431) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from G18-003-TAP (762431) 138.0 kV bus to NNBOSTN4 (508069) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from G18-003-TAP (762431) 138.0 kV bus to NNBOSTN4 (508069) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from G18-003-TAP (762431) 138.0 kV bus to NNBOSTN4 (508069) 138.0 kV bus CKT 1
P1_762431_G18-003-TAP-508070_NWT-BNT4_Ckt1	P1	3 Phase fault on G18-003-TAP (762431) 138.0 kV a. Apply fault on G18-003-TAP (762431) 138.0 kV b. Clear fault after 7 cycles and trip the faulted elements: b. 1. Trip branch from G18-003-TAP (762431) 138.0 kV bus to NWT-BNT4 (508070) 138.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from G18-003-TAP (762431) 138.0 kV bus to NWT-BNT4 (508070) 138.0 kV bus CKT 1 d. Leave fault on for 7 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from G18-003-TAP (762431) 138.0 kV bus to NWT-BNT4 (508070) 138.0 kV bus CKT 1
P1_764520_G20-020-TAP-510911_VALIANT7_Ckt1	P1	3 Phase fault on G20-020-TAP (764520) 345.0 kV a. Apply fault on G20-020-TAP (764520) 345.0 kV b. Clear fault after 6 cycles and trip the faulted elements: b. 1. Trip branch from G20-020-TAP (764520) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 c. Wait 20 cycles, and then reclose the faulted elements in (b) back into the fault: c. 1. Reclose branch from G20-020-TAP (764520) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 d. Leave fault on for 6 cycles, then trip the faulted elements in (b) and clear the fault: d. 1. Trip branch from G20-020-TAP (764520) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1
P4_HOL-507431_PATTERS4	P4	Single Phase Fault with Stuck Breaker on PATTERS4 (507431) 138.0 kV bus a. Apply single-phase fault on PATTERS4 (507431) 138.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip branch from PATTERS4 (507431) 138.0 kV bus to G21-036-TAP (765641) 138.0 kV bus CKT 1 b. 2. Drop load from bus SNASHVL4 (507434) 138.0 kV bus

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		b. 3. Trip branch from PATTERS4 (507431) 138.0 kV bus to SNASHVL4 (507434) 138.0 kV bus CKT 1
P4_HOL-508053_BANN	P4	Single Phase Fault with Stuck Breaker on BANN (508053) 69.0 kV bus a. Apply single-phase fault on BANN (508053) 69.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Disconnect BANN2-1 (508096) 14.5 kV bus to trip transformer at BANN2-1 14.500 (508096) 14.5 kV bus b. 2. Disconnect BANN1-1 (508097) 13.8000001907 kV bus to trip transformer at BANN1-1 13.800 (508097) 13.8000001907 kV bus
P4_HOL-508054_BANN	P4	Single Phase Fault with Stuck Breaker on BANN (508054) 138.0 kV bus a. Apply single-phase fault on BANN (508054) 138.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip branch from BANN (508054) 138.0 kV bus to NWT-BNT4 (508070) 138.0 kV bus CKT 1 b. 2. Trip branch from BANN (508054) 138.0 kV bus to REDSPRG4 (508075) 138.0 kV bus CKT 1
P4_HOL-508069_NNBOSTN4	P4	Single Phase Fault with Stuck Breaker on NNBOSTN4 (508069) 138.0 kV bus a. Apply single-phase fault on NNBOSTN4 (508069) 138.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip branch from NNBOSTN4 (508069) 138.0 kV bus to G18-003-TAP (762431) 138.0 kV bus CKT 1 b. 2. Trip branch from NNBOSTN4 (508069) 138.0 kV bus to RIFFIN (508104) 138.0 kV bus CKT 1 b. 3. Drop load from bus RIFFIN (508104) 138.0 kV bus b. 4. Trip branch from RIFFIN (508104) 138.0 kV bus to ANDRSNC4 (508050) 138.0 kV bus CKT 1
P4_HOL-508070_NWT-BNT4	P4	Single Phase Fault with Stuck Breaker on NWT-BNT4 (508070) 138.0 kV bus a. Apply single-phase fault on NWT-BNT4 (508070) 138.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip branch from NWT-BNT4 (508070) 138.0 kV bus to NWTXARK4 (508071) 138.0 kV bus CKT 1 b. 2. Trip branch from NWT-BNT4 (508070) 138.0 kV bus to BANN (508054) 138.0 kV bus CKT 1
P4_HOL-508071_NWTXARK4	P4	Single Phase Fault with Stuck Breaker on NWTXARK4 (508071) 138.0 kV bus a. Apply single-phase fault on NWTXARK4 (508071) 138.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip branch from NWTXARK4 (508071) 138.0 kV bus to NWT-BNT4 (508070) 138.0 kV bus CKT 1 b. 2. Disconnect NWTEX1-1 (508100) 13.8000001907 kV bus to trip transformer at NWTEX1-1 13.800 (508100) 13.8000001907 kV bus
P4_HOL-508072_NWTXARK7	P4	Single Phase Fault with Stuck Breaker on NWTXARK7 (508072) 345.0 kV bus a. Apply single-phase fault on NWTXARK7 (508072) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip branch from NWTXARK7 (508072) 345.0 kV bus to TURK (507455) 345.0 kV bus CKT 1 b. 2. Trip branch from NWTXARK7 (508072) 345.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1
P4_HOL-508078_SETEXAR4	P4	Single Phase Fault with Stuck Breaker on SETEXAR4 (508078) 138.0 kV bus a. Apply single-phase fault on SETEXAR4 (508078) 138.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Disconnect SETEX1-1 (508102) 13.1999998093 kV bus to trip transformer at SETEX1-1 13.200 (508102) 13.1999998093 kV bus b. 2. Trip branch from SETEXAR4 (508078) 138.0 kV bus to MANDEVILTP4 (508105) 138.0 kV bus CKT 1
P4_HOL-508080_SUGARHL4	P4	Single Phase Fault with Stuck Breaker on SUGARHL4 (508080) 138.0 kV bus a. Apply single-phase fault on SUGARHL4 (508080) 138.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip branch from SUGARHL4 (508080) 138.0 kV bus to TURK (507454) 138.0 kV bus CKT 1 b. 2. Disconnect SHILL1-1 (508103) 12.470000267 kV bus to trip transformer at SHILL1-1 12.470 (508103) 12.470000267 kV bus
P4_HOL-508298_LYDIA	P4	Single Phase Fault with Stuck Breaker on LYDIA (508298) 345.0 kV bus a. Apply single-phase fault on LYDIA (508298) 345.0 kV bus

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		b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip branch from LYDIA (508298) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 b. 2. Trip branch from LYDIA (508298) 345.0 kV bus to NWTXARK7 (508072) 345.0 kV bus CKT 1
P4_HOL-508359_WELSH	P4	Single Phase Fault with Stuck Breaker on WELSH (508359) 345.0 kV bus a. Apply single-phase fault on WELSH (508359) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip branch from WELSH (508359) 345.0 kV bus to DIANA (508832) 345.0 kV bus CKT 1 b. 2. Trip branch from WELSH (508359) 345.0 kV bus to DIANA (508832) 345.0 kV bus CKT 2
P4_HOL-508841_WILKES	P4	Single Phase Fault with Stuck Breaker on WILKES (508841) 345.0 kV bus a. Apply single-phase fault on WILKES (508841) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip branch from WILKES (508841) 345.0 kV bus to LONGWD (508809) 345.0 kV bus CKT 1 b. 2. Trip branch from WILKES (508841) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1
P4_HOL-764520_G20-020-TAP	P4	Single Phase Fault with Stuck Breaker on G20-020-TAP (764520) 345.0 kV bus a. Apply single-phase fault on G20-020-TAP (764520) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip branch from G20-020-TAP (764520) 345.0 kV bus to NWTXARK7 (508072) 345.0 kV bus CKT 1 b. 2. Trip branch from G20-020-TAP (764520) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1
P4_TO-508359_WELSH-ConID-AEPW-3	P4	Single Phase Fault with Stuck Breaker on WELSH (508359) 345.0 kV bus a.Apply single-phase fault on WELSH (508359) 345.0 kV bus b.Run for 5.0 cycles and trip the following elements: b. 1. Open branch from WELSH (508359) 345.0 kV bus to NWTXARK7 (508072) 345.0 kV bus CKT 1 b.Run for 10.0 cycles and trip the following elements: b. 2. Open branch from WELSH (508359) 345.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1 b. 3. Clear fault from WELSH (508359)
P4_TO-508809_LONGWD-ConID-AEPW-8	P4	Single Phase Fault with Stuck Breaker on LONGWD (508809) 345.0 kV bus a.Apply single-phase fault on LONGWD (508809) 345.0 kV bus b.Run for 5.0 cycles and trip the following elements: b. 1. Open branch from LONGWD (508809) 345.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1 b.Run for 10.0 cycles and trip the following elements: b. 2. Open branch from LONGWD (508809) 345.0 kV bus to SW (507760) 345.0 kV bus CKT 1 b. 3. Clear fault from LONGWD (508809)
P4_TO-508841_WILKES-ConID-AEPW-5	P4	Single Phase Fault with Stuck Breaker on WILKES (508841) 345.0 kV bus a.Apply single-phase fault on WILKES (508841) 345.0 kV bus b.Run for 5.0 cycles and trip the following elements: b. 1. Open branch from WILKES (508841) 345.0 kV bus to LONGWD (508809) 345.0 kV bus CKT 1 b.Run for 10.0 cycles and trip the following elements: b. 2. Open branch from WILKES (508841) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 b. 3. Clear fault from WILKES (508841)
P4_CON-507455_TURK-ConID-135666	P4	Single Phase Fault with Stuck Breaker on TURK (507455) 345.0 kV bus a. Apply single-phase fault on TURK (507455) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from TURK (507455) 345.0 kV bus to NWTXARK7 (508072) 345.0 kV bus CKT 1 b. 2. Trip transformer from TURK (507454) 138.0 kV bus to TURK (507455) 345.0 kV bus to TURK (507457) 13.8000001907 kV bus CKT 1
P4_CON-508072_NWTXARK7-ConID-135660	P4	Single Phase Fault with Stuck Breaker on NWTXARK7 (508072) 345.0 kV bus a. Apply single-phase fault on NWTXARK7 (508072) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements:

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		b. 1. Trip line from TURK (507455) 345.0 kV bus to NWTXARK7 (508072) 345.0 kV bus CKT 1 b. 2. Trip transformer from NWTXARK4 (508071) 138.0 kV bus to NWTXARK7 (508072) 345.0 kV bus to NWTEX1-1 (508100) 13.8000001907 kV bus CKT 1
P4_CON-508072_NWTXARK7-ConID-135663	P4	Single Phase Fault with Stuck Breaker on NWTXARK7 (508072) 345.0 kV bus a. Apply single-phase fault on NWTXARK7 (508072) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from NWTXARK7 (508072) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 b. 2. Trip transformer from NWTXARK4 (508071) 138.0 kV bus to NWTXARK7 (508072) 345.0 kV bus to NWTEX2-1 (508101) 13.8000001907 kV bus CKT 2
P4_CON-508072_NWTXARK7-ConID-135664	P4	Single Phase Fault with Stuck Breaker on NWTXARK7 (508072) 345.0 kV bus a. Apply single-phase fault on NWTXARK7 (508072) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from NWTXARK7 (508072) 345.0 kV bus to G20-020-TAP (764520) 345.0 kV bus CKT 1 b. 2. Trip line from TURK (507455) 345.0 kV bus to NWTXARK7 (508072) 345.0 kV bus CKT 1
P4_CON-508072_NWTXARK7-ConID-135665	P4	Single Phase Fault with Stuck Breaker on NWTXARK7 (508072) 345.0 kV bus a. Apply single-phase fault on NWTXARK7 (508072) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from NWTXARK7 (508072) 345.0 kV bus to G20-020-TAP (764520) 345.0 kV bus CKT 1 b. 2. Trip line from NWTXARK7 (508072) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1
P4_CON-508298_LYDIA-ConID-135653	P4	Single Phase Fault with Stuck Breaker on LYDIA (508298) 345.0 kV bus a. Apply single-phase fault on LYDIA (508298) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from LYDIA (508298) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 b. 2. Trip line from LYDIA (508298) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 b. 3. Trip line from NWTXARK7 (508072) 345.0 kV bus to LYDIA (508298) 345.0 kV bus CKT 1
P4_CON-508298_LYDIA-ConID-135655	P4	Single Phase Fault with Stuck Breaker on LYDIA (508298) 345.0 kV bus a. Apply single-phase fault on LYDIA (508298) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from LYDIA (508298) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 b. 2. Trip line from LYDIA (508298) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 b. 3. Trip line from NWTXARK7 (508072) 345.0 kV bus to LYDIA (508298) 345.0 kV bus CKT 1 b. 4. Disconnect WELSH3-1 (509406) 18.0 kV bus
P4_CON-508298_LYDIA-ConID-135661	P4	Single Phase Fault with Stuck Breaker on LYDIA (508298) 345.0 kV bus a. Apply single-phase fault on LYDIA (508298) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from LYDIA (508298) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 b. 2. Trip line from LYDIA (508298) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 b. 3. Trip line from NWTXARK7 (508072) 345.0 kV bus to LYDIA (508298) 345.0 kV bus CKT 1 b. 4. Trip transformer from NWTXARK4 (508071) 138.0 kV bus to NWTXARK7 (508072) 345.0 kV bus to NWTEX2-1 (508101) 13.8000001907 kV bus CKT 2
P4_CON-508298_LYDIA-ConID-135662	P4	Single Phase Fault with Stuck Breaker on LYDIA (508298) 345.0 kV bus a. Apply single-phase fault on LYDIA (508298) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from LYDIA (508298) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 b. 2. Trip line from LYDIA (508298) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 b. 3. Trip line from NWTXARK7 (508072) 345.0 kV bus to LYDIA (508298) 345.0 kV

Fault ID	Planning Event	Fault Description
		bus CKT 1 b. 4. Trip transformer from NWTXARK4 (508071) 138.0 kV bus to NWTXARK7 (508072) 345.0 kV bus to NWTEX1-1 (508100) 13.8000001907 kV bus CKT 1
P4_CON-508298_LYDIA-ConID-135671	P4	Single Phase Fault with Stuck Breaker on LYDIA (508298) 345.0 kV bus a. Apply single-phase fault on LYDIA (508298) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from LYDIA (508298) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 b. 2. Trip line from LYDIA (508298) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 b. 3. Trip line from NWTXARK7 (508072) 345.0 kV bus to LYDIA (508298) 345.0 kV bus CKT 1 b. 4. Trip line from VALIANT7 (510911) 345.0 kV bus to HUGO (521157) 345.0 kV bus CKT 1
P4_CON-508298_LYDIA-ConID-135672	P4	Single Phase Fault with Stuck Breaker on LYDIA (508298) 345.0 kV bus a. Apply single-phase fault on LYDIA (508298) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from PITTSB-7 (510907) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 b. 2. Trip line from LYDIA (508298) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 b. 3. Trip line from LYDIA (508298) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 b. 4. Trip line from NWTXARK7 (508072) 345.0 kV bus to LYDIA (508298) 345.0 kV bus CKT 1
P4_CON-508359_WELSH-ConID-135650	P4	Single Phase Fault with Stuck Breaker on WELSH (508359) 345.0 kV bus a. Apply single-phase fault on WELSH (508359) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from NWTXARK7 (508072) 345.0 kV bus to WELSH (508359) 345.0 kV bus CKT 1 b. 2. Trip line from WELSH (508359) 345.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1
P4_CON-508809_LONGWD-ConID-135636	P4	Single Phase Fault with Stuck Breaker on LONGWD (508809) 345.0 kV bus a. Apply single-phase fault on LONGWD (508809) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from SW (507760) 345.0 kV bus to LONGWD (508809) 345.0 kV bus CKT 1 b. 2. Trip line from LONGWD (508809) 345.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1
P4_CON-508809_LONGWD-ConID-135637	P4	Single Phase Fault with Stuck Breaker on LONGWD (508809) 345.0 kV bus a. Apply single-phase fault on LONGWD (508809) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from LONGWD (508809) 345.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1 b. 2. Trip transformer from LONGWD (508808) 138.0 kV bus to LONGWD (508809) 345.0 kV bus to LONGW1-1 (508819) 13.1999998093 kV bus CKT 1
P4_CON-508841_WILKES-ConID-135646	P4	Single Phase Fault with Stuck Breaker on WILKES (508841) 345.0 kV bus a. Apply single-phase fault on WILKES (508841) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from LONGWD (508809) 345.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1 b. 2. Trip transformer from WILKES-1 (508826) 13.1999998093 kV bus to WILKES (508840) 138.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1
P4_CON-508841_WILKES-ConID-135647	P4	Single Phase Fault with Stuck Breaker on WILKES (508841) 345.0 kV bus a. Apply single-phase fault on WILKES (508841) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from WELSH (508359) 345.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1 b. 2. Disconnect WILKE3-1 (509409) 22.0 kV bus
P4_CON-508841_WILKES-ConID-135648	P4	Single Phase Fault with Stuck Breaker on WILKES (508841) 345.0 kV bus a. Apply single-phase fault on WILKES (508841) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from LONGWD (508809) 345.0 kV bus to WILKES (508841) 345.0 kV

Fault ID	Planning Event	Fault Description
		bus CKT 1 b. 2. Trip line from WELSH (508359) 345.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1
P4_CON-508841_WILKES-ConID-135649	P4	Single Phase Fault with Stuck Breaker on WILKES (508841) 345.0 kV bus a. Apply single-phase fault on WILKES (508841) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip transformer from WILKES-1 (508826) 13.1999998093 kV bus to WILKES (508840) 138.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1 b. 2. Disconnect WILKE3-1 (509409) 22.0 kV bus
P4_CON-508841_WILKES-ConID-135651	P4	Single Phase Fault with Stuck Breaker on WILKES (508841) 345.0 kV bus a. Apply single-phase fault on WILKES (508841) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from WELSH (508359) 345.0 kV bus to WILKES (508841) 345.0 kV bus CKT 1 b. 2. Disconnect WELSH1-1 (509404) 18.0 kV bus
P4_CON-510911_VALIANT7-ConID-135668	P4	Single Phase Fault with Stuck Breaker on VALIANT7 (510911) 345.0 kV bus a. Apply single-phase fault on VALIANT7 (510911) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from G20-020-TAP (764520) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 b. 2. Trip transformer from VALIANT7 (510911) 345.0 kV bus to VALIANT4 (510918) 138.0 kV bus to VALN3-1 (510939) 13.8000001907 kV bus CKT 1
P4_CON-510911_VALIANT7-ConID-135670	P4	Single Phase Fault with Stuck Breaker on VALIANT7 (510911) 345.0 kV bus a. Apply single-phase fault on VALIANT7 (510911) 345.0 kV bus b. Clear fault after 16 cycles and trip the faulted elements: b. 1. Trip line from G20-020-TAP (764520) 345.0 kV bus to VALIANT7 (510911) 345.0 kV bus CKT 1 b. 2. Trip line from VALIANT7 (510911) 345.0 kV bus to HUGO (521157) 345.0 kV bus CKT 1

RESULTS

Table 7 shows the relevant results of the fault events simulated for each of the modified models. Existing DISIS base case issues are documented separately in Appendix C. The associated stability plots are also provided in Appendix C.

Table 7: GEN-2018-003 Dynamic Stability Results

Fault ID	25SP			25WP		
	Voltage Violation	Voltage Recovery	Stable	Voltage Violation	Voltage Recovery	Stable
P1_504029_SFOREMAN-507431_PATTERS4_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_507431_PATTERS4-507434_SNASHVL4_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_507431_PATTERS4-765641_G21-036-TAP_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_507455_TURK-507454_TURK_3Winding	Pass	Pass	Stable	Pass	Pass	Stable
P1_507455_TURK-510911_VALIANT7_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508050_ANDRSNC4-508064_MUNZCTY4_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508050_ANDRSNC4-508069_NNBOSTN4_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508053_BANN-508054_BANN_3Winding	Pass	Pass	Stable	Pass	Pass	Stable
P1_508054_BANN-508049_NASH_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable

Fault ID	25SP			25WP		
	Voltage Violation	Voltage Recovery	Stable	Voltage Violation	Voltage Recovery	Stable
P1_508054_BANN-508053_BANN_3Winding	Pass	Pass	Stable	Pass	Pass	Stable
P1_508054_BANN-508075_REDSPRG4_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508054_BANN-508078_SETEXAR4_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508064_MUNZCTY4-508050_ANDRSNC4_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508064_MUNZCTY4-508840_WILKES_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508064_MUNZCTY4-509645_DUGLASV2_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508067_NEWBOST2-508063_LSORDTP2_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508067_NEWBOST2-508069_NNBOSTN4_3Winding	Pass	Pass	Stable	Pass	Pass	Stable
P1_508067_NEWBOST2-508287_BUFORDR2_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508069_NNBOSTN4-504029_SFOREMAN_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508069_NNBOSTN4-508050_ANDRSNC4_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508069_NNBOSTN4-508067_NEWBOST2_3Winding	Pass	Pass	Stable	Pass	Pass	Stable
P1_508070_NWT-BNT4-508054_BANN_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508070_NWT-BNT4-508071_NWTXARK4_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508071_NWTXARK4-507431_PATTERS4_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508071_NWTXARK4-508049_NASH_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508071_NWTXARK4-508072_NWTXARK7_3Winding	Pass	Pass	Stable	Pass	Pass	Stable
P1_508071_NWTXARK4-508080_SUGARHL4_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508072_NWTXARK7-507455_TURK_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508072_NWTXARK7-508071_NWTXARK4_3Winding	Pass	Pass	Stable	Pass	Pass	Stable
P1_508072_NWTXARK7-508298_LYDIA_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508072_NWTXARK7-508359_WELSH_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508072_NWTXARK7-508841_WILKES_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508072_NWTXARK7-764520_G20-020-TAP_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508075_REDSPRG4-508059_IPC_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508078_SETEXAR4-508077_SETEXAR2_3Winding	Pass	Pass	Stable	Pass	Pass	Stable
P1_508078_SETEXAR4-508105_MANDEVILTP4_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508080_SUGARHL4-507454_TURK_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508080_SUGARHL4-508079_SUGARHL2_3Winding	Pass	Pass	Stable	Pass	Pass	Stable
P1_508298_LYDIA-508359_WELSH_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508298_LYDIA-510911_VALIANT7_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508359_WELSH-508832_DIANA_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508359_WELSH-508832_DIANA_Ckt2	Pass	Pass	Stable	Pass	Pass	Stable
P1_508841_WILKES-508359_WELSH_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_508841_WILKES-508809_LONGWD_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_762431_G18-003-TAP-508069_NNBOSTN4_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_762431_G18-003-TAP-508070_NWT-BNT4_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable
P1_764520_G20-020-TAP-510911_VALIANT7_Ckt1	Pass	Pass	Stable	Pass	Pass	Stable

Fault ID	25SP			25WP		
	Voltage Violation	Voltage Recovery	Stable	Voltage Violation	Voltage Recovery	Stable
P4_HOL-507431_PATTERS4	Pass	Pass	Stable	Pass	Pass	Stable
P4_HOL-508053_BANN	Pass	Pass	Stable	Pass	Pass	Stable
P4_HOL-508054_BANN	Pass	Pass	Stable	Pass	Pass	Stable
P4_HOL-508069_NNBOSTN4	Pass	Pass	Stable	Pass	Pass	Stable
P4_HOL-508070_NWT-BNT4	Pass	Pass	Stable	Pass	Pass	Stable
P4_HOL-508071_NWTXARK4	Pass	Pass	Stable	Pass	Pass	Stable
P4_HOL-508072_NWTXARK7	Pass	Pass	Stable	Pass	Pass	Stable
P4_HOL-508078_SETEXAR4	Pass	Pass	Stable	Pass	Pass	Stable
P4_HOL-508080_SUGARHL4	Pass	Pass	Stable	Pass	Pass	Stable
P4_HOL-508298_LYDIA	Pass	Pass	Stable	Pass	Pass	Stable
P4_HOL-508359_WELSH	Pass	Pass	Stable	Pass	Pass	Stable
P4_HOL-508841_WILKES	Pass	Pass	Stable	Pass	Pass	Stable
P4_HOL-764520_G20-020-TAP	Pass	Pass	Stable	Pass	Pass	Stable
P4_TO-508359_WELSH-ConID-AEPW-3	Pass	Pass	Stable	Pass	Pass	Stable
P4_TO-508809_LONGWD-ConID-AEPW-8	Pass	Pass	Stable	Pass	Pass	Stable
P4_TO-508841_WILKES-ConID-AEPW-5	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-507455_TURK-ConID-135666	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508072_NWTXARK7-ConID-135660	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508072_NWTXARK7-ConID-135663	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508072_NWTXARK7-ConID-135664	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508072_NWTXARK7-ConID-135665	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508298_LYDIA-ConID-135653	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508298_LYDIA-ConID-135655	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508298_LYDIA-ConID-135661	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508298_LYDIA-ConID-135662	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508298_LYDIA-ConID-135671	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508298_LYDIA-ConID-135672	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508359_WELSH-ConID-135650	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508809_LONGWD-ConID-135636	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508809_LONGWD-ConID-135637	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508841_WILKES-ConID-135646	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508841_WILKES-ConID-135647	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508841_WILKES-ConID-135648	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508841_WILKES-ConID-135649	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-508841_WILKES-ConID-135651	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-510911_VALIANT7-ConID-135668	Pass	Pass	Stable	Pass	Pass	Stable
P4_CON-510911_VALIANT7-ConID-135670	Pass	Pass	Stable	Pass	Pass	Stable

There were no damping or voltage recovery violations attributed to the GEN-2018-003 modification request observed during the simulated faults. A few faults showed generator tripping issues which were also observed in the base cases. Plots for these can be seen in Appendix C. The list of tripped generators are listed in Appendix D. 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.

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 making them 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.

RESULTS

SPP determined the requested modification is not a Material Modification based on the results of this Modification Request Impact Study. 1898 & Co. evaluated the impact of the requested modification on the prior study results. 1898 & Co. 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 steady-state conclusions.

This determination implies that any network upgrades already required by GEN-2018-003 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.