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GEN-2015-066 Modification Study

Prepared for

Southwest Power Pool, Inc

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Revision History

Date	Rev.	Description
06/06/2025	0	Initial draft
07/16/2025	1	Sensitivity results are added
07/23/2025	2	Final report

Contents

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Executive Summary

Siemens PTI conducted this Modification Study for Southwest Power Pool, Inc. (SPP) to evaluate the impact of GEN-2015-066 Modification Request (Modification Request). GEN-2015-066 is an active wind generation project with POI tapping at Sooner - Cleveland 345kV line in the Oklahoma Gas & Electric Company (OG&E) control area. For such turbine modifications, SPP requires the interconnection customer to demonstrate that the changes will not have a material adverse impact on the transmission system.

GEN-2015-066 was evaluated in the DISIS-2015-002 Impact Study requesting Energy Resource Interconnection Service (ERIS) of 248.4 MW with the project modeled using 108 GE 2.3 MW WTGs. NextEra proposes to construct the GEN-2015-066 project using 78 GE 2.82 MW WTGs (55 units on substation A side and 23 units on substation B side).

Due to a potential change of main power transformer (MPT) of substation B side, GEN-2015-066 Modification Request was also evaluated in a sensitivity scenario using a 115 MVA MPT instead of 85 MVA MPT on substation B side.

1.1 WTGs Change

GEN-2015-066 was previously evaluated in the DISIS-2015-002 Impact Study for Energy Resource Interconnection Service (ERIS), which included 108 GE 2.3 MW WTGs with a total nameplate rating of 248.4 MW. NextEra now proposes to construct the GEN-2015-066 project using 78 GE 2.82 MW WTGs (55 units on Sub A side and 23 units on Sub B side), resulting in a total nameplate rating of 219.96 MW with a maximum injection of 213.4 MW at the POI. The Modification Request results in a decrease in total active power at the turbine terminals by 28.44 MW, and an increase in both total reactive power injection and absorption capabilities at the turbine terminals by 33.22 MVAR.

Since the Modification Request does not include a technology type change, steady state thermal and voltage analysis is not required.

1.2 Other GEN-2015-066 Facility Changes

NextEra provided updated modeling data for the turbine step-up transformers, 34.5 kV collector system, main power transformer, and generator tie line.

1.3 Reactive Power Analysis

For the modification study, the results of the reactive power analysis showed that approximately 20.9 MVAR of inductive compensation at GEN-2015-066 345 kV substation will be needed to reduce the POI MVAR to zero after the Modification Request.

1.4 Short Circuit Analysis

The results of the short circuit analysis showed that after the Modification Request the maximum fault contribution from GEN-2015-066 to the immediate transmission systems at or near the GEN-2015-066 POI under three-phase (3PH) fault is not greater than 0.4041 kA. This short circuit current contribution from the GEN-2015-066 does not overstress any existing circuit breakers.

1.5 Dynamic Stability Analysis

Since the Modification Request includes dynamic model change, dynamic stability analysis was performed to evaluate the impact of the Modification Request on the interconnected system. A total of 48 local disturbances were simulated in the dynamic stability analysis for 2025 summer peak (25SP) and 2025 winter peak (25WP) scenarios.

1.5.1 25SP Scenario

Based on the 25SP dynamic stability analysis, no new damping, generation tripping or voltage recovery violations were identified after the Modification Request. Results also show that the outputs of new WTGs are stable and meet the Low Voltage Ride Through (LVRT) requirements.

1.5.2 25WP Scenario

Based on the 25WP dynamic stability analysis, no new damping, generation tripping or voltage recovery violations were identified after the Modification Request. Results also show that the outputs of new WTGs are stable and meet the LVRT requirements.

1.6 Sensitivity Analysis

A sensitivity analysis was performed to demonstrate that GEN-2015-066 Modification Request will not have a material adverse impact on the transmission system with larger MPT on substation B side.

1.6.1 Sensitivity Reactive Power Analysis

For the sensitivity analysis, the results of the reactive power analysis showed that approximately 21.4 MVAR of inductive compensation at GEN-2015-066 345 kV substation will be needed to reduce the POI MVAR to zero after the Modification Request.

1.6.2 Sensitivity Short Circuit Analysis

For the sensitivity analysis, the maximum fault contribution from GEN-2015-066 to the immediate transmission systems at or near the GEN-2015-066 POI under three-phase (3PH) fault is not greater than 0.4075 kA. This short circuit current contribution from the GEN-2015-066 does not overstress any existing circuit breakers.

1.6.3 Sensitivity Dynamic Stability Analysis

Sensitivity dynamic stability analysis was performed to evaluate the impact of the Modification Request on the interconnected system with larger MPT on substation B side. A total of 48 local disturbances were simulated in the dynamic stability analysis for 2025 sensitivity summer peak (25SP) and 2025 sensitivity winter peak (25WP) scenarios.

1.6.3.1 25SP Sensitivity Scenario

Based on the 25SP sensitivity dynamic stability analysis, no new damping, generation tripping or voltage recovery violations were identified for the sensitivity case. Results also show that the outputs of new WTGs are stable and meet the LVRT requirements.

1.6.3.2 25WP Sensitivity Scenario

Based on the 25WP sensitivity dynamic stability analysis, no new damping, generation tripping or voltage recovery violations were identified for the sensitivity case. Results also show that the outputs of new WTGs are stable and meet the LVRT requirements.

1.7 Conclusions

Based on the reactive power analysis, approximately 20.9 MVAR of inductive compensation at GEN-2015-066 345 kV substation will be needed to reduce the POI MVAR to zero after the Modification Request.

The short circuit current contribution from GEN-2015-066 Modification Request does not overstress any existing circuit breakers.

No new damping, generation tripping or voltage recovery violations were identified in the Modification Request in 25SP and 25WP dynamic stability analysis. Results also show that the outputs of new WTGs are stable and meet the LVRT requirements.

The analyses summarized in this report show that the change from 108 GE 2.3 MW WTGs to 78 GE 2.82 MW WTGs is not a material modification to the GEN-2015-066 interconnection request.

Based on the sensitivity reactive power analysis, approximately 21.4 MVAR of inductive compensation at GEN-2015-066 345 kV substation will be needed to reduce the POI MVAR to zero after the Modification Request with larger MPT on substation B side.

The short circuit current contribution from GEN-2015-066 sensitivity analysis does not overstress any existing circuit breakers.

No new damping, generation tripping or voltage recovery violations were identified in the Modification Request with larger MPT on substation B side in 25SP and 25WP sensitivity dynamic stability analysis. Results also show that the outputs of new WTGs are stable and meet the LVRT requirements.

The sensitivity analyses summarized in this report show that the change from 108 GE 2.3 MW WTGs to 78 GE 2.82 MW WTGs with larger MPT on substation B side is not a material modification to the GEN-2015-066 interconnection request.

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Section

1

Project and Modification Request

1.1 Introduction

GEN-2015-066 (Willow Creek Wind) Interconnection Customer (NextEra) has requested a modification (the Modification Request) to its Interconnection Request (IR) with a Point of Interconnection (POI) tapping at Sooner - Cleveland 345kV line in the Oklahoma Gas & Electric Company (OG&E) control area.

At the time of report posting, GEN-2015-066 is an active Interconnection Request with a queue status of "IA FULLY EXECUTED/ON SCHEDULE". GEN-2015-066 is a wind generation project with a maximum summer and winter queue capacity of 248.4 MW at the POI. It was studied in the DISIS-2015-002 cluster. Figure 1-1 shows the power flow model single line diagram for the original GEN-2015-066 configuration using the DISIS-2021-001 stability models. The original GEN-2015-066 information is listed in Table 1-1

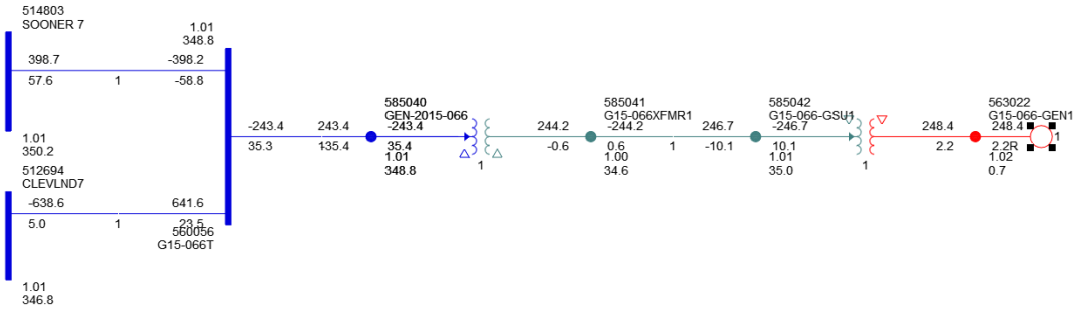

Figure 1-1. GEN-2015-066 Single Line Diagram (Original Configuration)

Table 1-1. GEN-2015-066 Original Configuration

Request	POI	Original Generator Configuration	GIA Capacity
GEN-2015-066	Sooner - Cleveland 345kV line	108 units x GE 2.3 MW WTGs	248.4 MW

NextEra is proposing to construct the GEN-2015-066 project using 78 GE 2.82 MW WTGs instead of 108 GE 2.3 MW WTGs. The Modification Request results in a decrease in total active power at the turbine terminals by 28.44 MW, and an increase in both total reactive power injection and absorption capabilities at the turbine terminals by 33.22 MVAR. Figure 1-2 shows the power flow model single line diagram for the modified GEN-2015-066 configuration.

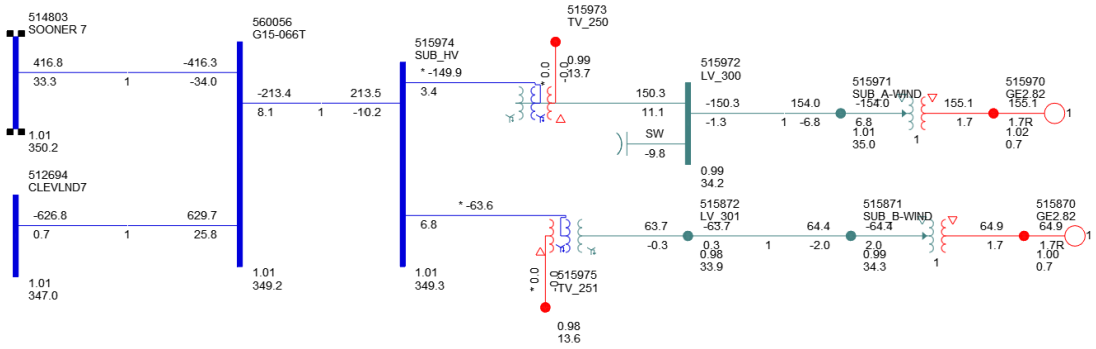

Figure 1-2. GEN-2015-066 Single Line Diagram (Modified Configuration)

1.2 Data Comparison

Steady state model data and stability model for original GEN-2015-066 are listed in Appendix A.1 and Appendix A.3.

Steady state model data and stability model for modified GEN-2015-066 are listed in Appendix A.2 and Appendix A.4.

The original and modified configuration of GEN-2015-066 are summarized in Table 1-2.

Table 1-2. Comparison between Original and Modified Configuration

Equipment	Original Configuration (108 x GE 2.3 MW turbines)	Modified Configuration (78 x GE 2.82 MW turbines)
Turbines	108 GE 2.3 MW turbines Gross Output: 248.4 MW Total MVA: 257.6 MVA	78 GE 2.82 MW turbines **SUB-A Side: 55 units** Gross Output: 155.1 MW Total MVA: 173.09 MVA **SUB-B Side: 23 units** Gross Output: 64.86 MW Total MVA: 74.55 MVA
Reactive power capability	0.96 lag / 0.96 lead (2.3 MW / 2.385 MVA) Qmax = 0.63 MVAr, Qmin = - 0.63 MVAr per WTG Gross Output: +68.23 / -68.23 MVAr	**SUB-A Side: 55 units** 0.9 lag / 0.9 lead (2.82 MW / 3.147 MVA) Qmax = 1.396 MVAr, Qmin = -1.396 MVAr per WTG Gross Output: +76.754 / -76.754 MVAr **SUB-B Side: 23 units** 0.87 lag / 0.87 lead (2.82 MW / 3.24 MVA) Qmax = 1.598 MVAr, Qmin = -1.598 MVAr per WTG Gross Output: +36.754 / -36.754 MVAr

Equipment	Original Configuration (108 x GE 2.3 MW turbines)	Modified Configuration (78 x GE 2.82 MW turbines)
GSU transformers	34.5 kV Delta / 0.69 kV YG Z1 = 5.8 % on 276.48 MVA base; X/R = 7.1 Z0 = 5.8 % on 276.48 MVA base; X/R = 7.1 NLTC: ±2.5%, 5 steps	**SUB-A Side: 55 units** 34.5 kV Delta / 0.69 kV YG Z1 = 5.75% on 154 MVA, X/R = 7.5 Z0 = 5.75% on 154 MVA, X/R = 7.5 NLTC: ±2.5%, 5 steps **SUB-B Side: 23 units** Z1 = 5.75% on 64.4 MVA, X/R = 7.5 Z0 = 5.75% on 64.4 MVA, X/R = 7.5 NLTC: ±2.5%, 5 steps
Collector System	R1 = 0.004130 pu X1 = 0.00608 pu B = 0.1291 pu R0 = 0.004130 pu X0 = 0.00608 pu	**SUB-A Side: 55 units** R = 0.015848 pu X = 0.033073 pu B = 0.15619 pu R0 = 0.225 pu X0 = 0.121 pu 1x10 MVAr shunt capacitor **SUB-B Side: 23 units** R1: 0.015182 pu X1: 0.025672 pu B: 0.02795 pu R0: 0.171 pu X0: 0.0884 pu
Main Power Transformer	220/280 MVA 345 kV YG / 34.5 kV YG Z1 = 10 % on 170 MVA base; X/R = 42 Taps: ±2.5%, 5 steps	**SUB-A side:** 135/180/225 MVA 345 kV YG / 34.5 kV YG / 13.8 kV Delta Z12= 8.5% X/R = 40 on 135 MVA Z13= 12% X/R = 40 on 135 MVA Z23= 4% X/R = 40 on 135 MVA Z12_0= 8.5% X/R = 40 on 135 MVA Z13_0= 12% X/R = 40 on 135 MVA Z23_0= 4% X/R = 40 on 135 MVA Taps: ±12%, 33 steps **SUB-B side:** 51/68/85 MVA 345 kV YG / 34.5 kV YG / 13.8 kV Delta Z12= 7.9% X/R = 40 on 51 MVA Z13= 12% X/R = 40 on 51 MVA Z23= 4% X/R = 40 on 51 MVA Z12_0= 7.9% X/R = 40 on 51 MVA Z13_0= 12% X/R = 40 on 51 MVA Z23_0= 4% X/R = 40 on 51 MVA Taps: ±12%, 33 steps

Equipment	Original Configuration (108 x GE 2.3 MW turbines)	Modified Configuration (78 x GE 2.82 MW turbines)
Gen Tie Line	R1 = 0.000010 pu X1 = 0.00009 pu B = 0.001170 pu R0 = 0.000010 pu X0 = 0.00009 pu	R1 = 0.000165 pu X1 = 0.001453 pu B = 0.02697 pu R0 = 0.000165 pu X0 = 0.001453 pu

Section

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Reactive Power Analysis

The reactive power analysis was performed for GEN-2015-066 Modification Request 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.

2.1 Methodology and Criteria

The generators and capacitors of GEN-2015-066 modified configuration were switched out of service while other system elements remained in-service. A shunt reactor was tested at the GEN-2015-066 345 kV substation to set 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).

Reactive power analysis was performed with stability study model from 2025 summer peak (25SP) scenario.

2.2 Reactive Power Analysis Results

The results from the analysis showed that GEN-2015-066 project with modified configuration needed approximately 20.9 MVAR of inductive compensation at its 345 kV substation to reduce the POI MVAR to zero as shown in Figure 2-1. The final shunt reactor requirements or equivalent support for GEN-2015-066 with modified configuration are listed in Table 2-1.

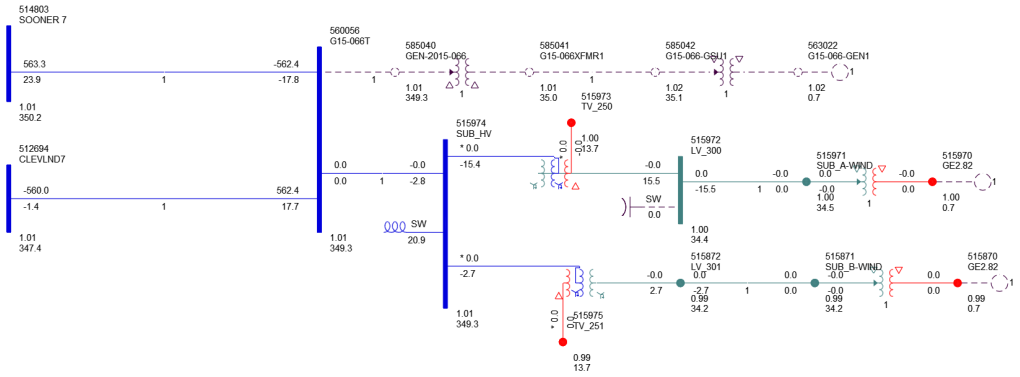

Figure 2-1. Shunt Reactor Size for GEN-2015-066 with Modified Configuration

Table 2-1. Shunt Reactor Size for Modification Request

Machine	POI Bus Number	POI Bus Name	Reactor Size (MVAR) 25SP
GEN-2015-066 Modification	560056	G15-066T	20.9

Section

3

Short Circuit Analysis

A short circuit analysis was performed using 25SP model for GEN-2015-066 with modified configuration. The detailed results of the short circuit analysis are provided in Appendix B.

3.1 Methodology

The short circuit analysis was performed by applying a three-phase fault (3PH) on buses up to 5 levels away from the 345 kV POI bus. The PSS®E "Automatic Sequence Fault Calculation (ASCC)" fault analysis module was used to calculate the fault current levels in the transmission system with and without new WTGs of GEN-2015-066 online.

A short circuit model was created from the DISIS-2021-001 25SP stability study model by adjusting the short circuit parameters (Table 3-1) of the new WTGs of GEN-2015-066 consistent with Modification Request.

Table 3-1. Short-Circuit Model Parameters[1]

Parameter	Value by Generator Bus # 515870	Value by Generator Bus # 515970
Machine MVA Base	74.55	173.09
R (pu)	0	0
Sub-transient X" (pu)	0.355	0.355

Notes

1. pu values based on Machine MVA Base

3.2 Short-Circuit Analysis Results

The results of the short circuit analysis for 25SP model of modification study case are summarized in Table 3-2 and Table 3-3. The GEN-2015-066 345 kV POI bus fault current magnitudes are listed in Table 3-2 showing a maximum difference of kA with and without new WTGs of GEN-2015-066. Table 3-3 shows the maximum fault current magnitudes and fault current increases.

The maximum fault current contribution to three-phase fault current is about 2.1% and 0.4041 kA increase with the GEN-2015-066.

Table 3-2. POI Short Circuit Results for Modification Study

Case	Gen-OFF Current (kA)	Gen-ON Current (kA)	Max kA Change	Max % Change
25 SP	19.2549	19.6590	0.4041	2.10%

Table 3-3. Max Short Circuit Results at Different Voltage for Modification Study

Voltage (kV)	Max. Current (kA)	Max kA Change	Max % Change
69	18.3149	0.0018	0.02%
138	52.6238	0.0328	0.10%
161	16.8124	0.0012	0.01%
345	34.7665	0.4041	2.10%

Section

4

Dynamic Stability Analysis

Since the Modification Request includes dynamic model change, dynamic stability analysis was performed to evaluate the impact of the Modification Request on the interconnected system.

4.1 Procedure

4.1.1 Computer Programs

Stability analysis was performed using PSS®E version 34.9.

4.1.2 Methodology

The modification study stability package representing the 2025 summer peak (25SP) scenario and 2025 winter peak (25WP) scenario with the GEN-2015-066 modification was created from the stability package used in the DISIS-2021-001 cluster.

No-fault tests are performed for 25SP and 25WP scenarios with power flow models and snapshot files of modified GEN-2015-066 models. Errors during initialization are fixed.

During fault simulation, the active power (PELEC), reactive power (QELEC) and terminal voltage (ETERM) were monitored for new WTGs of GEN-2015-066 and other generators in the nearby area. The machine rotor angles for nearby synchronous machines were also monitored. In addition, bus voltages within 5 steps of GEN-2015-066 POI were monitored and plotted.

4.2 Dynamic Stability Faults

A set of 48 faults were developed. The fault events included three-phase faults (P1) and single-line-to-ground stuck breaker faults (P4). P1 Planning Events were defined for facilities within 3 levels of the POI. P4 Planning Events consisted of the two branches (including transformers) with the highest MVA flow at the POI and each bus directly connected to the POI.

Single-line-to-ground faults were approximated by applying a fault impedance to reduce the faulted bus positive sequence voltage to 0.6 per unit (pu). Fault clearing times were 6 cycles for facilities over 300 kV and 7 cycles for facilities under 300 kV.

Developed stability faults are listed in Table 4-1. Simulations were conducted using both the 25SP and 25WP stability packages employed in DISIS-2021-001 cluster, incorporating the proposed GEN-2015-066 project modification. In each simulation, the disturbance was initiated at 0.5 seconds, with a total simulation duration of 20 seconds.

Table 4-1. Stability Fault Descriptions

Disturbance Name	Description	NERC Cat.
Nofault	No fault	P0
P4_SOONER_7	SLG fault on SOONER 7; Cleared after 6 cycles and trip SOONER 7-THUNDER7 345kV, and after 11 cycles trip SOONER 7- G15-066T (POI).	P4
P4_CLEVLND7	SLG fault on CLEVLND7; Cleared after 6 cycles and trip CLEVLND7-T.NO.--7 345kV, and after 11 cycles trip CLEVLND7- G15-066T (POI).	P4
P1_No1_G15-066T_3PH_CLEVLND7_FAULT	3PH fault on G15-066T to CLEVLND7 345 kV line; Cleared at 6 cycles	P1-2
P1_No2_G15-066T_3PH_SOONER 7_FAULT	3PH fault on G15-066T to SOONER 7 345 kV line; Cleared at 6 cycles	P1-2
P1_No3_CLEVLND7_3PH_T.NO.--7_FAULT	3PH fault on CLEVLND7 to T.NO.--7 345 kV line; Cleared at 6 cycles	P1-2
P1_No4_CLEVLND7_3PH_G15-066T_FAULT	3PH fault on CLEVLND7 to G15-066T 345 kV line; Cleared at 6 cycles	P1-2
P1_No5_CLEVLND7_3PH_CLEVLND 4_XFMR1_FAULT	3PH fault on CLEVLND7 345/138 kV xfmr #1; Cleared at 6 cycles	P1-3
P1_No6_SOONER 7_3PH_WEKIWA-7_FAULT	3PH fault on SOONER 7 to WEKIWA-7 345 kV line; Cleared at 6 cycles	P1-2
P1_No7_SOONER 7_3PH_RANCHRD7_FAULT	3PH fault on SOONER 7 to RANCHRD7 345 kV line; Cleared at 6 cycles	P1-2
P1_No8_SOONER 7_3PH_THUNDER7_FAULT	3PH fault on SOONER 7 to THUNDER7 345 kV line; Cleared at 6 cycles	P1-2
P1_No9_SOONER 7_3PH_PINTAIL7_FAULT	3PH fault on SOONER 7 to PINTAIL7 345 kV line; Cleared at 6 cycles	P1-2
P1_No10_SOONER 7_3PH_G15-066T_FAULT	3PH fault on SOONER 7 to G15-066T 345 kV line; Cleared at 6 cycles	P1-2
P1_No11_SOONER 7_3PH_G16-119-TAP_FAULT	3PH fault on SOONER 7 to G16-119-TAP 345 kV line; Cleared at 6 cycles	P1-2
P1_No12_SOONER 7_3PH_SOONER2G_XFMR1_FAULT	3PH fault on SOONER 7 345/20 kV xfmr #1; Cleared at 6 cycles	P1-3
P1_No13_SOONER 7_3PH_SOONER 4_XFMR1_FAULT	3PH fault on SOONER 7 345/138 kV xfmr #1; Cleared at 6 cycles	P1-3
P1_No14_WEKIWA-7_3PH_T.NO.--7_FAULT	3PH fault on WEKIWA-7 to T.NO.--7 345 kV line; Cleared at 6 cycles	P1-2
P1_No15_WEKIWA-7_3PH_SAPLPRD7_FAULT	3PH fault on WEKIWA-7 to SAPLPRD7 345 kV line; Cleared at 6 cycles	P1-2
P1_No16_WEKIWA-7_3PH_SOONER 7_FAULT	3PH fault on WEKIWA-7 to SOONER 7 345 kV line; Cleared at 6 cycles	P1-2

Disturbance Name	Description	NERC Cat.
P1_No17_WEKIWA-7_3PH_WEKIWA-4_XFMR1_FAULT	3PH fault on WEKIWA-7 345/138 kV xfmr #1; Cleared at 6 cycles	P1-3
P1_No18_T.NO.--7_3PH_WEKIWA-7_FAULT	3PH fault on T.NO.--7 to WEKIWA-7 345 kV line; Cleared at 6 cycles	P1-2
P1_No19_T.NO.--7_3PH_N.E.S.-7_FAULT	3PH fault on T.NO.--7 to N.E.S.-7 345 kV line; Cleared at 6 cycles	P1-2
P1_No20_T.NO.--7_3PH_CLEVLND7_FAULT	3PH fault on T.NO.--7 to CLEVLND7 345 kV line; Cleared at 6 cycles	P1-2
P1_No21_T.NO.--7_3PH_G21-047-TAP_FAULT	3PH fault on T.NO.--7 to G21-047-TAP 345 kV line; Cleared at 6 cycles	P1-2
P1_No22_T.NO.--7_3PH_T.NO.2-4_XFMR1_FAULT	3PH fault on T.NO.--7 345/138 kV xfmr #1; Cleared at 6 cycles	P1-3
P1_No23_CLEVLND 4_3PH_4CLEVLND_FAULT	3PH fault on CLEVLND 4 to 4CLEVLND 138 kV line; Cleared at 7 cycles	P1-2
P1_No24_CLEVLND 4_3PH_CLEVLND7_XFMR1_FAULT	3PH fault on CLEVLND 4 138/345 kV xfmr #1; Cleared at 7 cycles	P1-3
P1_No25_SOONER 4_3PH_MILLERT4_FAULT	3PH fault on SOONER 4 to MILLERT4 138 kV line; Cleared at 7 cycles	P1-2
P1_No26_SOONER 4_3PH_PERRY 4_FAULT	3PH fault on SOONER 4 to PERRY 4 138 kV line; Cleared at 7 cycles	P1-2
P1_No27_SOONER 4_3PH_SNRPMPT4_FAULT	3PH fault on SOONER 4 to SNRPMPT4 138 kV line; Cleared at 7 cycles	P1-2
P1_No28_SOONER 4_3PH_MORISNT4_FAULT	3PH fault on SOONER 4 to MORISNT4 138 kV line; Cleared at 7 cycles	P1-2
P1_No29_SOONER 4_3PH_SOONER1G_XFMR1_FAULT	3PH fault on SOONER 4 138/22 kV xfmr #1; Cleared at 7 cycles	P1-3
P1_No30_SOONER 4_3PH_SOONER 7_XFMR1_FAULT	3PH fault on SOONER 4 138/345 kV xfmr #1; Cleared at 7 cycles	P1-3
P1_No31_RANCHRD7_3PH_SOONER 7_FAULT	3PH fault on RANCHRD7 to SOONER 7 345 kV line; Cleared at 6 cycles	P1-2
P1_No32_RANCHRD7_3PH_OPENSKY7_FAULT	3PH fault on RANCHRD7 to OPENSKY7 345 kV line; Cleared at 6 cycles	P1-2
P1_No33_RANCHRD7_3PH_FRNTWND7_FAULT	3PH fault on RANCHRD7 to FRNTWND7 345 kV line; Cleared at 6 cycles	P1-2

Disturbance Name	Description	NERC Cat.
P1_No34_RANCHRD7_3PH_OMCDLEC7_FAULT	3PH fault on RANCHRD7 to OMCDLEC7 345 kV line; Cleared at 6 cycles	P1-2
P1_No35_RANCHRD7_3PH_G18-071_TAP_FAULT	3PH fault on RANCHRD7 to G18-071_TAP 345 kV line; Cleared at 6 cycles	P1-2
P1_No36_THUNDER7_3PH_SOONER 7_FAULT	3PH fault on THUNDER7 to SOONER 7 345 kV line; Cleared at 6 cycles	P1-2
P1_No37_THUNDER7_3PH_GEN-2021-018_FAULT	3PH fault on THUNDER7 to GEN-2021-018 345 kV line; Cleared at 6 cycles	P1-2
P1_No38_THUNDER7_3PH_GEN-2021-019_FAULT	3PH fault on THUNDER7 to GEN-2021-019 345 kV line; Cleared at 6 cycles	P1-2
P1_No39_THUNDER7_3PH_THNDRL11_XFMR1_FAULT	3PH fault on THUNDER7 345/34 kV xfmr #1; Cleared at 6 cycles	P1-3
P1_No40_THUNDER7_3PH_THNDRL21_XFMR1_FAULT	3PH fault on THUNDER7 345/34 kV xfmr #1; Cleared at 6 cycles	P1-3
P1_No41_PINTAIL7_3PH_WOODRNG7_FAULT	3PH fault on PINTAIL7 to WOODRNG7 345 kV line; Cleared at 6 cycles	P1-2
P1_No42_PINTAIL7_3PH_SOONER 7_FAULT	3PH fault on PINTAIL7 to SOONER 7 345 kV line; Cleared at 6 cycles	P1-2
P1_No43_PINTAIL7_3PH_KINGWD 7_FAULT	3PH fault on PINTAIL7 to KINGWD 7 345 kV line; Cleared at 6 cycles	P1-2
P1_No44_G16-119-TAP_3PH_SOONER 7_FAULT	3PH fault on G16-119-TAP to SOONER 7 345 kV line; Cleared at 6 cycles	P1-2
P1_No45_G16-119-TAP_3PH_SPRNGCK7_FAULT	3PH fault on G16-119-TAP to SPRNGCK7 345 kV line; Cleared at 6 cycles	P1-2
P1_No46_G16-119-TAP_3PH_GEN-2016-119_FAULT	3PH fault on G16-119-TAP to GEN-2016-119 345 kV line; Cleared at 6 cycles	P1-2

4.3 Performance Criteria

The no-fault test results should have no errors in the initial conditions of the system and the dynamic data, or no machine deviations of 0.1 MW or 0.1 MAR, or no tripping of generation.

For fault analysis, SPP Disturbance Performance Requirements[1] are applied to identify damping, generation tripping and voltage recovery violations.

4.4 Stability Package Development

4.4.1 Power Flow Models

Starting models used in DISIS-2021-001 dynamic stability analysis are listed below:

[1] Southwest Power Pool Disturbance Performance Requirements, Revision 3.0, July 21, 2016

- 25SP: DIS2101-25SP-G04-CQ_SS.sav
- 25WP : DIS2101-25WP-G04-CQ_SS.sav

GEN-2015-066 modified configuration was added and dispatched at full rated output. GEN-2015-066 original configuration was turned off. Power mismatch was balanced within SPP footprint based on load ratio share of the Transmission Owners (TOs) areas.

4.4.2 Snapshot Files

Stability model for new WTG of GEN-2015-066 as listed in Appendix A.4 was added to the following snapshot files used in DISIS-2021-001 dynamic stability analysis:

- 25SP: DIS2101-25SP-G04-CQ_SS.snp
- 25WP: DIS2101-25WP-G04-CQ_SS.snp

Initialization errors and generator output movements were identified in the no-fault test. Fixes listed in Table 4-2 were applied to achieve desirable performance during no-fault test.

Table 4-2. Errors and Fixes for No-Fault Test

Unit	Issue	Method
760538 [G17-117-GEN10.6000]	Generator output has movement during flat run	MVA base is updated to more reasonable value.
645066 [GRPR12 W 0.6900]	Generator output has movement during flat run	In OPPD. Far away from study area and netted as a negative load.
645065 [GRPR11 W 0.6900]	Generator output has movement during flat run	In OPPD. Far away from study area and netted as a negative load.
588244 [G16-149-GEN2]	In summer case, Generator output was increased from 0 to 10 MW during flat run. Pmin in the dynamic model is not zero.	Turned off in summer case
659272 [GROTON_2-BEG13.800] Machine "2 "	Initial PMECH= 0.4636 Initialized out of limit PMIN= 0.5000.	In BEPC. Far away from study area and netted as a negative load.
672360, 672361 and 672362	Numerical oscillations observed during flat run	Solution is to change T''d0 from 0.01 to 0.02 in the generator models.
364233 [1GLEASON T3 13.800] Machine "3 "	Model GGOV1 initialized out of limit(s) V3	In TVA. Far away from study area and netted as a negative load.

For majority simulated faults in 25SP and 25WP scenarios, oscillations were identified in the nearby area. The issues were pinpointed to the following four units. Their MW active power output under fault ' P1_No1_G15-066T_3PH_CLEVLND7_FAULT' are shown in Figure 4-1.

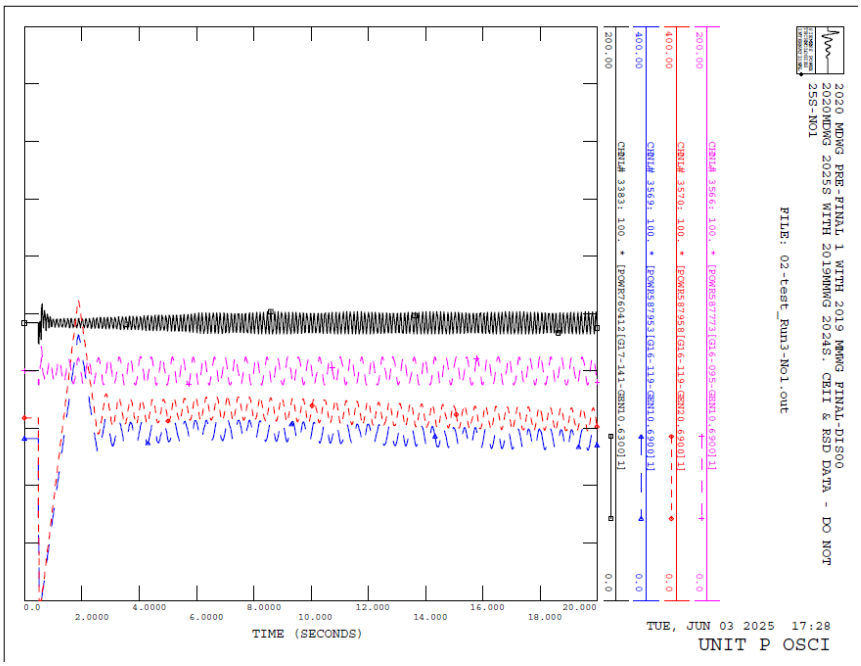

Figure 4-1. Active Power Output with Oscillations

After investigation, G17-115GEN1 was netted as a negative load since it is far away from GEN-2015-066. KPP in "WTTQA1' for G16-119-GEN1, G16-119-GEN2 and G16-095-GEN1 were updated from 3 to 2. With these changes applied, their MW active power output under the same fault are shown in Figure 4-2.

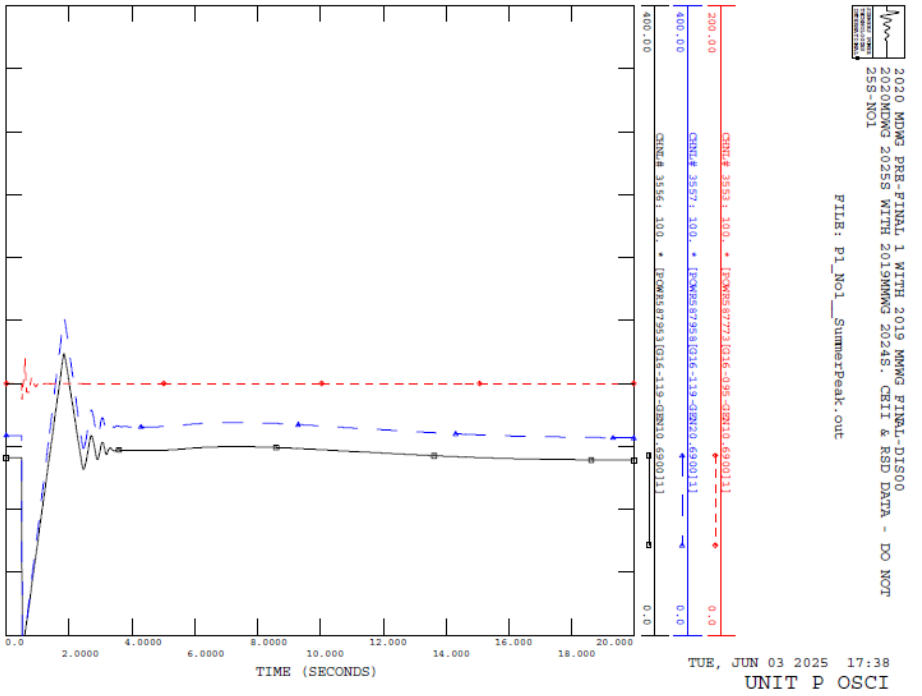

Figure 4-2. Active Power Output with Fixes

For faults at RANCHRD 345 kV bus, network diverged during fault and unreasonable voltages including 'NAN' were spotted which lead to multiple units tripping. The investigated results and fixes are summarized in Table 4-3.

Table 4-3. Network Convergency Issues and Fixes – Modification Study

Unit	Issue	Method
KAYWNDG1 (515651) KAYWNDG2 (515652)	SP fault No7; WP fault No7, No31, No34 and No35, multiple tripping and diverge, and simulation crashing.	Update the 'REGCA1' acceleration factor to 0.1 (was 1 before)
763068 [G18-071-GEN1] 1	WP only. Fault No7, No31, No34 and No35, multiple tripping and diverge, and simulation crashing.	Update the 'REGCA1' acceleration factor to 0.5 (was 1 before)
516061 [FRNT2G21 0.6900] 1	WP only. Fault No7, No31, No34and No35, multiple tripping and diverge, and simulation crashing.	Update the 'REGCA1' acceleration factor updated to 0.5 (was 0.01 before)

4.5 Dynamic Stability Analysis Results

The contingencies listed in Table 4-1 were simulated using the 25SP and 25WP scenarios. Stability results are summarized in Appendix C. Simulations were performed with a 0.5 second steady-state run followed by the appropriate disturbance. Simulations were run for a 20-second duration.

4.5.1 25SP Dynamic Stability Results

Appendix C.1.2 contains plots of generator rotor angles, generator power output, generator terminal voltages, and bus voltages for each simulation.

25SP dynamic stability study results summary is in Appendix C.1.1, Table C-1.

Based on SPP 25SP dynamic stability analysis for modification study, no new damping, generation tripping or voltage recovery violations were identified after the Modification Request. Results also show that the outputs of new WTGs are stable and meet the Low Voltage Ride Through (LVRT) requirements.

4.5.2 25WP Dynamic Stability Results

Appendix C.2.2 contains plots of generator rotor angles, generator power output, generator terminal voltages, and bus voltages for each simulation.

25WP dynamic stability study results summary is in Appendix C.2.1, Table C-2.

Based on SPP 25WP dynamic stability analysis for modification study, no new damping, generation tripping or voltage recovery violations were identified after the Modification Request. Results also show that the outputs of new WTGs are stable and meet the LVRT requirements.

4.6 Conclusion

No new damping, generation tripping or voltage recovery violations were identified after the Modification Request in 25SP and 25WP dynamic stability analysis. Results also show that the outputs of new WTGs are stable and meet the LVRT requirements.

Section

5

Sensitivity Analysis

NextEra might use a larger (115 MVA) main power transformer (MPT) on substation B side other than MPT (85 MVA) listed in Table 1-2. A sensitivity analysis was performed to demonstrate that GEN-2015-066 Modification Request with larger MPT on substation B side is not a material modification to the GEN-2015-066 interconnection request.

Figure 5-1 shows the power flow model single line diagram for the GEN-2015-066 sensitivity case.

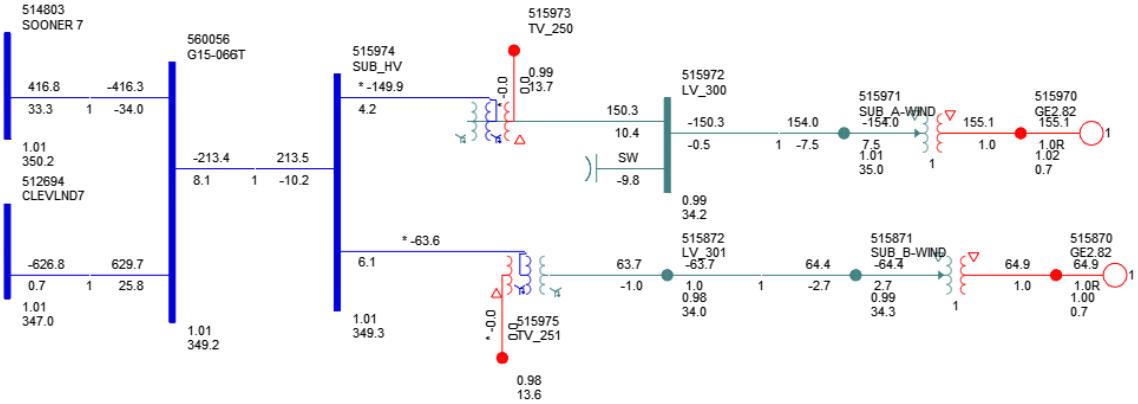

Figure 5-1. GEN-2015-066 Single Line Diagram (Sensitivity Analysis)

Changes of Substation B side's MPT in sensitivity analysis are summarized Table 5-1.

Table 5-1. Substation B Side MPT Data

85 MVA MPT	115 MVA MPT
354/34.5/13.8 kV (Yg-Yg-D), +- 12% (33 taps) 51/68/85 MVA Z12= 7.9% X/R = 40 on 51 MVA Z13= 12% X/R = 40 on 51 MVA Z23= 4% X/R = 40 on 51 MVA Z12_0= 7.9% X/R = 40 on 51 MVA Z13_0= 12% X/R = 40 on 51 MVA Z23_0= 4% X/R = 40 on 51 MVA	354/34.5/13.8 kV (Yg-Yg-D), +- 12% (33 taps) 69 /115 MVA Z12= 8.19% X/R = 40.98 on 69 MVA Z13= 11.63% X/R = 31.53 on 69 MVA Z23= 2.46% X/R = 7.94 on 69 MVA Z12_0= 8.19% X/R = 40.98 on 69 MVA Z13_0= 11.63% X/R = 31.53 on 69 MVA Z23_0= 2.46% X/R = 7.94 on 69 MVA

5.1 Sensitivity Reactive Power Analysis

Sensitivity reactive power analysis is performed following methodology described in Section 2.1. The sensitivity reactive power analysis results showed that the GEN-2015-066 project with larger Sub-B side MPT needed approximately 21.4 MVAR of inductive compensation at its 345 kV substation to reduce the POI MVAR to zero, as shown in Figure 5-2. The final shunt reactor requirements or equivalent support for GEN-2015-066 for the sensitivity analysis case are listed in Table 5-2.

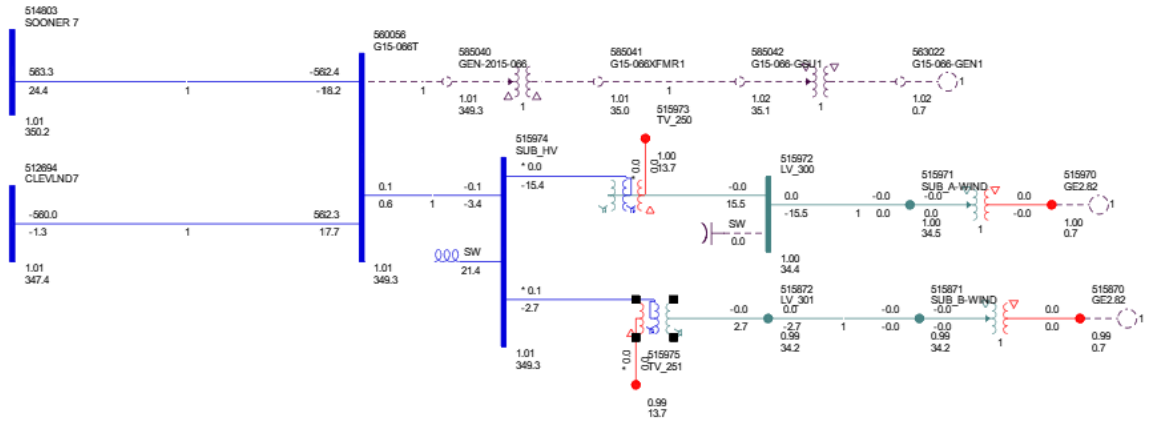

Figure 5-2. Shunt Reactor Size for GEN-2015-066 Sensitivity Analysis Case

Table 5-2. Shunt Reactor Size for Sensitivity Analysis Case

Machine	POI Bus Number	POI Bus Name	Reactor Size (MVAR) 25SP
GEN-2015-066 Modification	560056	G15-066T	21.4

5.2 Sensitivity Short Circuit Analysis

A sensitivity short circuit model was created from 25SP sensitivity stability study model by adjusting the short circuit parameters as listed in Table 3-1.

Sensitivity short circuit analysis was performed based on methodology described in Section 3.1. The detailed results of the sensitivity short circuit analysis are provided in Appendix D.2.

The results for 25SP sensitivity short circuit analysis are summarized in Table 5-3 and Table 5-4. The GEN-2015-066 345 kV POI bus fault current magnitudes are listed in Table 5-3 showing a maximum difference of kA with and without new WTGs of GEN-2015-066 in sensitivity scenario. Table 5-4 shows the maximum fault current magnitudes and fault current increases in sensitivity scenario.

The maximum fault current contribution to three-phase fault current is about 2.12% and 0.4075 kA increase with the GEN-2015-066 sensitivity scenario.

Table 5-3. POI Short Circuit Results for Sensitivity Analysis

Case	Gen-OFF Current (kA)	Gen-ON Current (kA)	Max kA Change	Max % Change
25 SP	19.2549	19.6624	0.4075	2.12%

Table 5-4. Max Short Circuit Results at Different Voltage for Sensitivity Analysis

Voltage (kV)	Max. Current (kA)	Max kA Change	Max % Change
69	18.3149	0.0018	0.02%
138	52.6239	0.0330	0.11%
161	16.8124	0.0012	0.01%
345	34.7666	0.4075	2.12%

5.3 Sensitivity Dynamic Stability Analysis

Sensitivity dynamic stability analysis was performed to evaluate the impact of the Modification Request with larger MPT on substation B side on the interconnected system following study procedure described in Section 4.1 and with dynamic stability faults listed in Table 4-1.

25SP and 25WP sensitivity power flow models are created from models developed in Section 4.4.1 by updating MPT parameter as listed in Table 5-1. Snapshot files created in Section 4.4.2 are used including fixes identified in Table 4-2 and Table 4-3.

5.3.1 25SP Sensitivity Dynamic Stability Results

Appendix D.3.2 contains plots of generator rotor angles, generator power output, generator terminal voltages, and bus voltages for each simulation.

25SP sensitivity dynamic stability study results summary is in Appendix D.3.1, Table D-2.

Based on the SPP 25SP sensitivity dynamic stability analysis results, no new damping, generation tripping, or voltage recovery violations were identified in the sensitivity analysis. Results also show that the outputs of the new WTGs are stable and meet the Low Voltage Ride Through (LVRT) requirements.

5.3.2 25WP Sensitivity Dynamic Stability Results

Appendix D.4.2 contains plots of generator rotor angles, generator power output, generator terminal voltages, and bus voltages for each simulation.

25WP sensitivity dynamic stability study results summary is in Appendix D.4.1, Table D-3.

Based on the SPP 25WP sensitivity dynamic stability analysis results, no new damping, generation tripping, or voltage recovery violations were identified in the sensitivity analysis. Results also show that the outputs of the new WTGs are stable and meet the Low Voltage Ride Through (LVRT) requirements.

5.4 Conclusion

No new damping, generation tripping or voltage recovery violations were identified after the Modification Request in 25SP and 25WP sensitivity dynamic stability analysis. Results also show that the outputs of new WTGs are stable and meet the LVRT requirements.

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Section

6

Conclusions

Based on the reactive power analysis, approximately 20.9 MVAR of inductive compensation at GEN-2015-066 345 kV substation will be needed to reduce the POI MVAR to zero after the Modification Request.

The short circuit current contribution from GEN-2015-066 Modification Request does not overstress any existing circuit breakers.

No new damping, generation tripping or voltage recovery violations were identified in the Modification Request in 25SP and 25WP dynamic stability analysis. Results also show that the outputs of new WTGs are stable and meet the LVRT requirements.

The analyses summarized in this report show that the change from 108 GE 2.3 MW WTGs to 78 GE 2.82 MW WTGs is not a material modification to the GEN-2015-066 interconnection request.

Based on the sensitivity reactive power analysis, approximately 21.4 MVAR of inductive compensation at GEN-2015-066 345 kV substation will be needed to reduce the POI MVAR to zero after the Modification Request with larger MPT on substation B side.

The short circuit current contribution from GEN-2015-066 sensitivity analysis does not overstress any existing circuit breakers.

No new damping, generation tripping or voltage recovery violations were identified in the Modification Request with larger MPT on substation B side in 25SP and 25WP sensitivity dynamic stability analysis. Results also show that the outputs of new WTGs are stable and meet the LVRT requirements.

The sensitivity analyses summarized in this report show that the change from 108 GE 2.3 MW WTGs to 78 GE 2.82 MW WTGs with larger MPT on substation B side is not a material modification to the GEN-2015-066 interconnection request.

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Appendix

A

GEN-2015-066 Power Flow and Dynamic Data

A.1 Power Flow Data – Original Configuration

```
DATA FOR BUS 563022     [G15-066-GEN10.6900] RESIDING IN AREA  524, ZONE  566, OWNER  524:
                                                                                X--- NORMAL --X  X- EMERGENCY -X
 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE   VMAX    VMIN     VMAX    VMIN
  4     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.02000  28.24 1.10000 0.90000  1.10000 0.90000

                                          X------------ REGULATED BUS -------------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS#-SCT X-- NAME --X BASKV NODE VOLTAGE
      99.4    -6.3    32.7   -32.7 1.02000 100.00 563022     G15-066-GEN10.6900     0 1.02000

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2 FRAC2 OWN3
FRAC3 OWN4 FRAC4 WMOD   WPF
 1  1   99.4   -6.3   32.7  -32.7  257.6 0.0000 0.8000 0.0000 0.0000 1.0000  248.4    0.0  524 1.000
2  0.9500

 X--------- TO BUS ----------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS#-SCT X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2    X
1-2
 585042     G15-066-GSU134.500  1               0 T T 2 1  0.00810  0.05750  276.5  0.00000  0.00000  0

 X--------- TO BUS ----------X     C
   BUS#-SCT X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATE1  RATE2  RATE3  RATE4  RATE5  RATE6
RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4 VECTOR GROUP
 585042     G15-066-GSU134.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  276.5  276.5    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0  524 1.000

 X--------- TO BUS ----------X     W C                                       X-------- CONTROLLED BUS ---------X
CONECXN
   BUS#-SCT X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS#-SCT X-- NAME --X BASKV NODE
ANGLE    CR       CX
 585042     G15-066-GSU134.500  1  T 1  0 1.10000 0.90000 1.10000 0.90000    5                                    0
0.000


 DATA FOR BUS 585040     [GEN-2015-066345.00] RESIDING IN AREA  524, ZONE  566, OWNER  524:
                                                                                X--- NORMAL --X  X- EMERGENCY -X
 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE   VMAX    VMIN     VMAX    VMIN
  4     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.01240  23.52 1.10000 0.90000  1.10000 0.90000

 X--------- TO BUS ----------X
   BUS#-SCT X-- NAME --X BASKV CKT   R (PU)   X (PU)   B (PU) ST MET  RATE1  RATE2  RATE3  RATE4  RATE5  RATE6  RATE7
RATE8  RATE9 RATE10 RATE11 RATE12 LENGTH ZI OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 560056     G15-066T    345.00  1   0.00001  0.00009  0.00117  0  T     0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.2     524 1.000

 X--------- TO BUS ----------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS#-SCT X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2    X
1-2
 585041     G15-066XFMR134.500  1               0 F F 2 1  0.00238  0.10000  170.0  0.00000  0.00000  0

 X--------- TO BUS ----------X     C
   BUS#-SCT X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATE1  RATE2  RATE3  RATE4  RATE5  RATE6
RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4 VECTOR GROUP
 585041     G15-066XFMR134.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  220.0  280.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0  524 1.000

 X--------- TO BUS ----------X     W C                                       X-------- CONTROLLED BUS ---------X
CONECXN
   BUS#-SCT X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS#-SCT X-- NAME --X BASKV NODE
ANGLE    CR       CX
 585041     G15-066XFMR134.500  1  F 1  0 1.10000 0.90000 1.10000 0.90000   30                                    0
0.000
```

```
 DATA FOR BUS 585041     [G15-066XFMR134.500] RESIDING IN AREA  524, ZONE  566, OWNER  524:
                                                                                X--- NORMAL --X  X- EMERGENCY -X
 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE   VMAX    VMIN     VMAX    VMIN
  4     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.01474  26.75 1.10000 0.90000  1.10000 0.90000

 X--------- TO BUS ----------X
   BUS#-SCT X-- NAME --X BASKV CKT   R (PU)   X (PU)   B (PU) ST MET  RATE1  RATE2  RATE3  RATE4  RATE5  RATE6  RATE7
RATE8  RATE9 RATE10 RATE11 RATE12 LENGTH ZI OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 585042     G15-066-GSU134.500  1   0.00413  0.00608  0.12910  0  F     0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0     524 1.000

 X--------- TO BUS ----------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS#-SCT X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2    X
1-2
 585040     GEN-2015-066345.00  1               0 T T 2 1  0.00238  0.10000  170.0  0.00000  0.00000  0

 X--------- TO BUS ----------X     C
   BUS#-SCT X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATE1  RATE2  RATE3  RATE4  RATE5  RATE6
RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4 VECTOR GROUP
 585040     GEN-2015-066345.00  1  1 1.00000 0.0000    0.0 1.00000 0.0000  220.0  280.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0  524 1.000

 X--------- TO BUS ----------X     W C                                       X-------- CONTROLLED BUS ---------X
CONECXN
   BUS#-SCT X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS#-SCT X-- NAME --X BASKV NODE
ANGLE    CR       CX
 585040     GEN-2015-066345.00  1  T 1  0 1.10000 0.90000 1.10000 0.90000   30                                  0
0.000


 DATA FOR BUS 585042     [G15-066-GSU134.500] RESIDING IN AREA  524, ZONE  566, OWNER  524:
                                                                                X--- NORMAL --X  X- EMERGENCY -X
 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE   VMAX    VMIN     VMAX    VMIN
  4     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.01864  27.09 1.10000 0.90000  1.10000 0.90000

 X--------- TO BUS ----------X
   BUS#-SCT X-- NAME --X BASKV CKT   R (PU)   X (PU)   B (PU) ST MET  RATE1  RATE2  RATE3  RATE4  RATE5  RATE6  RATE7
RATE8  RATE9 RATE10 RATE11 RATE12 LENGTH ZI OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 585041     G15-066XFMR134.500  1   0.00413  0.00608  0.12910  0  T     0.0    0.0    0.0    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0     524 1.000

 X--------- TO BUS ----------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS#-SCT X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2    X
1-2
 563022     G15-066-GEN10.6900  1               0 F F 2 1  0.00810  0.05750  276.5  0.00000  0.00000  0

 X--------- TO BUS ----------X     C
   BUS#-SCT X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATE1  RATE2  RATE3  RATE4  RATE5  RATE6
RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4 VECTOR GROUP
 563022     G15-066-GEN10.6900  1  1 1.00000 0.0000    0.0 1.00000 0.0000  276.5  276.5    0.0    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0  524 1.000

 X--------- TO BUS ----------X     W C                                       X-------- CONTROLLED BUS ---------X
CONECXN
   BUS#-SCT X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS#-SCT X-- NAME --X BASKV NODE
ANGLE    CR       CX
 563022     G15-066-GEN10.6900  1  F 1  0 1.10000 0.90000 1.10000 0.90000    5                                  0
0.000
```

A.2 Power Flow Data – Modified Configuration

```
DATA FOR BUS 515870     [GE2.82      0.6900] RESIDING IN AREA    1, ZONE    1, OWNER    1:
                                                                                X--- NORMAL --X  X-
EMERGENCY -X
 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE    VMAX    VMIN     VMAX
VMIN
   2     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.00060  34.71 1.10000 0.90000  1.10000
0.90000

                                              X------------ REGULATED BUS -------------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS#-SCT X-- NAME --X BASKV NODE VOLTAGE
      64.9     1.7    36.8   -36.8 1.01240 100.00 515974     SUB_HV      345.00    0 1.01240

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4 WMOD   WPF
 1  1   64.9    1.7   36.8  -36.8   74.6 0.0000 0.8000 0.0000 0.0000 1.0000   64.9    3.2    1 1.000
1  1.0000

 X--------- TO BUS ----------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS#-SCT X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-
2    X 1-2
 515871     SUB_B-WIND  34.500  1               1 T F 2 2  0.00760  0.05700   64.4        0  0.00000  0

 X--------- TO BUS ----------X     C
   BUS#-SCT X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATE1  RATE2  RATE3  RATE4  RATE5
RATE6  RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4 VECTOR GROUP
 515871     SUB_B-WIND  34.500  1  1 1.00000 34.500    0.0 1.00000 0.6900   74.8   74.8   74.8    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    1 1.000

 X--------- TO BUS ----------X     W C                                          X-------- CONTROLLED BUS ------
---X CONECXN
   BUS#-SCT X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS#-SCT X-- NAME --X BASKV
NODE   ANGLE    CR      CX
 515871     SUB_B-WIND  34.500  1   T 1   0 1.10000 0.90000 1.10000 0.90000    5
0   0.000


 DATA FOR BUS 515871     [SUB_B-WIND  34.500] RESIDING IN AREA    1, ZONE    1, OWNER    1:
                                                                                X--- NORMAL --X  X-
EMERGENCY -X
 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE    VMAX    VMIN     VMAX
VMIN
   1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 0.99307  31.41 1.10000 0.90000  1.10000
0.90000

 X--------- TO BUS ----------X
   BUS#-SCT X-- NAME --X BASKV CKT   R (PU)   X (PU)   B (PU) ST MET  RATE1  RATE2  RATE3  RATE4  RATE5  RATE6
RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 LENGTH ZI OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 515872     LV_301      34.500  1   0.01518  0.02567  0.02795  1  F    83.1   83.1   83.1    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0       1 1.000

 X--------- TO BUS ----------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS#-SCT X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-
2    X 1-2
 515870     GE2.82      0.6900  1               1 F T 2 2  0.00760  0.05700   64.4        0  0.00000  0

 X--------- TO BUS ----------X     C
   BUS#-SCT X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATE1  RATE2  RATE3  RATE4  RATE5
RATE6  RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4 VECTOR GROUP
 515870     GE2.82      0.6900  1  1 1.00000 34.500    0.0 1.00000 0.6900   74.8   74.8   74.8    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    1 1.000

 X--------- TO BUS ----------X     W C                                          X-------- CONTROLLED BUS ------
---X CONECXN
   BUS#-SCT X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS#-SCT X-- NAME --X BASKV
NODE   ANGLE    CR      CX
 515870     GE2.82      0.6900  1   F 1   0 1.10000 0.90000 1.10000 0.90000    5
0   0.000


 DATA FOR BUS 515872     [LV_301      34.500] RESIDING IN AREA    1, ZONE    1, OWNER    1:
                                                                                X--- NORMAL --X  X-
EMERGENCY -X
 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE    VMAX    VMIN     VMAX
VMIN
   1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 0.98353  30.44 1.10000 0.90000  1.10000
0.90000

 X--------- TO BUS ----------X
   BUS#-SCT X-- NAME --X BASKV CKT   R (PU)   X (PU)   B (PU) ST MET  RATE1  RATE2  RATE3  RATE4  RATE5  RATE6
RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 LENGTH ZI OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
```

```
 515871     SUB_B-WIND  34.500  1   0.01518  0.02567  0.02795  1  T    83.1   83.1   83.1    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0       1 1.000

 X- XFRMER -X X------ WINDING 1 BUS ------X X------ WINDING 2 BUS ------X X------ WINDING 3 BUS ------X     S
C C C
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV   BUS#-SCT X-- NAME --X BASKV   BUS#-SCT X-- NAME --X BASKV CKT T
W Z M OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4 VECTOR GROUP
 SUB_B        515974     SUB_HV      345.00 515872     LV_301      34.500 515975     TV_251      13.800  1  1
3 2 1    1 1.000                              YN0yn0d1

 X- XFRMER -X S C X--------- SPECIFIED NOMINAL MEASURED IMPEDANCES AND MVA BASES ----------X X-ACTUAL
IMPEDANCES FROM IMPEDANCE CORRECTION TABLE-X IMP TABLE
 X-- NAME --X T Z   R 1-2    X 1-2 SBAS1-2   R 2-3    X 2-3 SBAS2-3   R 3-1    X 3-1 SBAS3-1   R 1-2    X 1-2
R 2-3    X 2-3    R 3-1    X 3-1  CORRECTION
 SUB_B        1 2  0.00197  0.07898   51.0  0.00100  0.03999   51.0  0.00300  0.11996   51.0
WINDING

 X- XFRMER -X X------- WINDING BUS -------X  S C    MAGNETIZING Y   SYSTEM BASE NOM.
TBL CORRECTED   STAR POINT BUS
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV  T M    MAG1     MAG2   R WNDNG  X WNDNG  RATE1  RATE2  RATE3
RATE4  RATE5  RATE6  RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 TBL R WNDNG  X WNDNG VOLTAGE  ANGLE
 SUB_B        515974     SUB_HV      345.00* 1 1  0.00000  0.00000  0.00390  0.15583   85.0   85.0   85.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0                   0.98354   30.5
              515872     LV_301      34.500  1                     -0.00002 -0.00098   85.0   85.0   85.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0
              515975     TV_251      13.800* 1                      0.00198  0.07939   85.0   85.0   85.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0

 X- XFRMER -X X------- WINDING BUS -------X C                                                                X-
------- CONTROLLED BUS ---------X CNXTN
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV W CN  WIND V  NOM V  ANGLE   RMAX    RMIN    VMAX    VMIN  NTPS
BUS#-SCT X-- NAME --X BASKV NODE ANGLE    CR       CX
 SUB_B        515974     SUB_HV      345.00 3  1 1.00000 354.00    0.0 1.12000 0.88000 1.10000 0.90000   33
515872     LV_301      34.500    0   0.0
              515872     LV_301      34.500    0 1.00000 34.500    0.0 1.00000 1.00000 1.10000 0.90000   33
0   0.0
              515975     TV_251      13.800    0 1.00000 13.800    0.0 1.00000 1.00000 1.10000 0.90000   33
0   0.0


 DATA FOR BUS 515970     [GE2.82      0.6900] RESIDING IN AREA    1, ZONE    1, OWNER    1:
                                                                          X--- NORMAL --X  X-
EMERGENCY -X
 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE   VMAX    VMIN     VMAX
VMIN
  2     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.02127  36.20 1.10000 0.90000  1.10000
0.90000

                                          X------------ REGULATED BUS -------------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS#-SCT X-- NAME --X BASKV NODE VOLTAGE
     155.1     1.7    76.8   -76.8 1.01240 100.00 515974     SUB_HV      345.00    0 1.01240

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2
FRAC2 OWN3 FRAC3 OWN4 FRAC4 WMOD   WPF
 1  1  155.1    1.7   76.8  -76.8  173.1 0.0000 0.8000 0.0000 0.0000 1.0000  155.1    7.8    1 1.000
1  1.0000

 X--------- TO BUS ----------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS#-SCT X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-
2    X 1-2
 515971     SUB_A-WIND  34.500  1               1 T F 2 2  0.00760  0.05700  154.0        0  0.00000  0

 X--------- TO BUS ----------X     C
   BUS#-SCT X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATE1  RATE2  RATE3  RATE4  RATE5
RATE6  RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4 VECTOR GROUP
 515971     SUB_A-WIND  34.500  1  1 1.00000 34.500    0.0 1.00000 0.6900  178.8  178.8  178.8    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    1 1.000

 X--------- TO BUS ----------X     W C                                          X-------- CONTROLLED BUS ------
---X CONECXN
   BUS#-SCT X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS#-SCT X-- NAME --X BASKV
NODE   ANGLE    CR       CX
 515971     SUB_A-WIND  34.500  1   T 1   0 1.10000 0.90000 1.10000 0.90000    5
0   0.000


 DATA FOR BUS 515971     [SUB_A-WIND  34.500] RESIDING IN AREA    1, ZONE    1, OWNER    1:
                                                                          X--- NORMAL --X  X-
EMERGENCY -X
 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE   VMAX    VMIN     VMAX
VMIN
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.01470  33.03 1.10000 0.90000  1.10000
0.90000

 X--------- TO BUS ----------X
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   BUS#-SCT X-- NAME --X BASKV CKT   R (PU)   X (PU)   B (PU) ST MET  RATE1  RATE2  RATE3  RATE4  RATE5  RATE6
RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 LENGTH ZI OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 515972     LV_300      34.500  1   0.01585  0.03307  0.15619  1  F   198.6  198.6  198.6    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0       1 1.000

 X--------- TO BUS ----------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL
CORRECTED
   BUS#-SCT X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-
2    X 1-2
 515970     GE2.82      0.6900  1              1 F T 2 2  0.00760  0.05700  154.0        0  0.00000  0

 X--------- TO BUS ----------X     C
   BUS#-SCT X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATE1  RATE2  RATE3  RATE4  RATE5
RATE6  RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4 VECTOR GROUP
 515970     GE2.82      0.6900  1  1 1.00000 34.500    0.0 1.00000 0.6900  178.8  178.8  178.8    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    1 1.000

 X--------- TO BUS ----------X     W C                                          X-------- CONTROLLED BUS ------
---X CONECXN
   BUS#-SCT X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS#-SCT X-- NAME --X BASKV
NODE   ANGLE    CR      CX
 515970     GE2.82      0.6900  1  F 1  0 1.10000 0.90000 1.10000 0.90000    5
0   0.000


 DATA FOR BUS 515972     [LV_300      34.500] RESIDING IN AREA    1, ZONE    1, OWNER    1:
                                                                                X--- NORMAL --X  X-
EMERGENCY -X
 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE    VMAX    VMIN     VMAX
VMIN
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 0.99151  30.14 1.10000 0.90000  1.10000
0.90000

     S ADJ                                                                      X-------- REGULATED BUS ---
------X X--FACTS/--X
 MOD T METH VHI     VLO      SHUNT  X-------X X-------X X-------X X-------X  PCT Q   BUS#-SCT X-- NAME --X
BASKV NODE X-VSC NAME-X
  1  1   0 1.10000 0.90000    10.00  1:  10.00                                100.00 515972     LV_300
34.500    0

 X--------- TO BUS ----------X
   BUS#-SCT X-- NAME --X BASKV CKT   R (PU)   X (PU)   B (PU) ST MET  RATE1  RATE2  RATE3  RATE4  RATE5  RATE6
RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 LENGTH ZI OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 515971     SUB_A-WIND  34.500  1   0.01585  0.03307  0.15619  1  T   198.6  198.6  198.6    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0       1 1.000

 X- XFRMER -X X------ WINDING 1 BUS ------X X------ WINDING 2 BUS ------X X------ WINDING 3 BUS ------X     S
C C C
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV   BUS#-SCT X-- NAME --X BASKV   BUS#-SCT X-- NAME --X BASKV CKT T
W Z M OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4 VECTOR GROUP
 SUB_A        515974     SUB_HV      345.00 515972     LV_300      34.500 515973     TV_250      13.800  1  1
3 2 1    1 1.000                          YN0yn0d1

 X- XFRMER -X S C X--------- SPECIFIED NOMINAL MEASURED IMPEDANCES AND MVA BASES ----------X X-ACTUAL
IMPEDANCES FROM IMPEDANCE CORRECTION TABLE-X IMP TABLE
 X-- NAME --X T Z   R 1-2    X 1-2 SBAS1-2   R 2-3    X 2-3 SBAS2-3   R 3-1    X 3-1 SBAS3-1   R 1-2    X 1-2
R 2-3    X 2-3    R 3-1    X 3-1  CORRECTION
 SUB_A        1 2  0.00212  0.08497  135.0  0.00100  0.03999  135.0  0.00300  0.11996  135.0
WINDING

 X- XFRMER -X X------- WINDING BUS -------X  S C    MAGNETIZING Y   SYSTEM BASE NOM.
TBL CORRECTED   STAR POINT BUS
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV  T M    MAG1     MAG2   R WNDNG  X WNDNG  RATE1  RATE2  RATE3
RATE4  RATE5  RATE6  RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 TBL R WNDNG  X WNDNG VOLTAGE  ANGLE
 SUB_A        515974     SUB_HV      345.00* 1 1  0.00000  0.00000  0.00153  0.06109  225.0  225.0  225.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0                  0.99123   30.0
              515972     LV_300      34.500  1                      0.00005  0.00185  225.0  225.0  225.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0
              515973     TV_250      13.800* 1                      0.00069  0.02777  225.0  225.0  225.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0

 X- XFRMER -X X------- WINDING BUS -------X C                                                                X-
------- CONTROLLED BUS ----------X CNXTN
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV W CN  WIND V  NOM V  ANGLE   RMAX    RMIN    VMAX    VMIN  NTPS
BUS#-SCT X-- NAME --X BASKV NODE ANGLE    CR      CX
 SUB_A        515974     SUB_HV      345.00 3  1 1.00000 354.00    0.0 1.12000 0.88000 1.10000 0.90000   33
515972     LV_300      34.500    0   0.0
              515972     LV_300      34.500    0 1.00000 34.500    0.0 1.00000 1.00000 1.10000 0.90000   33
0   0.0
              515973     TV_250      13.800    0 1.00000 13.800    0.0 1.00000 1.00000 1.10000 0.90000   33
0   0.0


 DATA FOR BUS 515973     [TV_250      13.800] RESIDING IN AREA    1, ZONE    1, OWNER    1:
                                                                                X--- NORMAL --X  X-
EMERGENCY -X
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 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE   VMAX    VMIN     VMAX
VMIN
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 0.99123  29.98 1.10000 0.90000  1.10000
0.90000

 X- XFRMER -X X------ WINDING 1 BUS ------X X------ WINDING 2 BUS ------X X------ WINDING 3 BUS ------X     S
C C C
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV   BUS#-SCT X-- NAME --X BASKV   BUS#-SCT X-- NAME --X BASKV CKT T
W Z M OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4 VECTOR GROUP
 SUB_A        515974     SUB_HV      345.00 515972     LV_300      34.500 515973     TV_250      13.800  1  1
3 2 1    1 1.000                              YN0yn0d1

 X- XFRMER -X S C X--------- SPECIFIED NOMINAL MEASURED IMPEDANCES AND MVA BASES ----------X X-ACTUAL
IMPEDANCES FROM IMPEDANCE CORRECTION TABLE-X IMP TABLE
 X-- NAME --X T Z   R 1-2    X 1-2 SBAS1-2   R 2-3    X 2-3 SBAS2-3   R 3-1    X 3-1 SBAS3-1   R 1-2    X 1-2
R 2-3    X 2-3    R 3-1    X 3-1  CORRECTION
 SUB_A        1 2  0.00212  0.08497  135.0  0.00100  0.03999  135.0  0.00300  0.11996  135.0
WINDING

 X- XFRMER -X X------- WINDING BUS -------X  S C    MAGNETIZING Y   SYSTEM BASE NOM.
TBL CORRECTED   STAR POINT BUS
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV  T M    MAG1     MAG2   R WNDNG  X WNDNG  RATE1  RATE2  RATE3
RATE4  RATE5  RATE6  RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 TBL R WNDNG  X WNDNG VOLTAGE  ANGLE
 SUB_A        515974     SUB_HV      345.00* 1 1  0.00000  0.00000  0.00153  0.06109  225.0  225.0  225.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0                  0.99123   30.0
              515972     LV_300      34.500  1                      0.00005  0.00185  225.0  225.0  225.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0
              515973     TV_250      13.800* 1                      0.00069  0.02777  225.0  225.0  225.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0

 X- XFRMER -X X------- WINDING BUS -------X C                                                                X-
------- CONTROLLED BUS ---------X CNXTN
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV W CN  WIND V  NOM V  ANGLE   RMAX    RMIN    VMAX    VMIN  NTPS
BUS#-SCT X-- NAME --X BASKV NODE ANGLE    CR      CX
 SUB_A        515974     SUB_HV      345.00 3  1 1.00000 354.00    0.0 1.12000 0.88000 1.10000 0.90000   33
515972     LV_300      34.500    0   0.0
              515972     LV_300      34.500    0 1.00000 34.500    0.0 1.00000 1.00000 1.10000 0.90000   33
0   0.0
              515973     TV_250      13.800    0 1.00000 13.800    0.0 1.00000 1.00000 1.10000 0.90000   33
0   0.0


 DATA FOR BUS 515974     [SUB_HV      345.00] RESIDING IN AREA    1, ZONE    1, OWNER    1:
                                                                                X--- NORMAL --X  X-
EMERGENCY -X
 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE   VMAX    VMIN     VMAX
VMIN
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.01240  24.60 1.10000 0.90000  1.10000
0.90000

 X--------- TO BUS ----------X
   BUS#-SCT X-- NAME --X BASKV CKT   R (PU)   X (PU)   B (PU) ST MET  RATE1  RATE2  RATE3  RATE4  RATE5  RATE6
RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 LENGTH ZI OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 560056     G15-066T    345.00  1   0.00017  0.00145  0.02697  1  T   531.8  531.8  531.8    0.0    0.0    0.0
0.0    0.0    0.0    0.0    0.0    0.0    3.0       1 1.000

 X- XFRMER -X X------ WINDING 1 BUS ------X X------ WINDING 2 BUS ------X X------ WINDING 3 BUS ------X     S
C C C
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV   BUS#-SCT X-- NAME --X BASKV   BUS#-SCT X-- NAME --X BASKV CKT T
W Z M OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4 VECTOR GROUP
 SUB_A        515974     SUB_HV      345.00 515972     LV_300      34.500 515973     TV_250      13.800  1  1
3 2 1    1 1.000                              YN0yn0d1
 SUB_B        515974     SUB_HV      345.00 515872     LV_301      34.500 515975     TV_251      13.800  1  1
3 2 1    1 1.000                              YN0yn0d1

 X- XFRMER -X S C X--------- SPECIFIED NOMINAL MEASURED IMPEDANCES AND MVA BASES ----------X X-ACTUAL
IMPEDANCES FROM IMPEDANCE CORRECTION TABLE-X IMP TABLE
 X-- NAME --X T Z   R 1-2    X 1-2 SBAS1-2   R 2-3    X 2-3 SBAS2-3   R 3-1    X 3-1 SBAS3-1   R 1-2    X 1-2
R 2-3    X 2-3    R 3-1    X 3-1  CORRECTION
 SUB_A        1 2  0.00212  0.08497  135.0  0.00100  0.03999  135.0  0.00300  0.11996  135.0
WINDING
 SUB_B        1 2  0.00197  0.07898   51.0  0.00100  0.03999   51.0  0.00300  0.11996   51.0
WINDING

 X- XFRMER -X X------- WINDING BUS -------X  S C    MAGNETIZING Y   SYSTEM BASE NOM.
TBL CORRECTED   STAR POINT BUS
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV  T M    MAG1     MAG2   R WNDNG  X WNDNG  RATE1  RATE2  RATE3
RATE4  RATE5  RATE6  RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 TBL R WNDNG  X WNDNG VOLTAGE  ANGLE
 SUB_A        515974     SUB_HV      345.00* 1 1  0.00000  0.00000  0.00153  0.06109  225.0  225.0  225.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0                  0.99123   30.0
              515972     LV_300      34.500  1                      0.00005  0.00185  225.0  225.0  225.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0
              515973     TV_250      13.800* 1                      0.00069  0.02777  225.0  225.0  225.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0
 SUB_B        515974     SUB_HV      345.00* 1 1  0.00000  0.00000  0.00390  0.15583   85.0   85.0   85.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0                  0.98354   30.5
```

```
              515872     LV_301      34.500  1                    -0.00002 -0.00098   85.0   85.0   85.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0
              515975     TV_251      13.800* 1                     0.00198  0.07939   85.0   85.0   85.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0

 X- XFRMER -X X------- WINDING BUS -------X C                                                          X-
------- CONTROLLED BUS ---------X CNXTN
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV W CN  WIND V  NOM V  ANGLE   RMAX    RMIN    VMAX    VMIN  NTPS
BUS#-SCT X-- NAME --X BASKV NODE ANGLE    CR       CX
 SUB_A        515974     SUB_HV      345.00 3  1 1.00000 354.00    0.0 1.12000 0.88000 1.10000 0.90000   33
515972     LV_300      34.500    0   0.0
              515972     LV_300      34.500    0 1.00000 34.500    0.0 1.00000 1.00000 1.10000 0.90000   33
0   0.0
              515973     TV_250      13.800    0 1.00000 13.800    0.0 1.00000 1.00000 1.10000 0.90000   33
0   0.0
 SUB_B        515974     SUB_HV      345.00 3  1 1.00000 354.00    0.0 1.12000 0.88000 1.10000 0.90000   33
515872     LV_301      34.500    0   0.0
              515872     LV_301      34.500    0 1.00000 34.500    0.0 1.00000 1.00000 1.10000 0.90000   33
0   0.0
              515975     TV_251      13.800    0 1.00000 13.800    0.0 1.00000 1.00000 1.10000 0.90000   33
0   0.0


 DATA FOR BUS 515975     [TV_251      13.800] RESIDING IN AREA    1, ZONE    1, OWNER    1:
                                                                          X--- NORMAL --X  X-
EMERGENCY -X
 CODE P Q - L O A D     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE   VMAX    VMIN     VMAX
VMIN
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 0.98354  30.47 1.10000 0.90000  1.10000
0.90000

 X- XFRMER -X X------ WINDING 1 BUS ------X X------ WINDING 2 BUS ------X X------ WINDING 3 BUS ------X     S
C C C
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV   BUS#-SCT X-- NAME --X BASKV   BUS#-SCT X-- NAME --X BASKV CKT T
W Z M OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4 VECTOR GROUP
 SUB_B        515974     SUB_HV      345.00 515872     LV_301      34.500 515975     TV_251      13.800  1  1
3 2 1    1 1.000                                YN0yn0d1

 X- XFRMER -X S C X--------- SPECIFIED NOMINAL MEASURED IMPEDANCES AND MVA BASES ----------X X-ACTUAL
IMPEDANCES FROM IMPEDANCE CORRECTION TABLE-X IMP TABLE
 X-- NAME --X T Z   R 1-2    X 1-2 SBAS1-2   R 2-3    X 2-3 SBAS2-3   R 3-1    X 3-1 SBAS3-1   R 1-2    X 1-2
R 2-3    X 2-3    R 3-1    X 3-1  CORRECTION
 SUB_B        1 2  0.00197  0.07898   51.0  0.00100  0.03999   51.0  0.00300  0.11996   51.0
WINDING

 X- XFRMER -X X------- WINDING BUS -------X  S C    MAGNETIZING Y   SYSTEM BASE NOM.
TBL CORRECTED   STAR POINT BUS
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV  T M    MAG1     MAG2   R WNDNG  X WNDNG  RATE1  RATE2  RATE3
RATE4  RATE5  RATE6  RATE7  RATE8  RATE9 RATE10 RATE11 RATE12 TBL R WNDNG  X WNDNG VOLTAGE  ANGLE
 SUB_B        515974     SUB_HV      345.00* 1 1  0.00000  0.00000  0.00390  0.15583   85.0   85.0   85.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0                  0.98354   30.5
              515872     LV_301      34.500  1                    -0.00002 -0.00098   85.0   85.0   85.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0
              515975     TV_251      13.800* 1                     0.00198  0.07939   85.0   85.0   85.0
0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0  0

 X- XFRMER -X X------- WINDING BUS -------X C                                                          X-
------- CONTROLLED BUS ---------X CNXTN
 X-- NAME --X   BUS#-SCT X-- NAME --X BASKV W CN  WIND V  NOM V  ANGLE   RMAX    RMIN    VMAX    VMIN  NTPS
BUS#-SCT X-- NAME --X BASKV NODE ANGLE    CR       CX
 SUB_B        515974     SUB_HV      345.00 3  1 1.00000 354.00    0.0 1.12000 0.88000 1.10000 0.90000   33
515872     LV_301      34.500    0   0.0
              515872     LV_301      34.500    0 1.00000 34.500    0.0 1.00000 1.00000 1.10000 0.90000   33
0   0.0
              515975     TV_251      13.800    0 1.00000 13.800    0.0 1.00000 1.00000 1.10000 0.90000   33
0   0.0
```

A.3 Dynamics Data – Original Configuration

```
RENEWABLE MODELS

REPORT FOR ALL MODELS                    BUS 563022 [G15-066-GEN10.6900] MODELS


Model GEWTGCU1 Bus 563022 [G15-066-GEN10.6900] Machine "1 " :

  I C O N S        C O N S       S T A T E S       V A R S
  79125-79126    222462-222479    88617-88619    214795-214797

  PRATE         XEQ     VLVPL1     VLVPL2     GLVPL2    VHVRCR2
  2.3000        0.8     0.5000     0.9000     1.2200     1.2000

  CURHVRCR2 VLVACR1    VLVACR2    RIp_LVPL    T_LVPL     LVPL1V
  2.0000     0.4000     0.8000    10.0000     0.0200     0.0000

  LVPL1P    LVPL2V     LVPL2P     LVPL3V     LVPL3P      XLVPL
  0.0000     0.5000     0.1670     0.9000     0.9250     0.0000


   Number of aggregated original WT units:   108
   WT units DFIG/Full Converter flag:   0


Model GEWTECU1 Bus 563022 [G15-066-GEN10.6900] Machine "1 " :

  I C O N S        C O N S       S T A T E S       V A R S
  82757-82765    254123-254189    95018-95035    225141-225156

  TFV       KPV         KIV        RC         XC         TFP        KPP
  0.1500     2.0000     1.0000     0.0000     0.0000     0.0500     3.0000

  KIP        PMX        PMN        QMX        QMN        IPMAX      TRV
  0.6000     1.1200     0.0400     0.4360    -0.4360     1.1000     0.0200

  RPMX       RPMN       T_POWER    KQi        VMINCL     VMAXCL     KVi
  0.4500    -0.4500    60.0000     0.1000     0.9000     1.1000    40.0000

  XIQmin     XIQmax     Tv         Tp         Fn         TPav
  0.5000     1.4500     0.0500     0.0500     1.0000     0.1500

  FRa        FRb        FRc        FRd
  0.9600     0.9960     1.0040     1.0400

  PFRa       PFRb       PFRc       PFRd
  1.0000     1.0000     1.0000     0.4000

  PFRmax     PFRmin     TW         T_LVPL     V_LVPL
  1.0000     0.2000     1.0000     0.2500    -1.0000

  SPDW1      SPDWMX     SPDWMN     SPD_LOW   WTTHRES
 14.0000    25.0000     3.0000    -0.9000     8.0000

  EBST       KDBR       Pdbr_MAX
  0.2000    10.0000     1.0000

  ImaxTD     Iphl       Iqhl       TIpqd       Kqd       Xqd       Kwi
  1.7000     1.2200     1.2500     5.0000     0.0000     0.0000     0.0000

  dbwi       Tipwi      Twowi      urIwi      drIwi     Pmxwi      Pmnwi
  0.0025     1.0000     5.5000     0.1000    -1.0000     0.1000     0.0000

  Vermx      Vermn      Vfrz       QmxZP      QmnZP
  0.1000    -0.1000     0.7000     0.1200    -0.1200

       Remote controlled Bus:  563022
       PFAFLG:   0;   VARFLG:   1;   APCFLG:   0;   PQFLAG:   0
       Q Droop Branch FROM Bus:       0;    TO Bus:       0;    ID: '1           '
       WindFREE Enabling Flag =  0


Model GEWT2MU1 Bus 563022 [G15-066-GEN10.6900] Machine "1 " :

   I C O N         C O N S       S T A T E S       V A R S
     87494       289010-289014   102243-102246   233259-233261

    H           DAMP          Htfrac       Freq1       DSHAFT
   3.2200       0.0000       0.0000       1.8800       1.5000


Model GEWTPTU1 Bus 563022 [G15-066-GEN10.6900] Machine "1 " :

  I C O N S        C O N S       S T A T E S       V A R S
  89176-89177    295265-295274   104849-104851   237059-237061
```

```
       Tp             Kpp        Kip            Kpc           Kic
      0.3000     150.0000      25.0000       3.0000      30.0000

        TetaMin   TetaMax   RTetaMin   RTetaMax    PMX
        -4.0000   27.0000  -10.0000   10.0000    1.0000


Model GEWTARU1 Bus 563022 [G15-066-GEN10.6900] Machine "1 " :

   I C O N         C O N S       S T A T E S       V A R S
     91880       300574-300582   106018-106019   241151-241154

    Lambda_Max      Lambda_Min    PITCH_MAX    PITCH_MIN      Ta          RHO
     20.0000       0.0000       27.0000      -4.0000       0.0000       1.2250

      Radius      GB_RATIO        SYNCHR
     53.5000     104.0000        1200.0000


Model GEWTGDU1 Bus 563022 [G15-066-GEN10.6900] Machine "1 " :

   I C O N         C O N S                       V A R S
     92020       302831-302836                 241884-241887

 T1G          TG       MAXG       T1R      T2R       MAXR
0.100E+05  5.00      30.0     0.100E+05 0.100E+05  30.0

Model VTGTPAT Model Instance 56302201:

  I C O N S        C O N S                        V A R
 151354-151359   363775-363778                  261645

          VL        VU       PICKUP     TB
          0.200     5.000     1.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   563022
     GENERATOR BUS                    :   563022
     MACHINE ID                       :     "1 "


Model VTGTPAT Model Instance 56302202:

  I C O N S        C O N S                        V A R
 151360-151365   363779-363782                  261646

          VL        VU       PICKUP     TB
          0.400     5.000     1.700     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   563022
     GENERATOR BUS                    :   563022
     MACHINE ID                       :     "1 "


Model VTGTPAT Model Instance 56302203:

  I C O N S        C O N S                        V A R
 151366-151371   363783-363786                  261647

          VL        VU       PICKUP     TB
          0.600     5.000     2.200     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   563022
     GENERATOR BUS                    :   563022
     MACHINE ID                       :     "1 "


Model VTGTPAT Model Instance 56302204:

  I C O N S        C O N S                        V A R
 151372-151377   363787-363790                  261648

          VL        VU       PICKUP     TB
          0.750     5.000     3.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   563022
     GENERATOR BUS                    :   563022
     MACHINE ID                       :     "1 "


Model VTGTPAT Model Instance 56302205:

  I C O N S        C O N S                        V A R
 151378-151383   363791-363794                  261649

          VL        VU       PICKUP     TB
```

```
          0.850     5.000    10.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   563022
     GENERATOR BUS                     :   563022
     MACHINE ID                        :     "1 "


Model VTGTPAT Model Instance 56302206:

  I C O N S        C O N S                          V A R
 151384-151389   363795-363798                   261650

          VL        VU       PICKUP     TB
          0.900     5.000   600.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   563022
     GENERATOR BUS                     :   563022
     MACHINE ID                        :     "1 "


Model VTGTPAT Model Instance 56302207:

  I C O N S        C O N S                          V A R
 151390-151395   363799-363802                   261651

          VL        VU       PICKUP     TB
          0.000     1.101     1.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   563022
     GENERATOR BUS                     :   563022
     MACHINE ID                        :     "1 "


Model VTGTPAT Model Instance 56302208:

  I C O N S        C O N S                          V A R
 151396-151401   363803-363806                   261652

          VL        VU       PICKUP     TB
          0.000     1.150     0.500     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   563022
     GENERATOR BUS                     :   563022
     MACHINE ID                        :     "1 "


Model VTGTPAT Model Instance 56302209:

  I C O N S        C O N S                          V A R
 151402-151407   363807-363810                   261653

          VL        VU       PICKUP     TB
          0.000     1.175     0.200     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   563022
     GENERATOR BUS                     :   563022
     MACHINE ID                        :     "1 "


Model VTGTPAT Model Instance 56302210:

  I C O N S        C O N S                          V A R
 151408-151413   363811-363814                   261654

          VL        VU       PICKUP     TB
          0.000     1.200     0.100     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   563022
     GENERATOR BUS                     :   563022
     MACHINE ID                        :     "1 "


Model VTGTPAT Model Instance 56302211:

  I C O N S        C O N S                          V A R
 151414-151419   363815-363818                   261655

          VL        VU       PICKUP     TB
          0.000     1.300     0.010     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   563022
     GENERATOR BUS                     :   563022
     MACHINE ID                        :     "1 "
```

A.4 Dynamics Data – Modified Configuration

```
Model REGCA1 Bus 515870 [GE2.82      0.6900] Machine "1 " :

   I C O N         C O N S       S T A T E S       V A R S
    195908       396985-396998   113773-113775   273022-273025


    Tg          Rrpwr       Brkpt       Zerox      Lvpl1
    0.0200      3.0000      0.9000      0.5000     1.2300

    Volim      Lvpnt1      Lvpnt0       Iolim
    1.2000      0.1000      0.0100     -1.3000

    Tfltr       Khv          Iqrmax       Iqrmin         Accel
    0.0200      0.2000       999.0000      -999.0000      0.7000


    LVPL Switch flag:   1


Model REECA1 Bus 515870 [GE2.82      0.6900] Machine "1 " :

  I C O N S        C O N S       S T A T E S       V A R S
 195910-195915   397013-397057   113779-113784   273030-273038

    Vdip       Vup        Trv        dbd1       dbd2       Kqv        Iqhl
  -99.0000    99.0000     0.0200    -0.0500     0.0500     0.0000     1.0500

    Iqll       Vref0      Iqfrz      Thld       Thld2      Tp         QMAX
   -1.0500     0.0000     0.1500     0.0000     0.0000     0.0500     0.4900

    QMIN       VMAX       VMIN       Kqp        Kqi        Kvp        Kvi
   -0.4900     1.1000     0.9000     0.0000     0.4100     1.0000    60.0000

    Vbias      Tiq        dPMax      dPMin      Pmax       Pmin
    0.0000     0.0200    99.0000   -99.0000     0.8700     0.0440

    Imax       Tpord      VQ1        IQ1        VQ2        IQ2        VQ3
    1.5000     0.0200     0.5000     0.9900     0.9000     0.5400     1.1000

    IQ3        VQ4        IQ4        VP1        IP1        VP2        IP2
    0.5400     1.2500     1.2600     0.0000     0.0000     0.5000     0.0000

    VP3        IP3        VP4        IP4
    0.9000     1.2300     1.0000     1.1070


        PfFLAG: 0
         VFLAG: 1
         QFLAG: 1
         PFLAG: 0
        PQFLAG: 0


Model WTDTA1 Bus 515870 [GE2.82      0.6900] Machine "1 " :

                 C O N S       S T A T E S       V A R S
               397103-397107   113791-113794   273048-273050

       H           DAMP          Htfrac       Freq1       DSHAFT
     2.8200        0.0000       0.0000       1.8800       1.5000


Model WTPTA1 Bus 515870 [GE2.82      0.6900] Machine "1 " :

                 C O N S       S T A T E S        V A R
               397113-397122   113799-113801   273054

      Kiw          Kpw          Kic          Kpc          Kcc
    50.0000     200.0000       0.0000       0.0000       0.0000

       Tp        TetaMax     TetaMin    RtetaMax    RTetaMin
       0.3000    27.0000     0.0000     10.0000     -10.0000


Model WTARA1 Bus 515870 [GE2.82      0.6900] Machine "1 " :

                 C O N S                        V A R
               397133-397134                  273056

     Ka         Theta0
    0.0070    10.0000
```

```
Model REPCTA1 Bus 515870 [GE2.82      0.6900] Machine "1 " :

  I C O N S        C O N S       S T A T E S       V A R S
 195922-195928   397137-397163   113805-113811   273058-273066

    Tfltr     Kp        Ki        Tft       Tfv       Vfrz      Rc
    0.5000    2.0000    1.0000    0.0200    0.2500    0.7000    0.0000

    Xc        Kc        emax      emin       dbd1      dbd2      QMAX
    0.0000    0.0206    0.1000    -0.1000    0.0000    0.0000    0.4900

    QMIN      Kpg       Kig       tp        fdbd1     fdbd2     femax
   -0.4900    1.2000    0.1400    0.1000   -0.0006    0.0006  999.0000

    femin     Pmax      Pmin        Tg       Ddn        Dup
 -999.0000    0.8700     0.0440    0.2500   59.0100   59.0100


  Bus Number for Voltage Control (if 0 local control):  515974
   Branch FROM bus number:  515974
     Branch TO bus number:  560056
        Branch circuit ID:       1
                   VCFlag:       0
                  RefFlag:       1
                    Fflag:       1


Model WTTQA1 Bus 515870 [GE2.82      0.6900] Machine "1 " :

   I C O N         C O N S       S T A T E S       V A R S
    195936       397191-397205   113819-113821   273076-273078

    Kpp       Kip       Tp        Twref     Temax     Temin
    0.0100    0.1000    0.1000   60.0000    1.2000    0.0400

    p1        spd1      p2        spd2       p3        spd3
    0.2000    0.6900    0.4000    0.7800    0.6000    0.9800

    p4        spd4      TRATE
    0.7400    1.2000    0.0000

     Tflag (0 for speed control, 1 for power control):     1

Model REGCA1 Bus 515970 [GE2.82      0.6900] Machine "1 " :

   I C O N         C O N S       S T A T E S       V A R S
    195909       396999-397012   113776-113778   273026-273029


    Tg          Rrpwr      Brkpt       Zerox     Lvpl1
    0.0200      3.0000     0.9000      0.5000    1.2300

    Volim     Lvpnt1      Lvpnt0      Iolim
    1.2000     0.1000     0.0100     -1.3000

    Tfltr      Khv         Iqrmax       Iqrmin         Accel
    0.0200     0.2000      999.0000      -999.0000      0.7000


    LVPL Switch flag:   1


Model REECA1 Bus 515970 [GE2.82      0.6900] Machine "1 " :

  I C O N S        C O N S       S T A T E S       V A R S
 195916-195921   397058-397102   113785-113790   273039-273047

    Vdip      Vup       Trv       dbd1      dbd2      Kqv       Iqhl
  -99.0000   99.0000    0.0200   -0.0500    0.0500    0.0000    1.0500

    Iqll      Vref0     Iqfrz     Thld      Thld2     Tp        QMAX
   -1.0500    0.0000    0.1500    0.0000    0.0000    0.0500    0.4440

    QMIN      VMAX      VMIN      Kqp       Kqi       Kvp       Kvi
   -0.4440    1.1000    0.9000    0.0000    0.4100    1.0000   60.0000

    Vbias     Tiq       dPMax     dPMin     Pmax      Pmin
    0.0000    0.0200   99.0000  -99.0000    0.8970    0.0450

    Imax      Tpord     VQ1       IQ1       VQ2       IQ2       VQ3
    1.5000    0.0200    0.5000    0.9900    0.9000    0.5400    1.1000

    IQ3       VQ4       IQ4       VP1       IP1       VP2       IP2
    0.5400    1.2500    1.2600    0.0000    0.0000    0.5000    0.0000

    VP3       IP3       VP4       IP4
    0.9000    1.2300    1.0000    1.1070
```

```
        PfFLAG: 0
         VFLAG: 1
         QFLAG: 1
         PFLAG: 0
        PQFLAG: 0


Model WTDTA1 Bus 515970 [GE2.82      0.6900] Machine "1 " :

                  C O N S       S T A T E S       V A R S
                397108-397112   113795-113798   273051-273053

       H           DAMP          Htfrac       Freq1       DSHAFT
    2.8200         0.0000        0.0000       1.8800       1.5000


Model WTPTA1 Bus 515970 [GE2.82      0.6900] Machine "1 " :

                  C O N S       S T A T E S       V A R
                397123-397132   113802-113804   273055

       Kiw          Kpw           Kic          Kpc          Kcc
    50.0000     200.0000        0.0000       0.0000       0.0000

        Tp        TetaMax     TetaMin    RtetaMax    RTetaMin
    0.3000       27.0000      0.0000     10.0000     -10.0000


Model WTARA1 Bus 515970 [GE2.82      0.6900] Machine "1 " :

                  C O N S                         V A R
                397135-397136                 273057

     Ka         Theta0
  0.0070    10.0000


Model REPCTA1 Bus 515970 [GE2.82      0.6900] Machine "1 " :

  I C O N S       C O N S       S T A T E S       V A R S
 195929-195935   397164-397190   113812-113818   273067-273075

    Tfltr      Kp         Ki         Tft        Tfv        Vfrz       Rc
    0.5000     2.0000     1.0000     0.0200     0.2500     0.7000     0.0000

    Xc         Kc         emax       emin       dbd1       dbd2       QMAX
    0.0000     0.0479     0.1000     -0.1000    0.0000     0.0000     0.4440

    QMIN       Kpg        Kig        tp         fdbd1      fdbd2      femax
   -0.4400     1.2000     0.1400     0.1000   -0.0006      0.0006   999.0000

    femin      Pmax       Pmin         Tg       Ddn         Dup
  -999.0000     0.8970      0.0450     0.2500   25.4157    25.4157


  Bus Number for Voltage Control (if 0 local control):  515974
   Branch FROM bus number:  515974
     Branch TO bus number:  560056
        Branch circuit ID:       1
                  VCFlag:        0
                RefFlag:         1
                  Fflag:         1


Model WTTQA1 Bus 515970 [GE2.82      0.6900] Machine "1 " :

   I C O N         C O N S       S T A T E S       V A R S
    195937       397206-397220   113822-113824   273079-273081

    Kpp        Kip        Tp         Twref      Temax      Temin
    0.0100     0.1000     0.1000    60.0000     1.2000     0.0400

    p1         spd1       p2         spd2        p3         spd3
    0.2000     0.6900     0.4000     0.7800     0.6000     0.9800

    p4         spd4       TRATE
    0.7400     1.2000     0.0000

     Tflag (0 for speed control, 1 for power control):     1

Model FRQTPAT Model Instance 51587001:

  I C O N S       C O N S                         V A R
 196016-196021   397273-397276                 273095
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          FL        FU       PICKUP     TB
        55.000    65.000     0.262     0.080

     BUS AT WHICH FREQUENCY IS MONITORED:   515870
     GENERATOR BUS                      :   515870
     MACHINE ID                         :     "1 "


Model FRQTPAT Model Instance 51587002:

  I C O N S        C O N S                          V A R
196022-196027   397277-397280                   273096

          FL        FU       PICKUP     TB
        57.000    63.000    60.000     0.080

     BUS AT WHICH FREQUENCY IS MONITORED:   515870
     GENERATOR BUS                      :   515870
     MACHINE ID                         :     "1 "


Model VTGTPAT Model Instance 51587003:

  I C O N S        C O N S                          V A R
196028-196033   397281-397284                   273097

          VL        VU       PICKUP     TB
          0.400     5.000     1.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515870
     GENERATOR BUS                      :   515870
     MACHINE ID                         :     "1 "


Model VTGTPAT Model Instance 51587004:

  I C O N S        C O N S                          V A R
196034-196039   397285-397288                   273098

          VL        VU       PICKUP     TB
          0.600     5.000     1.700     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515870
     GENERATOR BUS                      :   515870
     MACHINE ID                         :     "1 "


Model VTGTPAT Model Instance 51587005:

  I C O N S        C O N S                          V A R
196040-196045   397289-397292                   273099

          VL        VU       PICKUP     TB
          0.700     5.000     2.500     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515870
     GENERATOR BUS                      :   515870
     MACHINE ID                         :     "1 "


Model VTGTPAT Model Instance 51587006:

  I C O N S        C O N S                          V A R
196046-196051   397293-397296                   273100

          VL        VU       PICKUP     TB
          0.750     5.000     3.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515870
     GENERATOR BUS                      :   515870
     MACHINE ID                         :     "1 "


Model VTGTPAT Model Instance 51587007:

  I C O N S        C O N S                          V A R
196052-196057   397297-397300                   273101

          VL        VU       PICKUP     TB
          0.850     5.000    10.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515870
     GENERATOR BUS                      :   515870
     MACHINE ID                         :     "1 "
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Model VTGTPAT Model Instance 51587008:

  I C O N S        C O N S                          V A R
 196058-196063   397301-397304                    273102

          VL        VU       PICKUP     TB
          0.900     5.000   600.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515870
     GENERATOR BUS                    :   515870
     MACHINE ID                       :     "1 "


Model VTGTPAT Model Instance 51587009:

  I C O N S        C O N S                          V A R
 196064-196069   397305-397308                    273103

          VL        VU       PICKUP     TB
          0.000     1.120   300.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515870
     GENERATOR BUS                    :   515870
     MACHINE ID                       :     "1 "


Model VTGTPAT Model Instance 51587010:

  I C O N S        C O N S                          V A R
 196070-196075   397309-397312                    273104

          VL        VU       PICKUP     TB
          0.000     1.150    30.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515870
     GENERATOR BUS                    :   515870
     MACHINE ID                       :     "1 "


Model VTGTPAT Model Instance 51587011:

  I C O N S        C O N S                          V A R
 196076-196081   397313-397316                    273105

          VL        VU       PICKUP     TB
          0.000     1.200     2.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515870
     GENERATOR BUS                    :   515870
     MACHINE ID                       :     "1 "


Model VTGTPAT Model Instance 51587012:

  I C O N S        C O N S                          V A R
 196082-196087   397317-397320                    273106

          VL        VU       PICKUP     TB
          0.000     1.250     0.500     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515870
     GENERATOR BUS                    :   515870
     MACHINE ID                       :     "1 "


Model VTGTPAT Model Instance 51587013:

  I C O N S        C O N S                          V A R
 196088-196093   397321-397324                    273107

          VL        VU       PICKUP     TB
          0.000     1.380     0.300     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515870
     GENERATOR BUS                    :   515870
     MACHINE ID                       :     "1 "


Model FRQTPAT Model Instance 51597001:

  I C O N S        C O N S                          V A R
 195938-195943   397221-397224                    273082

          FL        FU       PICKUP     TB
         55.000    65.000     0.262     0.080
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     BUS AT WHICH FREQUENCY IS MONITORED:   515970
     GENERATOR BUS                      :   515970
     MACHINE ID                         :     "1 "


Model FRQTPAT Model Instance 51597002:

  I C O N S        C O N S                          V A R
 195944-195949   397225-397228                   273083

          FL        FU       PICKUP     TB
        57.000    63.000    60.000     0.080

     BUS AT WHICH FREQUENCY IS MONITORED:   515970
     GENERATOR BUS                      :   515970
     MACHINE ID                         :     "1 "


Model VTGTPAT Model Instance 51597003:

  I C O N S        C O N S                          V A R
 195950-195955   397229-397232                   273084

          VL        VU       PICKUP     TB
          0.400     5.000     1.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515970
     GENERATOR BUS                      :   515970
     MACHINE ID                         :     "1 "


Model VTGTPAT Model Instance 51597004:

  I C O N S        C O N S                          V A R
 195956-195961   397233-397236                   273085

          VL        VU       PICKUP     TB
          0.600     5.000     1.700     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515970
     GENERATOR BUS                      :   515970
     MACHINE ID                         :     "1 "


Model VTGTPAT Model Instance 51597005:

  I C O N S        C O N S                          V A R
 195962-195967   397237-397240                   273086

          VL        VU       PICKUP     TB
          0.700     5.000     2.500     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515970
     GENERATOR BUS                      :   515970
     MACHINE ID                         :     "1 "


Model VTGTPAT Model Instance 51597006:

  I C O N S        C O N S                          V A R
 195968-195973   397241-397244                   273087

          VL        VU       PICKUP     TB
          0.750     5.000     3.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515970
     GENERATOR BUS                      :   515970
     MACHINE ID                         :     "1 "


Model VTGTPAT Model Instance 51597007:

  I C O N S        C O N S                          V A R
 195974-195979   397245-397248                   273088

          VL        VU       PICKUP     TB
          0.850     5.000    10.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515970
     GENERATOR BUS                      :   515970
     MACHINE ID                         :     "1 "


Model VTGTPAT Model Instance 51597008:

  I C O N S        C O N S                          V A R
 195980-195985   397249-397252                   273089
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          VL        VU       PICKUP     TB
          0.900     5.000   600.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515970
     GENERATOR BUS                    :   515970
     MACHINE ID                       :     "1 "


Model VTGTPAT Model Instance 51597009:

  I C O N S        C O N S                          V A R
 195986-195991   397253-397256                   273090

          VL        VU       PICKUP     TB
          0.000     1.120   300.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515970
     GENERATOR BUS                    :   515970
     MACHINE ID                       :     "1 "


Model VTGTPAT Model Instance 51597010:

  I C O N S        C O N S                          V A R
 195992-195997   397257-397260                   273091

          VL        VU       PICKUP     TB
          0.000     1.150    30.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515970
     GENERATOR BUS                    :   515970
     MACHINE ID                       :     "1 "


Model VTGTPAT Model Instance 51597011:

  I C O N S        C O N S                          V A R
 195998-196003   397261-397264                   273092

          VL        VU       PICKUP     TB
          0.000     1.200     2.000     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515970
     GENERATOR BUS                    :   515970
     MACHINE ID                       :     "1 "


Model VTGTPAT Model Instance 51597012:

  I C O N S        C O N S                          V A R
 196004-196009   397265-397268                   273093

          VL        VU       PICKUP     TB
          0.000     1.250     0.500     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515970
     GENERATOR BUS                    :   515970
     MACHINE ID                       :     "1 "


Model VTGTPAT Model Instance 51597013:

  I C O N S        C O N S                          V A R
 196010-196015   397269-397272                   273094

          VL        VU       PICKUP     TB
          0.000     1.380     0.300     0.080

     BUS AT WHICH VOLTAGE IS MONITORED:   515970
     GENERATOR BUS                    :   515970
     MACHINE ID                       :     "1 "
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Appendix

B

Short Circuit Analysis Results

Table B-1. Full Short Circuit Analysis Results

Bus Number	Bus Name	Base kV	Area Name	3PH Fault Current (kA)		Difference (ON-OFF)		Distance from GEN POI BUS 560056
				GEN ON	GEN OFF	Change	%	
560056	G15-066T	345	OKGE	19.6590	19.2549	0.4041	2.10%	0
514803	SOONER 7	345	OKGE	29.1815	28.8737	0.3079	1.07%	1
512694	CLEVLND7	345	GRDA	15.9127	15.8138	0.0988	0.63%	1
509852	T.NO.--7	345	AEPW	24.5745	24.5287	0.0458	0.19%	2
516010	PINTAIL7	345	OKGE	17.0122	16.9684	0.0438	0.26%	2
516019	KINGWD 7	345	OKGE	16.9520	16.9086	0.0434	0.26%	3
515894	THUNDER7	345	OKGE	11.5181	11.4750	0.0431	0.38%	2
765480	GEN-2021-019	345	OKGE	11.4047	11.3625	0.0422	0.37%	3
587804	G16-119-TAP	345	OKGE	15.3513	15.3142	0.0370	0.24%	2
514802	SOONER 4	138	OKGE	31.4509	31.4181	0.0328	0.10%	2
509755	WEKIWA-7	345	AEPW	22.6675	22.6356	0.0319	0.14%	2
515576	RANCHRD7	345	OKGE	15.1985	15.1674	0.0311	0.21%	2
529200	OMCDLEC7	345	OMPA	15.1707	15.1397	0.0310	0.20%	3
763069	G18-071_TAP	345	OKGE	14.7748	14.7455	0.0292	0.20%	3
763065	GEN-2018-071	345	OKGE	14.7152	14.6862	0.0290	0.20%	4
514715	WOODRNG7	345	OKGE	19.4091	19.3868	0.0223	0.11%	3
512729	CLEVLND 4	138	GRDA	24.0678	24.0457	0.0221	0.09%	2
300138	4CLEVLND	138	AECI	24.0694	24.0474	0.0220	0.09%	3
509895	T.NO.2-4	138	AEPW	35.6532	35.6343	0.0189	0.05%	3
762636	GEN-2018-028	138	OKGE	35.6369	35.6180	0.0188	0.05%	4
509817	T.NO.--4	138	AEPW	35.6841	35.6655	0.0186	0.05%	4
515688	FRNTWND7	345	OKGE	11.7642	11.7458	0.0184	0.16%	3
516066	FRNT2WD7	345	OKGE	11.7556	11.7378	0.0179	0.15%	4
509757	WEKIWA-4	138	AEPW	33.7971	33.7793	0.0178	0.05%	3
560389	GEN-2010-055	138	AEPW	33.7971	33.7793	0.0178	0.05%	4

Bus Number	Bus Name	Base kV	Area Name	3PH Fault Current (kA)		Difference (ON-OFF)		Distance from GEN POI BUS 560056
				GEN ON	GEN OFF	Change	%	
515621	OPENSKY7	345	OKGE	13.3873	13.3701	0.0173	0.13%	3
514825	KAYWIND7	345	OKGE	13.3479	13.3307	0.0172	0.13%	4
514880	NORTWST7	345	OKGE	33.2105	33.1942	0.0163	0.05%	4
514881	SPRNGCK7	345	OKGE	23.4965	23.4816	0.0149	0.06%	3
765470	GEN-2021-018	345	OKGE	6.8174	6.8031	0.0144	0.21%	3
509870	SAPLPRD7	345	AEPW	22.9763	22.9622	0.0141	0.06%	3
515497	MATHWSN7	345	OKGE	33.1987	33.1852	0.0135	0.04%	5
514704	MILLERT4	138	OKGE	20.4016	20.3889	0.0127	0.06%	3
514798	SNRPMPT4	138	OKGE	20.4586	20.4460	0.0126	0.06%	3
509782	R.S.S.-7	345	AEPW	32.3916	32.3793	0.0123	0.04%	4
588039	G16133G16146	345	AEPW	32.3916	32.3793	0.0123	0.04%	5
587950	GEN-2016-119	345	OKGE	9.0555	9.0438	0.0117	0.13%	3
514901	CIMARON7	345	OKGE	34.7665	34.7554	0.0112	0.03%	5
509875	RSS T2 4	138	AEPW	52.6238	52.6135	0.0104	0.02%	5
509834	COGENT 7	345	AEPW	29.9942	29.9839	0.0103	0.03%	5
509773	RSS T1 4	138	AEPW	51.7014	51.6914	0.0100	0.02%	5
515875	REDNGTN7	345	OKGE	17.3961	17.3864	0.0097	0.06%	4
515877	REDDIRT7	345	OKGE	17.3917	17.3821	0.0097	0.06%	5
510406	N.E.S.-7	345	AEPW	18.9218	18.9127	0.0091	0.05%	3
509806	ONETA--4	138	AEPW	50.1579	50.1488	0.0091	0.02%	5
587955	GEN2016-119B	345	OKGE	7.7907	7.7822	0.0085	0.11%	4
514879	NORTWST4	138	OKGE	44.9722	44.9638	0.0083	0.02%	5
505610	KEYSTON4	138	**SWPA**	23.2859	23.2777	0.0081	0.03%	4
515978	OTOETAP4	138	OKGE	16.3109	16.3028	0.0081	0.05%	4
514737	OTOE 4	138	OKGE	16.2654	16.2573	0.0081	0.05%	5
301011	4REDRCK	138	AECI	15.9427	15.9350	0.0078	0.05%	5
560053	G15052_T	345	WERE	13.5333	13.5257	0.0076	0.06%	4
562900	G15052_1	345	WERE	13.4844	13.4768	0.0076	0.06%	5
509815	S.S.---4	138	AEPW	29.0101	29.0027	0.0074	0.03%	5
762321	GEN-2017-164	345	OKGE	11.4046	11.3972	0.0074	0.06%	4
509871	SAPLPRD4	138	AEPW	33.3032	33.2960	0.0072	0.02%	4
509807	ONETA--7	345	AEPW	29.3619	29.3547	0.0071	0.02%	4

Bus Number	Bus Name	Base kV	Area Name	3PH Fault Current (kA)		Difference (ON-OFF)		Distance from GEN POI BUS 560056
				GEN ON	GEN OFF	Change	%	
509896	DENV_WTAP4	138	AEPW	28.2649	28.2580	0.0070	0.02%	5
509836	OEC 7	345	AEPW	29.0686	29.0617	0.0069	0.02%	5
515477	CHSHLMV7	345	OKGE	13.1782	13.1716	0.0066	0.05%	5
515476	HUNTERS7	345	OKGE	13.1974	13.1908	0.0066	0.05%	4
509812	SHEFFD-4	138	AEPW	26.1848	26.1784	0.0064	0.02%	4
514908	ARCADIA7	345	OKGE	32.3421	32.3371	0.0050	0.02%	5
532794	ROSEHIL7	345	WERE	17.8989	17.8940	0.0049	0.03%	5
509842	CDC-WT 4	138	AEPW	19.6423	19.6373	0.0049	0.03%	5
514743	OSAGE 4	138	OKGE	17.2002	17.1953	0.0049	0.03%	4
514714	WOODRNG4	138	OKGE	20.5608	20.5560	0.0048	0.02%	4
515412	DMNCRKT4	138	OKGE	13.8748	13.8700	0.0047	0.03%	4
300140	4SILVCTY	138	AECI	17.7745	17.7701	0.0044	0.03%	4
514761	WHEAGLE4	138	OKGE	16.2748	16.2704	0.0044	0.03%	5
512726	SILVCTYGR4	138	GRDA	17.5576	17.5533	0.0044	0.02%	4
765721	G21-047-TAP	345	GRDA	15.9183	15.9141	0.0043	0.03%	3
509839	CDC-ET 4	138	AEPW	18.8690	18.8648	0.0042	0.02%	5
514709	FRMNTAP4	138	OKGE	19.0924	19.0883	0.0041	0.02%	5
765720	GEN-2021-047	345	GRDA	15.5691	15.5651	0.0041	0.03%	4
514909	REDBUD 7	345	OKGE	30.5450	30.5409	0.0041	0.01%	5
509823	WED-TAP4	138	AEPW	19.3119	19.3079	0.0039	0.02%	4
515447	MORISNT4	138	OKGE	14.3920	14.3882	0.0038	0.03%	3
514799	SNRPMP 4	138	OKGE	11.2741	11.2703	0.0038	0.03%	4
515006	MORRISN4	138	OKGE	14.3631	14.3593	0.0038	0.03%	4
510396	N.E.S.-4	138	AEPW	34.7904	34.7866	0.0037	0.01%	5
512865	GREC TAP5	345	GRDA	25.2145	25.2108	0.0037	0.01%	5
515543	RENFROW7	345	OKGE	12.5108	12.5072	0.0037	0.03%	5
513596	IGLOOV 7	345	GRDA	20.1078	20.1042	0.0036	0.02%	4
762342	GEN-2017-178	345	OKGE	7.9437	7.9401	0.0036	0.04%	5
509851	P&P WTP4	138	AEPW	15.3053	15.3017	0.0036	0.02%	4
300131	4FISHERTP	138	AECI	15.4517	15.4483	0.0035	0.02%	5
514758	STDBEAR4	138	OKGE	14.3173	14.3139	0.0034	0.02%	5
509848	OAKSWTP4	138	AEPW	25.0452	25.0419	0.0033	0.01%	5

Bus Number	Bus Name	Base kV	Area Name	3PH Fault Current (kA)		Difference (ON-OFF)		Distance from GEN POI BUS 560056
				GEN ON	GEN OFF	Change	%	
509759	JENKS--4	138	AEPW	25.4972	25.4941	0.0031	0.01%	5
509888	72ELWOD4	138	AEPW	23.4681	23.4651	0.0030	0.01%	5
514706	COWCRK 4	138	OKGE	11.7296	11.7269	0.0027	0.02%	4
514707	PERRY 4	138	OKGE	11.3775	11.3748	0.0027	0.02%	3
514711	WAUKOTP4	138	OKGE	16.4538	16.4512	0.0027	0.02%	5
300141	4STILWTR	138	AECI	18.7415	18.7393	0.0022	0.01%	5
515011	STILWTR4	138	OKGE	15.3993	15.3971	0.0022	0.01%	4
512749	PAWNSW4	138	GRDA	11.0994	11.0972	0.0022	0.02%	4
509844	OWASOTP4	138	AEPW	15.0269	15.0248	0.0021	0.01%	5
515009	MCELROY4	138	OKGE	15.3925	15.3904	0.0020	0.01%	5
510380	DELWARE7	345	AEPW	11.7330	11.7310	0.0020	0.02%	4
514770	MARLNDT4	138	OKGE	11.1823	11.1803	0.0020	0.02%	5
515235	PECANCK7	345	OKGE	22.5728	22.5708	0.0020	0.01%	5
509745	CLARKSV7	345	AEPW	20.6406	20.6387	0.0020	0.01%	5
300927	2CLEVLND	69	AECI	10.5294	10.5276	0.0018	0.02%	4
515400	DMANCRK4	138	OKGE	8.1031	8.1015	0.0016	0.02%	5
509865	CARSONT4	138	AEPW	11.9835	11.9820	0.0015	0.01%	5
514742	OSGE 2	69	OKGE	18.3149	18.3134	0.0015	0.01%	5
532793	NEOSHO 7	345	WERE	17.2337	17.2323	0.0014	0.01%	5
509884	SKIATOK4	138	AEPW	10.5087	10.5073	0.0014	0.01%	5
514713	WRVALLY4	138	OKGE	9.1985	9.1971	0.0014	0.01%	5
513095	GLENCOKM 4	138	GRDA	11.9115	11.9102	0.0013	0.01%	5
509746	DENVTAP4	138	AEPW	9.3834	9.3821	0.0013	0.01%	5
514708	OTTER 4	138	OKGE	11.3260	11.3248	0.0012	0.01%	5
513593	IGLOOV1 5	161	GRDA	16.8124	16.8112	0.0012	0.01%	5
513595	IGLOOV2 5	161	GRDA	16.8124	16.8112	0.0012	0.01%	5
515990	SKELTON7	345	OKGE	4.9756	4.9745	0.0011	0.02%	4
509805	PP----W4	138	AEPW	8.3657	8.3647	0.0010	0.01%	5
509900	46ST-TP-4	138	AEPW	9.6017	9.6007	0.0010	0.01%	5
588190	GEN-2016-128	345	OKGE	4.7308	4.7298	0.0010	0.02%	5
515574	SPGVLLY4	138	OKGE	11.1556	11.1547	0.0009	0.01%	5
505609	KEYSTON5	161	SWPA	7.1632	7.1624	0.0009	0.01%	5

Bus Number	Bus Name	Base kV	Area Name	3PH Fault Current (kA)		Difference (ON-OFF)		Distance from GEN POI BUS 560056
				GEN ON	GEN OFF	Change	%	
300139	4FAIRFAX	138	AECI	7.7216	7.7208	0.0008	0.01%	5
300943	2SILVCTY	69	AECI	10.5405	10.5398	0.0008	0.01%	5
300996	4JAVINE	138	AECI	6.7286	6.7279	0.0008	0.01%	4
510376	WEBBTAP4	138	AEPW	7.6826	7.6819	0.0007	0.01%	5
301339	4SFORKKTP	138	AECI	6.9744	6.9737	0.0007	0.01%	5
510379	DELWARE4	138	AEPW	11.5013	11.5007	0.0006	0.01%	5
512876	OSAGEK2	69	GRDA	7.2300	7.2294	0.0006	0.01%	5
514733	MARSHL 4	138	OKGE	8.0676	8.0671	0.0005	0.01%	5
300137	4BRISTOW	138	AECI	10.2892	10.2888	0.0004	0.00%	5
514705	COWCRK 2	69	OKGE	4.0742	4.0740	0.0002	0.00%	5
513098	HALLETTAP 2	69	GRDA	4.0612	4.0611	0.0001	0.00%	5

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Appendix

C

Dynamic Stability Analysis Results

C.1 25SP Dynamic Stability Analysis Results

Stability simulation for modification study was performed in the 25SP scenario.

C.1.1 25SP Dynamic Stability Analysis Results Summary

25SP dynamic stability results summary for modification study is in Table C-1.

Table C-1. GEN-2015-066 25SP Stability Analysis Results Summary

Table C-1. GEN-2015-066 25SP Stability Analysis Results Summary

Cont. No.	Contingency Description	Damping Violation	Trip	Out of step	Relay Violation	Voltage Violation	Plots	Mitigations	Scneario
1	Nofault	None	None	None	None	None	OK	Not required	25SP
2	P4_SOONER_7	None	None	None	None	None	OK	Not required	25SP
3	P4_CLEVLND7	None	None	None	None	None	OK	Not required	25SP
4	P1_No1_G15-066T_3PH_CLEVLND7_FAULT	None	None	None	None	None	OK	Not required	25SP
5	P1_No2_G15-066T_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25SP
6	P1_No3_CLEVLND7_3PH_T.NO.--7_FAULT	None	None	None	None	None	OK	Not required	25SP
7	P1_No4_CLEVLND7_3PH_G15-066T_FAULT	None	None	None	None	None	OK	Not required	25SP
8	P1_No5_CLEVLND7_3PH_CLEVLND 4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP
9	P1_No6_SOONER 7_3PH_WEKIWA-7_FAULT	None	None	None	None	None	OK	Not required	25SP
10	P1_No7_SOONER 7_3PH_RANCHRD7_FAULT	None	None	None	None	None	OK	Not required	25SP
11	P1_No8_SOONER 7_3PH_THUNDER7_FAULT	None	None	None	None	None	OK	Not required	25SP
12	P1_No9_SOONER 7_3PH_PINTAIL7_FAULT	None	None	None	None	None	OK	Not required	25SP
13	P1_No10_SOONER 7_3PH_G15-066T_FAULT	None	None	None	None	None	OK	Not required	25SP
14	P1_No11_SOONER 7_3PH_G16-119-TAP_FAULT	None	None	None	None	None	OK	Not required	25SP
15	P1_No12_SOONER 7_3PH_SOONER2G_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP
16	P1_No13_SOONER 7_3PH_SOONER 4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP
17	P1_No14_WEKIWA-7_3PH_T.NO.--7_FAULT	None	None	None	None	None	OK	Not required	25SP
18	P1_No15_WEKIWA-7_3PH_SAPLPRD7_FAULT	None	None	None	None	None	OK	Not required	25SP
19	P1_No16_WEKIWA-7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25SP
20	P1_No17_WEKIWA-7_3PH_WEKIWA-4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP
21	P1_No18_T.NO.--7_3PH_WEKIWA-7_FAULT	None	None	None	None	None	OK	Not required	25SP
22	P1_No19_T.NO.--7_3PH_N.E.S.-7_FAULT	None	None	None	None	None	OK	Not required	25SP
23	P1_No20_T.NO.--7_3PH_CLEVLND7_FAULT	None	None	None	None	None	OK	Not required	25SP
24	P1_No21_T.NO.--7_3PH_G21-047-TAP_FAULT	None	None	None	None	None	OK	Not required	25SP
25	P1_No22_T.NO.--7_3PH_T.NO.2-4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP
26	P1_No23_CLEVLND 4_3PH_4CLEVLND_FAULT	None	None	None	None	None	OK	Not required	25SP
27	P1_No24_CLEVLND 4_3PH_CLEVLND7_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP
28	P1_No25_SOONER 4_3PH_MILLERT4_FAULT	None	None	None	None	None	OK	Not required	25SP
29	P1_No26_SOONER 4_3PH_PERRY 4_FAULT	None	None	None	None	None	OK	Not required	25SP
30	P1_No27_SOONER 4_3PH_SNRPMPT4_FAULT	None	None	None	None	None	OK	Not required	25SP
31	P1_No28_SOONER 4_3PH_MORISNT4_FAULT	None	None	None	None	None	OK	Not required	25SP
32	P1_No29_SOONER 4_3PH_SOONER1G_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP
33	P1_No30_SOONER 4_3PH_SOONER 7_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP
34	P1_No31_RANCHRD7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25SP
35	P1_No32_RANCHRD7_3PH_OPENSKY7_FAULT	None	None	None	None	None	OK	Not required	25SP
36	P1_No33_RANCHRD7_3PH_FRNTWND7_FAULT	None	None	None	None	None	OK	Not required	25SP
37	P1_No34_RANCHRD7_3PH_OMCDLEC7_FAULT	None	None	None	None	None	OK	Not required	25SP
38	P1_No35_RANCHRD7_3PH_G18-071_TAP_FAULT	None	None	None	None	None	OK	Not required	25SP
39	P1_No36_THUNDER7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25SP
40	P1_No37_THUNDER7_3PH_GEN-2021-018_FAULT	None	None	None	None	None	OK	Not required	25SP
41	P1_No38_THUNDER7_3PH_GEN-2021-019_FAULT	None	None	None	None	None	OK	Not required	25SP
42	P1_No39_THUNDER7_3PH_THNDRL11_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP
43	P1_No40_THUNDER7_3PH_THNDRL21_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP
44	P1_No41_PINTAIL7_3PH_WOODRNG7_FAULT	None	None	None	None	None	OK	Not required	25SP
45	P1_No42_PINTAIL7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25SP
46	P1_No43_PINTAIL7_3PH_KINGWD 7_FAULT	None	None	None	None	None	OK	Not required	25SP
47	P1_No44_G16-119-TAP_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25SP

Cont. No.	Contingency Description	Damping Violation	Trip	Out of step	Relay Violation	Voltage Violation	Plots	Mitigations	Scneario
48	P1_No45_G16-119-TAP_3PH_SPRNGCK7_FAULT	None	None	None	None	None	OK	Not required	25SP
49	P1_No46_G16-119-TAP_3PH_GEN-2016-119_FAULT	None	None	None	None	None	OK	Not required	25SP

C.1.2 25SP Dynamic Stability Analysis Plots

Plots of stability simulations for 25SP scenario modification study are in separate files which are listed below.

AppendixC1-2_GEN-2015-066_Modification_25SP_Stability_Plots.zip

C.2 25WP Dynamic Stability Analysis Results

Stability simulation for modification study was performed in the 25WP scenario.

C.2.1 25WP Dynamic Stability Analysis Results Summary

25SP dynamic stability results summary for modification study is in Table C-2.

Table C-2. GEN-2015-066 25WP Stability Analysis Results Summary

Table C-2. GEN-2015-066 25WP Stability Analysis Results Summary

Cont. No.	Contingency Description	Damping Violation	Trip	Out of step	Relay Violation	Voltage Violation	Plots	Mitigations	Scneario
1	Nofault	None	None	None	None	None	OK	Not required	25WP
2	P4_SOONER_7	None	None	None	None	None	OK	Not required	25WP
3	P4_CLEVLND7	None	None	None	None	None	OK	Not required	25WP
4	P1_No1_G15-066T_3PH_CLEVLND7_FAULT	None	None	None	None	None	OK	Not required	25WP
5	P1_No2_G15-066T_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25WP
6	P1_No3_CLEVLND7_3PH_T.NO.--7_FAULT	None	None	None	None	None	OK	Not required	25WP
7	P1_No4_CLEVLND7_3PH_G15-066T_FAULT	None	None	None	None	None	OK	Not required	25WP
8	P1_No5_CLEVLND7_3PH_CLEVLND 4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP
9	P1_No6_SOONER 7_3PH_WEKIWA-7_FAULT	None	None	None	None	None	OK	Not required	25WP
10	P1_No7_SOONER 7_3PH_RANCHRD7_FAULT	None	None	None	None	None	OK	Not required	25WP
11	P1_No8_SOONER 7_3PH_THUNDER7_FAULT	None	None	None	None	None	OK	Not required	25WP
12	P1_No9_SOONER 7_3PH_PINTAIL7_FAULT	None	None	None	None	None	OK	Not required	25WP
13	P1_No10_SOONER 7_3PH_G15-066T_FAULT	None	None	None	None	None	OK	Not required	25WP
14	P1_No11_SOONER 7_3PH_G16-119-TAP_FAULT	None	None	None	None	None	OK	Not required	25WP
15	P1_No12_SOONER 7_3PH_SOONER2G_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP
16	P1_No13_SOONER 7_3PH_SOONER 4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP
17	P1_No14_WEKIWA-7_3PH_T.NO.--7_FAULT	None	None	None	None	None	OK	Not required	25WP
18	P1_No15_WEKIWA-7_3PH_SAPLPRD7_FAULT	None	None	None	None	None	OK	Not required	25WP
19	P1_No16_WEKIWA-7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25WP
20	P1_No17_WEKIWA-7_3PH_WEKIWA-4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP
21	P1_No18_T.NO.--7_3PH_WEKIWA-7_FAULT	None	None	None	None	None	OK	Not required	25WP
22	P1_No19_T.NO.--7_3PH_N.E.S.-7_FAULT	None	None	None	None	None	OK	Not required	25WP
23	P1_No20_T.NO.--7_3PH_CLEVLND7_FAULT	None	None	None	None	None	OK	Not required	25WP
24	P1_No21_T.NO.--7_3PH_G21-047-TAP_FAULT	None	None	None	None	None	OK	Not required	25WP
25	P1_No22_T.NO.--7_3PH_T.NO.2-4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP
26	P1_No23_CLEVLND 4_3PH_4CLEVLND_FAULT	None	None	None	None	None	OK	Not required	25WP
27	P1_No24_CLEVLND 4_3PH_CLEVLND7_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP
28	P1_No25_SOONER 4_3PH_MILLERT4_FAULT	None	None	None	None	None	OK	Not required	25WP
29	P1_No26_SOONER 4_3PH_PERRY 4_FAULT	None	None	None	None	None	OK	Not required	25WP
30	P1_No27_SOONER 4_3PH_SNRPMPT4_FAULT	None	None	None	None	None	OK	Not required	25WP
31	P1_No28_SOONER 4_3PH_MORISNT4_FAULT	None	None	None	None	None	OK	Not required	25WP
32	P1_No29_SOONER 4_3PH_SOONER1G_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP
33	P1_No30_SOONER 4_3PH_SOONER 7_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP
34	P1_No31_RANCHRD7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25WP
35	P1_No32_RANCHRD7_3PH_OPENSKY7_FAULT	None	None	None	None	None	OK	Not required	25WP
36	P1_No33_RANCHRD7_3PH_FRNTWND7_FAULT	None	None	None	None	None	OK	Not required	25WP
37	P1_No34_RANCHRD7_3PH_OMCDLEC7_FAULT	None	None	None	None	None	OK	Not required	25WP
38	P1_No35_RANCHRD7_3PH_G18-071_TAP_FAULT	None	None	None	None	None	OK	Not required	25WP
39	P1_No36_THUNDER7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25WP
40	P1_No37_THUNDER7_3PH_GEN-2021-018_FAULT	None	None	None	None	None	OK	Not required	25WP
41	P1_No38_THUNDER7_3PH_GEN-2021-019_FAULT	None	None	None	None	None	OK	Not required	25WP
42	P1_No39_THUNDER7_3PH_THNDRL11_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP
43	P1_No40_THUNDER7_3PH_THNDRL21_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP
44	P1_No41_PINTAIL7_3PH_WOODRNG7_FAULT	None	None	None	None	None	OK	Not required	25WP
45	P1_No42_PINTAIL7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25WP
46	P1_No43_PINTAIL7_3PH_KINGWD 7_FAULT	None	None	None	None	None	OK	Not required	25WP
47	P1_No44_G16-119-TAP_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25WP

Cont. No.	Contingency Description	Damping Violation	Trip	Out of step	Relay Violation	Voltage Violation	Plots	Mitigations	Scneario
48	P1_No45_G16-119-TAP_3PH_SPRNGCK7_FAULT	None	None	None	None	None	OK	Not required	25WP
49	P1_No46_G16-119-TAP_3PH_GEN-2016-119_FAULT	None	None	None	None	None	OK	Not required	25WP

C.2.2 25WP Dynamic Stability Analysis Plots

Plots of stability simulations for 25WP scenario modification study are in separate files which are listed below.

AppendixC2-2_GEN-2015-066_Modification_25WP_Stability_Plots.zip

Appendix

D

Sensitivity Analysis

D.1 Power Flow Data – Sensitivity Analysis

```
DATA FOR BUS 515870     [GE2.82      0.6900] RESIDING IN AREA    1, ZONE    1, OWNER    1:

 CODE VOLTAGE   ANGLE
   2  1.00052   33.35

       X------POSITIVE SEQUENCE------X X--NEG. SEQ---X X----------ZERO SEQUENCE----------X
 ID ST    R       X"      X'       X       R       X       R       X     R-GRND  X-GRND CZG   MBASE    X T R A
N     GENTAP
 1  1  0.00000 0.80000 0.80000 0.80000 0.00000 0.80000 0.00000 0.80000 0.00000 0.00000  1    74.55 0.00000
0.00000 1.00000

 X--------- TO BUS ----------X        XFRMER    S W C X-- POS & NEG --X        C    MAGNETIZING Y  C
CORRECTION
   BUS#-SCT X-- NAME --X BASKV CKT X-- NAME --X T 1 Z   R 1-2    X 1-2 SBAS1-2 M    MAG1     MAG2  W  WINDV1
NOMV1  ANGLE  WINDV2  NOMV2 TAB FACTOR
 515871     SUB_B-WIND  34.500  1               1 T 2  0.00760  0.05700   64.4 2        0  0.00000 1 1.00000
34.500    0.0 1.00000 0.6900   0

 X--------- TO BUS ----------X
   BUS#-SCT X-- NAME --X BASKV CKT CC CZ0   R01      X01      R02      X02  CZG   RG1      XG1      RG2
XG2     RNUTRL   XNUTRL
 515871     SUB_B-WIND  34.500  1   4  1  0.01180  0.08850  0.00000  0.00000 1  0.00000  0.00000  0.00000
0.00000  0.00000  0.00000


 DATA FOR BUS 515871     [SUB_B-WIND  34.500] RESIDING IN AREA    1, ZONE    1, OWNER    1:

 CODE VOLTAGE   ANGLE
   1  0.99362   30.05

 X--------- TO BUS ----------X           X- POS AND NEG SEQUENCE -X X---- ZERO SEQUENCE -----X  MOV CUR  MOV
   BUS#-SCT X-- NAME --X BASKV CKT ST ZI   R (PU)   X (PU)   B (PU)   R (PU)   X (PU)   B (PU)    LEVEL FLAG
 515872     LV_301      34.500  1   1     0.01518  0.02567  0.02795  0.00000  0.00000  0.00000

 X--------- TO BUS ----------X        XFRMER    S W C X-- POS & NEG --X        C    MAGNETIZING Y  C
CORRECTION
   BUS#-SCT X-- NAME --X BASKV CKT X-- NAME --X T 1 Z   R 1-2    X 1-2 SBAS1-2 M    MAG1     MAG2  W  WINDV1
NOMV1  ANGLE  WINDV2  NOMV2 TAB FACTOR
 515870     GE2.82      0.6900  1               1 F 2  0.00760  0.05700   64.4 2        0  0.00000 1 1.00000
34.500    0.0 1.00000 0.6900   0

 X--------- TO BUS ----------X
   BUS#-SCT X-- NAME --X BASKV CKT CC CZ0   R01      X01      R02      X02  CZG   RG1      XG1      RG2
XG2     RNUTRL   XNUTRL
 515870     GE2.82      0.6900  1   4  1  0.01180  0.08850  0.00000  0.00000 1  0.00000  0.00000  0.00000
0.00000  0.00000  0.00000


 DATA FOR BUS 515872     [LV_301      34.500] RESIDING IN AREA    1, ZONE    1, OWNER    1:

 CODE VOLTAGE   ANGLE
   1  0.98427   29.07

 X--------- TO BUS ----------X           X- POS AND NEG SEQUENCE -X X---- ZERO SEQUENCE -----X  MOV CUR  MOV
   BUS#-SCT X-- NAME --X BASKV CKT ST ZI   R (PU)   X (PU)   B (PU)   R (PU)   X (PU)   B (PU)    LEVEL FLAG
 515871     SUB_B-WIND  34.500  1   1     0.01518  0.02567  0.02795  0.00000  0.00000  0.00000

 X- XFRMER -X S X--------- WINDING 1 ----------X X--------- WINDING 2 ----------X X--------- WINDING 3 -------
---X     C    MAGNETIZING Y
 X-- NAME --X T   BUS#-SCT X-- NAME --X BASKV ST   BUS#-SCT X-- NAME --X BASKV ST   BUS#-SCT X-- NAME --X
BASKV ST CKT M    MAG1     MAG2  SBAS1-2 SBAS2-3 SBAS3-1
 SUB_B        1 515974     SUB_HV      345.00  1 515872     LV_301      34.500  1 515975     TV_251
13.800  1  1  1  0.00051 -0.00035    69.0    69.0    69.0

 X- XFRMER -X S C X------ SPECIFIED NOMINAL MEASURED IMPEDANCES ------X C
 X-- NAME --X T Z   R 1-2    X 1-2    R 2-3    X 2-3    R 3-1    X 3-1  W  WINDV1  NOMV1 ANGLE1  WINDV2  NOMV2
ANGLE2  WINDV3  NOMV3 ANGLE3
```

```
 SUB_B        1 2  0.00200  0.08189  0.00307  0.02441  0.00369  0.11624 1 1.02609 354.00    0.0 1.00000 34.500
0.0 1.00000 13.800    0.0

 X- XFRMER -X S        X---------- SPECIFIED NOMINAL IMPEDANCES -----------X   X-----------------------
GROUNDING IMPEDANCES ------------------------X
 X-- NAME --X T  CC CZ0    R01      X01      R02      X02      R03      X03  CZG   RG1      XG1      RG2
XG2      RG3      XG3     RNUTRL   XNUTRL
 SUB_B        1   4  1  0.00390  0.15583 -0.00002 -0.00098  0.00198  0.07939 1  0.00000  0.00000  0.00000
0.00000  0.00000  0.00000  0.00000  0.00000


 DATA FOR BUS 515970     [GE2.82      0.6900] RESIDING IN AREA    1, ZONE    1, OWNER    1:

 CODE VOLTAGE   ANGLE
   2  1.02028   36.22

       X------POSITIVE SEQUENCE------X X--NEG. SEQ---X X----------ZERO SEQUENCE----------X
 ID ST    R       X"      X'       X       R       X       R       X     R-GRND  X-GRND CZG   MBASE    X T R A
N     GENTAP
 1  1  0.00000 0.80000 0.80000 0.80000 0.00000 0.80000 0.00000 0.80000 0.00000 0.00000  1   173.09 0.00000
0.00000 1.00000

 X--------- TO BUS ----------X        XFRMER    S W C X-- POS & NEG --X        C    MAGNETIZING Y  C
CORRECTION
   BUS#-SCT X-- NAME --X BASKV CKT X-- NAME --X T 1 Z   R 1-2    X 1-2 SBAS1-2 M    MAG1     MAG2  W  WINDV1
NOMV1  ANGLE  WINDV2  NOMV2 TAB FACTOR
 515971     SUB_A-WIND  34.500  1               1 T 2  0.00760  0.05700  154.0 2        0  0.00000 1 1.00000
34.500    0.0 1.00000 0.6900   0

 X--------- TO BUS ----------X
   BUS#-SCT X-- NAME --X BASKV CKT CC CZ0   R01      X01      R02      X02  CZG   RG1      XG1      RG2
XG2     RNUTRL   XNUTRL
 515971     SUB_A-WIND  34.500  1   4  1  0.00493  0.03701  0.00000  0.00000 1  0.00000  0.00000  0.00000
0.00000  0.00000  0.00000


 DATA FOR BUS 515971     [SUB_A-WIND  34.500] RESIDING IN AREA    1, ZONE    1, OWNER    1:

 CODE VOLTAGE   ANGLE
   1  1.01397   33.04

 X--------- TO BUS ----------X           X- POS AND NEG SEQUENCE -X X---- ZERO SEQUENCE -----X  MOV CUR  MOV
   BUS#-SCT X-- NAME --X BASKV CKT ST ZI   R (PU)   X (PU)   B (PU)   R (PU)   X (PU)   B (PU)    LEVEL FLAG
 515972     LV_300      34.500  1   1     0.01585  0.03307  0.15619  0.00000  0.00000  0.00000

 X--------- TO BUS ----------X        XFRMER    S W C X-- POS & NEG --X        C    MAGNETIZING Y  C
CORRECTION
   BUS#-SCT X-- NAME --X BASKV CKT X-- NAME --X T 1 Z   R 1-2    X 1-2 SBAS1-2 M    MAG1     MAG2  W  WINDV1
NOMV1  ANGLE  WINDV2  NOMV2 TAB FACTOR
 515970     GE2.82      0.6900  1               1 F 2  0.00760  0.05700  154.0 2        0  0.00000 1 1.00000
34.500    0.0 1.00000 0.6900   0

 X--------- TO BUS ----------X
   BUS#-SCT X-- NAME --X BASKV CKT CC CZ0   R01      X01      R02      X02  CZG   RG1      XG1      RG2
XG2     RNUTRL   XNUTRL
 515970     GE2.82      0.6900  1   4  1  0.00493  0.03701  0.00000  0.00000 1  0.00000  0.00000  0.00000
0.00000  0.00000  0.00000


 DATA FOR BUS 515972     [LV_300      34.500] RESIDING IN AREA    1, ZONE    1, OWNER    1:

 CODE VOLTAGE   ANGLE
   1  0.99101   30.14

     S ADJ                                                                    X-------- REGULATED BUS ---
------X X--FACTS/--X
 MOD T METH VHI     VLO      SHUNT  X-------X X-------X X-------X X-------X  PCT Q   BUS#-SCT X-- NAME --X
BASKV NODE X-VSC NAME-X
  1  1   0 1.10000 0.90000    10.00  1:  10.00                                100.00 515972     LV_300
34.500    0
           ZERO SEQUENCE:     0.00  1:   0.00

 X--------- TO BUS ----------X           X- POS AND NEG SEQUENCE -X X---- ZERO SEQUENCE -----X  MOV CUR  MOV
   BUS#-SCT X-- NAME --X BASKV CKT ST ZI   R (PU)   X (PU)   B (PU)   R (PU)   X (PU)   B (PU)    LEVEL FLAG
 515971     SUB_A-WIND  34.500  1   1     0.01585  0.03307  0.15619  0.00000  0.00000  0.00000

 X- XFRMER -X S X--------- WINDING 1 ----------X X--------- WINDING 2 ----------X X--------- WINDING 3 -------
---X     C    MAGNETIZING Y
 X-- NAME --X T   BUS#-SCT X-- NAME --X BASKV ST   BUS#-SCT X-- NAME --X BASKV ST   BUS#-SCT X-- NAME --X
BASKV ST CKT M    MAG1     MAG2  SBAS1-2 SBAS2-3 SBAS3-1
 SUB_A        1 515974     SUB_HV      345.00  1 515972     LV_300      34.500  1 515973     TV_250
13.800  1  1  1  0.00000  0.00000   135.0   135.0   135.0

 X- XFRMER -X S C X------ SPECIFIED NOMINAL MEASURED IMPEDANCES ------X C
 X-- NAME --X T Z   R 1-2    X 1-2    R 2-3    X 2-3    R 3-1    X 3-1  W  WINDV1  NOMV1 ANGLE1  WINDV2  NOMV2
ANGLE2  WINDV3  NOMV3 ANGLE3
```

```
 SUB_A        1 2  0.00212  0.08497  0.00100  0.03999  0.00300  0.11996 3 1.00000 354.00    0.0 1.00000 34.500
0.0 1.00000 13.800    0.0

 X- XFRMER -X S        X---------- SPECIFIED NOMINAL IMPEDANCES -----------X   X-----------------------
GROUNDING IMPEDANCES ------------------------X
 X-- NAME --X T  CC CZ0    R01      X01      R02      X02      R03      X03  CZG   RG1      XG1      RG2
XG2      RG3      XG3     RNUTRL   XNUTRL
 SUB_A        1   4  1  0.00153  0.06109  0.00005  0.00185  0.00069  0.02777 1  0.00000  0.00000  0.00000
0.00000  0.00000  0.00000  0.00000  0.00000


 DATA FOR BUS 515973     [TV_250      13.800] RESIDING IN AREA    1, ZONE    1, OWNER    1:

 CODE VOLTAGE   ANGLE
   1  0.99075   29.98

 X- XFRMER -X S X--------- WINDING 1 ----------X X--------- WINDING 2 ----------X X--------- WINDING 3 -------
---X     C    MAGNETIZING Y
 X-- NAME --X T   BUS#-SCT X-- NAME --X BASKV ST   BUS#-SCT X-- NAME --X BASKV ST   BUS#-SCT X-- NAME --X
BASKV ST CKT M    MAG1     MAG2  SBAS1-2 SBAS2-3 SBAS3-1
 SUB_A        1 515974     SUB_HV      345.00  1 515972     LV_300      34.500  1 515973     TV_250
13.800  1  1  1  0.00000  0.00000   135.0   135.0   135.0

 X- XFRMER -X S C X------ SPECIFIED NOMINAL MEASURED IMPEDANCES ------X C
 X-- NAME --X T Z   R 1-2    X 1-2    R 2-3    X 2-3    R 3-1    X 3-1  W  WINDV1  NOMV1 ANGLE1  WINDV2  NOMV2
ANGLE2  WINDV3  NOMV3 ANGLE3
 SUB_A        1 2  0.00212  0.08497  0.00100  0.03999  0.00300  0.11996 3 1.00000 354.00    0.0 1.00000 34.500
0.0 1.00000 13.800    0.0

 X- XFRMER -X S        X---------- SPECIFIED NOMINAL IMPEDANCES -----------X   X-----------------------
GROUNDING IMPEDANCES ------------------------X
 X-- NAME --X T  CC CZ0    R01      X01      R02      X02      R03      X03  CZG   RG1      XG1      RG2
XG2      RG3      XG3     RNUTRL   XNUTRL
 SUB_A        1   4  1  0.00153  0.06109  0.00005  0.00185  0.00069  0.02777 1  0.00000  0.00000  0.00000
0.00000  0.00000  0.00000  0.00000  0.00000


 DATA FOR BUS 515974     [SUB_HV      345.00] RESIDING IN AREA    1, ZONE    1, OWNER    1:

 CODE VOLTAGE   ANGLE
   1  1.01240   24.60

 X--------- TO BUS ----------X           X- POS AND NEG SEQUENCE -X X---- ZERO SEQUENCE -----X  MOV CUR  MOV
   BUS#-SCT X-- NAME --X BASKV CKT ST ZI    R (PU)    X (PU)    B (PU)    R (PU)    X (PU)    B (PU)     LEVEL FLAG
 560056     G15-066T    345.00  1   1     0.00017  0.00145  0.02697  0.00000  0.00000  0.00000

 X- XFRMER -X S X--------- WINDING 1 ----------X X--------- WINDING 2 ----------X X--------- WINDING 3 -------
---X     C    MAGNETIZING Y
 X-- NAME --X T   BUS#-SCT X-- NAME --X BASKV ST   BUS#-SCT X-- NAME --X BASKV ST   BUS#-SCT X-- NAME --X
BASKV ST CKT M    MAG1     MAG2  SBAS1-2 SBAS2-3 SBAS3-1
 SUB_A        1 515974     SUB_HV      345.00  1 515972     LV_300      34.500  1 515973     TV_250
13.800  1  1  1  0.00000  0.00000   135.0   135.0   135.0
 SUB_B        1 515974     SUB_HV      345.00  1 515872     LV_301      34.500  1 515975     TV_251
13.800  1  1  1  0.00051 -0.00035    69.0    69.0    69.0

 X- XFRMER -X S C X------ SPECIFIED NOMINAL MEASURED IMPEDANCES ------X C
 X-- NAME --X T Z   R 1-2    X 1-2    R 2-3    X 2-3    R 3-1    X 3-1  W  WINDV1  NOMV1 ANGLE1  WINDV2  NOMV2
ANGLE2  WINDV3  NOMV3 ANGLE3
 SUB_A        1 2  0.00212  0.08497  0.00100  0.03999  0.00300  0.11996 3 1.00000 354.00    0.0 1.00000 34.500
0.0 1.00000 13.800    0.0
 SUB_B        1 2  0.00200  0.08189  0.00307  0.02441  0.00369  0.11624 1 1.02609 354.00    0.0 1.00000 34.500
0.0 1.00000 13.800    0.0

 X- XFRMER -X S        X---------- SPECIFIED NOMINAL IMPEDANCES -----------X   X-----------------------
GROUNDING IMPEDANCES ------------------------X
 X-- NAME --X T  CC CZ0    R01      X01      R02      X02      R03      X03  CZG   RG1      XG1      RG2
XG2      RG3      XG3     RNUTRL   XNUTRL
 SUB_A        1   4  1  0.00153  0.06109  0.00005  0.00185  0.00069  0.02777 1  0.00000  0.00000  0.00000
0.00000  0.00000  0.00000  0.00000  0.00000
 SUB_B        1   4  1  0.00390  0.15583 -0.00002 -0.00098  0.00198  0.07939 1  0.00000  0.00000  0.00000
0.00000  0.00000  0.00000  0.00000  0.00000


 DATA FOR BUS 515975     [TV_251      13.800] RESIDING IN AREA    1, ZONE    1, OWNER    1:

 CODE VOLTAGE   ANGLE
   1  0.98356   29.34

 X- XFRMER -X S X--------- WINDING 1 ----------X X--------- WINDING 2 ----------X X--------- WINDING 3 -------
---X     C    MAGNETIZING Y
 X-- NAME --X T   BUS#-SCT X-- NAME --X BASKV ST   BUS#-SCT X-- NAME --X BASKV ST   BUS#-SCT X-- NAME --X
BASKV ST CKT M    MAG1     MAG2  SBAS1-2 SBAS2-3 SBAS3-1
 SUB_B        1 515974     SUB_HV      345.00  1 515872     LV_301      34.500  1 515975     TV_251
13.800  1  1  1  0.00051 -0.00035    69.0    69.0    69.0

 X- XFRMER -X S C X------ SPECIFIED NOMINAL MEASURED IMPEDANCES ------X C
```

```
 X-- NAME --X T Z   R 1-2    X 1-2    R 2-3    X 2-3    R 3-1    X 3-1  W  WINDV1  NOMV1 ANGLE1  WINDV2  NOMV2
ANGLE2  WINDV3  NOMV3 ANGLE3
 SUB_B        1 2  0.00200  0.08189  0.00307  0.02441  0.00369  0.11624 1 1.02609 354.00    0.0 1.00000 34.500
0.0 1.00000 13.800    0.0

 X- XFRMER -X S        X---------- SPECIFIED NOMINAL IMPEDANCES -----------X   X-----------------------
GROUNDING IMPEDANCES ----------------------X
 X-- NAME --X T  CC CZ0   R01      X01      R02      X02      R03      X03  CZG   RG1      XG1      RG2
XG2      RG3      XG3     RNUTRL   XNUTRL
 SUB_B        1   4  1  0.00390  0.15583 -0.00002 -0.00098  0.00198  0.07939 1  0.00000  0.00000  0.00000
0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
```

D.2 Short Circuit Analysis Results – Sensitivity Analysis Case

Table D-1. Full Sensitivity Short Circuit Analysis Results

Bus Number	Bus Name	Base kV	Area Name	3PH Fault Current (kA)		Difference (ON-OFF)		Distance from GEN POI BUS 560056
				GEN ON	GEN OFF	Change	%	
560056	G15-066T	345	OKGE	19.6624	19.2549	0.4075	2.12%	0
514803	SOONER 7	345	OKGE	29.1841	28.8737	0.3104	1.08%	1
512694	CLEVLND7	345	GRDA	15.9135	15.8138	0.0997	0.63%	1
515894	THUNDER7	345	OKGE	11.5185	11.4750	0.0434	0.38%	2
765480	GEN-2021-019	345	OKGE	11.4050	11.3625	0.0426	0.37%	3
516010	PINTAIL7	345	OKGE	17.0126	16.9684	0.0442	0.26%	2
516019	KINGWD 7	345	OKGE	16.9524	16.9086	0.0438	0.26%	3
587804	G16-119-TAP	345	OKGE	15.3516	15.3142	0.0373	0.24%	2
765470	GEN-2021-018	345	OKGE	6.8176	6.8031	0.0145	0.21%	3
515576	RANCHRD7	345	OKGE	15.1987	15.1674	0.0314	0.21%	2
529200	OMCDLEC7	345	OMPA	15.1710	15.1397	0.0312	0.21%	3
763069	G18-071_TAP	345	OKGE	14.7750	14.7455	0.0294	0.20%	3
763065	GEN-2018-071	345	OKGE	14.7154	14.6862	0.0292	0.20%	4
509852	T.NO.--7	345	AEPW	24.5749	24.5287	0.0462	0.19%	2
515688	FRNTWND7	345	OKGE	11.7643	11.7458	0.0185	0.16%	3
516066	FRNT2WD7	345	OKGE	11.7558	11.7378	0.0180	0.15%	4
509755	WEKIWA-7	345	AEPW	22.6678	22.6356	0.0322	0.14%	2
515621	OPENSKY7	345	OKGE	13.3875	13.3701	0.0174	0.13%	3
587950	GEN-2016-119	345	OKGE	9.0556	9.0438	0.0118	0.13%	3
514825	KAYWIND7	345	OKGE	13.3480	13.3307	0.0173	0.13%	4
514715	WOODRNG7	345	OKGE	19.4093	19.3868	0.0225	0.12%	3
587955	GEN2016-119B	345	OKGE	7.7908	7.7822	0.0085	0.11%	4
514802	SOONER 4	138	OKGE	31.4511	31.4181	0.0330	0.11%	2
512729	CLEVLND 4	138	GRDA	24.0680	24.0457	0.0222	0.09%	2
300138	4CLEVLND	138	AECI	24.0696	24.0474	0.0222	0.09%	3
762321	GEN-2017-164	345	OKGE	11.4047	11.3972	0.0074	0.07%	4
514881	SPRNGCK7	345	OKGE	23.4966	23.4816	0.0150	0.06%	3
514704	MILLERT4	138	OKGE	20.4016	20.3889	0.0128	0.06%	3
514798	SNRPMPT4	138	OKGE	20.4587	20.4460	0.0127	0.06%	3

Bus Number	Bus Name	Base kV	Area Name	3PH Fault Current (kA)		Difference (ON-OFF)		Distance from GEN POI BUS 560056
				GEN ON	GEN OFF	Change	%	
509870	SAPLPRD7	345	AEPW	22.9765	22.9622	0.0142	0.06%	3
560053	G15052_T	345	WERE	13.5334	13.5257	0.0077	0.06%	4
562900	G15052_1	345	WERE	13.4845	13.4768	0.0076	0.06%	5
515875	REDNGTN7	345	OKGE	17.3961	17.3864	0.0098	0.06%	4
515877	REDDIRT7	345	OKGE	17.3918	17.3821	0.0097	0.06%	5
509895	T.NO.2-4	138	AEPW	35.6534	35.6343	0.0190	0.05%	3
762636	GEN-2018-028	138	OKGE	35.6370	35.6180	0.0190	0.05%	4
509757	WEKIWA-4	138	AEPW	33.7972	33.7793	0.0179	0.05%	3
560389	GEN-2010-055	138	AEPW	33.7972	33.7793	0.0179	0.05%	4
509817	T.NO.--4	138	AEPW	35.6843	35.6655	0.0188	0.05%	4
515476	HUNTERS7	345	OKGE	13.1975	13.1908	0.0067	0.05%	4
515477	CHSHLMV7	345	OKGE	13.1783	13.1716	0.0067	0.05%	5
515978	OTOETAP4	138	OKGE	16.3110	16.3028	0.0082	0.05%	4
514737	OTOE 4	138	OKGE	16.2654	16.2573	0.0081	0.05%	5
514880	NORTWST7	345	OKGE	33.2106	33.1942	0.0164	0.05%	4
301011	4REDRCK	138	AECI	15.9428	15.9350	0.0078	0.05%	5
510406	N.E.S.-7	345	AEPW	18.9218	18.9127	0.0092	0.05%	3
762342	GEN-2017-178	345	OKGE	7.9437	7.9401	0.0036	0.05%	5
515497	MATHWSN7	345	OKGE	33.1989	33.1852	0.0136	0.04%	5
509782	R.S.S.-7	345	AEPW	32.3917	32.3793	0.0124	0.04%	4
588039	G16133G16146	345	AEPW	32.3917	32.3793	0.0124	0.04%	5
505610	KEYSTON4	138	SWPA	23.2860	23.2777	0.0082	0.04%	4
509834	COGENT 7	345	AEPW	29.9943	29.9839	0.0104	0.03%	5
515412	DMNCRKT4	138	OKGE	13.8748	13.8700	0.0048	0.03%	4
514799	SNRPMP 4	138	OKGE	11.2741	11.2703	0.0039	0.03%	4
514901	CIMARON7	345	OKGE	34.7666	34.7554	0.0113	0.03%	5
515543	RENFROW7	345	OKGE	12.5109	12.5072	0.0037	0.03%	5
514743	OSAGE 4	138	OKGE	17.2002	17.1953	0.0049	0.03%	4
532794	ROSEHIL7	345	WERE	17.8989	17.8940	0.0050	0.03%	5
514761	WHEAGLE4	138	OKGE	16.2749	16.2704	0.0045	0.03%	5
765721	G21-047-TAP	345	GRDA	15.9184	15.9141	0.0043	0.03%	3
515447	MORISNT4	138	OKGE	14.3920	14.3882	0.0039	0.03%	3

Bus Number	Bus Name	Base kV	Area Name	3PH Fault Current (kA)		Difference (ON-OFF)		Distance from GEN POI BUS 560056
				GEN ON	GEN OFF	Change	%	
515006	MORRISN4	138	OKGE	14.3631	14.3593	0.0038	0.03%	4
765720	GEN-2021-047	345	GRDA	15.5692	15.5651	0.0041	0.03%	4
509815	S.S.---4	138	AEPW	29.0102	29.0027	0.0075	0.03%	5
300140	4SILVCTY	138	AECI	17.7745	17.7701	0.0045	0.03%	4
509842	CDC-WT 4	138	AEPW	19.6423	19.6373	0.0050	0.03%	5
512726	SILVCTYGR4	138	GRDA	17.5577	17.5533	0.0044	0.03%	4
509896	DENV_WTAP4	138	AEPW	28.2650	28.2580	0.0070	0.02%	5
509812	SHEFFD-4	138	AEPW	26.1849	26.1784	0.0065	0.02%	4
509807	ONETA--7	345	AEPW	29.3619	29.3547	0.0072	0.02%	4
509836	OEC 7	345	AEPW	29.0687	29.0617	0.0070	0.02%	5
514707	PERRY 4	138	OKGE	11.3775	11.3748	0.0027	0.02%	3
514758	STDBEAR4	138	OKGE	14.3173	14.3139	0.0034	0.02%	5
514714	WOODRNG4	138	OKGE	20.5608	20.5560	0.0049	0.02%	4
509851	P&P WTP4	138	AEPW	15.3053	15.3017	0.0036	0.02%	4
514706	COWCRK 4	138	OKGE	11.7296	11.7269	0.0027	0.02%	4
300131	4FISHERTP	138	AECI	15.4518	15.4483	0.0035	0.02%	5
515990	SKELTON7	345	OKGE	4.9756	4.9745	0.0011	0.02%	4
509839	CDC-ET 4	138	AEPW	18.8690	18.8648	0.0042	0.02%	5
514709	FRMNTAP4	138	OKGE	19.0925	19.0883	0.0042	0.02%	5
509871	SAPLPRD4	138	AEPW	33.3032	33.2960	0.0072	0.02%	4
588190	GEN-2016-128	345	OKGE	4.7308	4.7298	0.0010	0.02%	5
509823	WED-TAP4	138	AEPW	19.3119	19.3079	0.0039	0.02%	4
515400	DMANCRK4	138	OKGE	8.1031	8.1015	0.0016	0.02%	5
512749	PAWNSW4	138	GRDA	11.0994	11.0972	0.0022	0.02%	4
509875	RSS T2 4	138	AEPW	52.6239	52.6135	0.0105	0.02%	5
509773	RSS T1 4	138	AEPW	51.7015	51.6914	0.0101	0.02%	5
514879	NORTWST4	138	OKGE	44.9723	44.9638	0.0084	0.02%	5
509806	ONETA--4	138	AEPW	50.1580	50.1488	0.0092	0.02%	5
513596	IGLOOV 7	345	GRDA	20.1078	20.1042	0.0036	0.02%	4
514770	MARLNDT4	138	OKGE	11.1823	11.1803	0.0020	0.02%	5
510380	DELWARE7	345	AEPW	11.7331	11.7310	0.0020	0.02%	4
300927	2CLEVLND	69	AECI	10.5294	10.5276	0.0018	0.02%	4

Bus Number	Bus Name	Base kV	Area Name	3PH Fault Current (kA)		Difference (ON-OFF)		Distance from GEN POI BUS 560056
				GEN ON	GEN OFF	Change	%	
514711	WAUKOTP4	138	OKGE	16.4538	16.4512	0.0027	0.02%	5
514908	ARCADIA7	345	OKGE	32.3421	32.3371	0.0050	0.02%	5
514713	WRVALLY4	138	OKGE	9.1985	9.1971	0.0014	0.01%	5
512865	GREC TAP5	345	GRDA	25.2145	25.2108	0.0037	0.01%	5
515011	STILWTR4	138	OKGE	15.3994	15.3971	0.0023	0.01%	4
509844	OWASOTP4	138	AEPW	15.0269	15.0248	0.0021	0.01%	5
509746	DENVTAP4	138	AEPW	9.3834	9.3821	0.0013	0.01%	5
515009	MCELROY4	138	OKGE	15.3925	15.3904	0.0021	0.01%	5
509848	OAKSWTP4	138	AEPW	25.0453	25.0419	0.0034	0.01%	5
514909	REDBUD 7	345	OKGE	30.5450	30.5409	0.0041	0.01%	5
509884	SKIATOK4	138	AEPW	10.5087	10.5073	0.0014	0.01%	5
509805	PP----W4	138	AEPW	8.3657	8.3647	0.0011	0.01%	5
509888	72ELWOD4	138	AEPW	23.4681	23.4651	0.0030	0.01%	5
509865	CARSONT4	138	AEPW	11.9835	11.9820	0.0015	0.01%	5
509759	JENKS--4	138	AEPW	25.4972	25.4941	0.0031	0.01%	5
505609	KEYSTON5	161	SWPA	7.1632	7.1624	0.0009	0.01%	5
300141	4STILWTR	138	AECI	18.7415	18.7393	0.0022	0.01%	5
300139	4FAIRFAX	138	AECI	7.7216	7.7208	0.0009	0.01%	5
300996	4JAVINE	138	AECI	6.7286	6.7279	0.0008	0.01%	4
514708	OTTER 4	138	OKGE	11.3261	11.3248	0.0013	0.01%	5
513095	GLENCOKM 4	138	GRDA	11.9115	11.9102	0.0013	0.01%	5
510396	N.E.S.-4	138	AEPW	34.7904	34.7866	0.0038	0.01%	5
509900	46ST-TP-4	138	AEPW	9.6017	9.6007	0.0010	0.01%	5
301339	4SFORKKTP	138	AECI	6.9744	6.9737	0.0007	0.01%	5
509745	CLARKSV7	345	AEPW	20.6406	20.6387	0.0020	0.01%	5
510376	WEBBTAP4	138	AEPW	7.6826	7.6819	0.0007	0.01%	5
515235	PECANCK7	345	OKGE	22.5728	22.5708	0.0020	0.01%	5
512876	OSAGEK2	69	GRDA	7.2300	7.2294	0.0006	0.01%	5
532793	NEOSHO 7	345	WERE	17.2337	17.2323	0.0014	0.01%	5
515574	SPGVLLY4	138	OKGE	11.1556	11.1547	0.0009	0.01%	5
514742	OSGE 2	69	OKGE	18.3149	18.3134	0.0015	0.01%	5
300943	2SILVCTY	69	AECI	10.5405	10.5398	0.0008	0.01%	5

Bus Number	Bus Name	Base kV	Area Name	3PH Fault Current (kA)		Difference (ON-OFF)		Distance from GEN POI BUS 560056
				GEN ON	GEN OFF	Change	%	
513593	IGLOOV1 5	161	GRDA	16.8124	16.8112	0.0012	0.01%	5
513595	IGLOOV2 5	161	GRDA	16.8124	16.8112	0.0012	0.01%	5
514733	MARSHL 4	138	OKGE	8.0676	8.0671	0.0005	0.01%	5
510379	DELWARE4	138	AEPW	11.5013	11.5007	0.0006	0.01%	5
513098	HALLETTAP 2	69	GRDA	4.0613	4.0611	0.0002	0.00%	5
300137	4BRISTOW	138	AECI	10.2892	10.2888	0.0004	0.00%	5
514705	COWCRK 2	69	OKGE	4.0742	4.0740	0.0002	0.00%	5

D.3 25SP Sensitivity Dynamic Stability Analysis Results

Stability simulation for sensitivity analysis was performed in the 25SP sensitivity scenario.

D.3.1 25SP Sensitivity Dynamic Stability Analysis Results Summary

25SP sensitivity dynamic stability results summary for sensitivity analysis is in Table D-2

Table D-2. GEN-2015-066 25SP Sensitivity Stability Analysis Results Summary

Table D-2. GEN-2015-066 25SP Sensitivity Stability Analysis Results Summary

Cont. No.	Contingency Description	Damping Violation	Trip	Out of step	Relay Violation	Voltage Violation	Plots	Mitigations	Scneario
1	Nofault	None	None	None	None	None	OK	Not required	25SP-Sens
2	P4_SOONER_7	None	None	None	None	None	OK	Not required	25SP-Sens
3	P4_CLEVLND7	None	None	None	None	None	OK	Not required	25SP-Sens
4	P1_No1_G15-066T_3PH_CLEVLND7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
5	P1_No2_G15-066T_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
6	P1_No3_CLEVLND7_3PH_T.NO.--7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
7	P1_No4_CLEVLND7_3PH_G15-066T_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
8	P1_No5_CLEVLND7_3PH_CLEVLND 4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
9	P1_No6_SOONER 7_3PH_WEKIWA-7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
10	P1_No7_SOONER 7_3PH_RANCHRD7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
11	P1_No8_SOONER 7_3PH_THUNDER7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
12	P1_No9_SOONER 7_3PH_PINTAIL7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
13	P1_No10_SOONER 7_3PH_G15-066T_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
14	P1_No11_SOONER 7_3PH_G16-119-TAP_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
15	P1_No12_SOONER 7_3PH_SOONER2G_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
16	P1_No13_SOONER 7_3PH_SOONER 4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
17	P1_No14_WEKIWA-7_3PH_T.NO.--7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
18	P1_No15_WEKIWA-7_3PH_SAPLPRD7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
19	P1_No16_WEKIWA-7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
20	P1_No17_WEKIWA-7_3PH_WEKIWA-4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
21	P1_No18_T.NO.--7_3PH_WEKIWA-7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
22	P1_No19_T.NO.--7_3PH_N.E.S.-7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
23	P1_No20_T.NO.--7_3PH_CLEVLND7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
24	P1_No21_T.NO.--7_3PH_G21-047-TAP_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
25	P1_No22_T.NO.--7_3PH_T.NO.2-4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
26	P1_No23_CLEVLND 4_3PH_4CLEVLND_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
27	P1_No24_CLEVLND 4_3PH_CLEVLND7_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
28	P1_No25_SOONER 4_3PH_MILLERT4_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
29	P1_No26_SOONER 4_3PH_PERRY 4_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
30	P1_No27_SOONER 4_3PH_SNRPMPT4_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
31	P1_No28_SOONER 4_3PH_MORISNT4_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
32	P1_No29_SOONER 4_3PH_SOONER1G_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
33	P1_No30_SOONER 4_3PH_SOONER 7_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
34	P1_No31_RANCHRD7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
35	P1_No32_RANCHRD7_3PH_OPENSKY7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
36	P1_No33_RANCHRD7_3PH_FRNTWND7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
37	P1_No34_RANCHRD7_3PH_OMCDLEC7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
38	P1_No35_RANCHRD7_3PH_G18-071_TAP_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
39	P1_No36_THUNDER7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
40	P1_No37_THUNDER7_3PH_GEN-2021-018_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
41	P1_No38_THUNDER7_3PH_GEN-2021-019_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
42	P1_No39_THUNDER7_3PH_THNDRL11_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
43	P1_No40_THUNDER7_3PH_THNDRL21_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
44	P1_No41_PINTAIL7_3PH_WOODRNG7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
45	P1_No42_PINTAIL7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
46	P1_No43_PINTAIL7_3PH_KINGWD 7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
47	P1_No44_G16-119-TAP_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens

Cont. No.	Contingency Description	Damping Violation	Trip	Out of step	Relay Violation	Voltage Violation	Plots	Mitigations	Scneario
48	P1_No45_G16-119-TAP_3PH_SPRNGCK7_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens
49	P1_No46_G16-119-TAP_3PH_GEN-2016-119_FAULT	None	None	None	None	None	OK	Not required	25SP-Sens

D.3.2 25SP Sensitivity Dynamic Stability Analysis Plots

Plots of stability simulations for 25SP sensitivity scenario analysis are in separate files which are listed below.

AppendixD3-2_GEN-2015-066_Sensitivity_25SP_Stability_Plots.zip

D.4 25WP Sensitivity Dynamic Stability Analysis Results

Stability simulation for modification study was performed in the 25WP sensitivity scenario.

D.4.1 25WP Sensitivity Dynamic Stability Analysis Results Summary

25SP sensitivity dynamic stability results summary is in Table D-3.

Table D-3. GEN-2015-066 25WP Sensitivity Stability Analysis Results Summary

Table D-3. GEN-2015-066 25WP Sensitivity Stability Analysis Results Summary

Cont. No.	Contingency Description	Damping Violation	Trip	Out of step	Relay Violation	Voltage Violation	Plots	Mitigations	Scneario
1	Nofault	None	None	None	None	None	OK	Not required	25WP-Sens
2	P4_SOONER_7	None	None	None	None	None	OK	Not required	25WP-Sens
3	P4_CLEVLND7	None	None	None	None	None	OK	Not required	25WP-Sens
4	P1_No1_G15-066T_3PH_CLEVLND7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
5	P1_No2_G15-066T_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
6	P1_No3_CLEVLND7_3PH_T.NO.--7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
7	P1_No4_CLEVLND7_3PH_G15-066T_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
8	P1_No5_CLEVLND7_3PH_CLEVLND 4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
9	P1_No6_SOONER 7_3PH_WEKIWA-7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
10	P1_No7_SOONER 7_3PH_RANCHRD7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
11	P1_No8_SOONER 7_3PH_THUNDER7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
12	P1_No9_SOONER 7_3PH_PINTAIL7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
13	P1_No10_SOONER 7_3PH_G15-066T_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
14	P1_No11_SOONER 7_3PH_G16-119-TAP_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
15	P1_No12_SOONER 7_3PH_SOONER2G_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
16	P1_No13_SOONER 7_3PH_SOONER 4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
17	P1_No14_WEKIWA-7_3PH_T.NO.--7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
18	P1_No15_WEKIWA-7_3PH_SAPLPRD7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
19	P1_No16_WEKIWA-7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
20	P1_No17_WEKIWA-7_3PH_WEKIWA-4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
21	P1_No18_T.NO.--7_3PH_WEKIWA-7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
22	P1_No19_T.NO.--7_3PH_N.ES.-7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
23	P1_No20_T.NO.--7_3PH_CLEVLND7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
24	P1_No21_T.NO.--7_3PH_G21-047-TAP_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
25	P1_No22_T.NO.--7_3PH_T.NO.2-4_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
26	P1_No23_CLEVLND 4_3PH_4CLEVLND_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
27	P1_No24_CLEVLND 4_3PH_CLEVLND7_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
28	P1_No25_SOONER 4_3PH_MILLERT4_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
29	P1_No26_SOONER 4_3PH_PERRY 4_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
30	P1_No27_SOONER 4_3PH_SNRPMPT4_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
31	P1_No28_SOONER 4_3PH_MORISNT4_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
32	P1_No29_SOONER 4_3PH_SOONER1G_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
33	P1_No30_SOONER 4_3PH_SOONER 7_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
34	P1_No31_RANCHRD7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
35	P1_No32_RANCHRD7_3PH_OPENSKY7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
36	P1_No33_RANCHRD7_3PH_FRNTWND7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
37	P1_No34_RANCHRD7_3PH_OMCDLEC7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
38	P1_No35_RANCHRD7_3PH_G18-071_TAP_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
39	P1_No36_THUNDER7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
40	P1_No37_THUNDER7_3PH_GEN-2021-018_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
41	P1_No38_THUNDER7_3PH_GEN-2021-019_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
42	P1_No39_THUNDER7_3PH_THNDRL11_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
43	P1_No40_THUNDER7_3PH_THNDRL21_XFMR1_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
44	P1_No41_PINTAIL7_3PH_WOODRNG7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
45	P1_No42_PINTAIL7_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
46	P1_No43_PINTAIL7_3PH_KINGWD 7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
47	P1_No44_G16-119-TAP_3PH_SOONER 7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens

Cont. No.	Contingency Description	Damping Violation	Trip	Out of step	Relay Violation	Voltage Violation	Plots	Mitigations	Scneario
48	P1_No45_G16-119-TAP_3PH_SPRNGCK7_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens
49	P1_No46_G16-119-TAP_3PH_GEN-2016-119_FAULT	None	None	None	None	None	OK	Not required	25WP-Sens

D.4.2 25WP Sensitivity Dynamic Stability Analysis Plots

Plots of stability simulations for 25WP sensitivity scenario modification study are in separate files which are listed below.

AppendixD4-2_GEN-2015-066_ Sensitivity _25WP_Stability_Plots.zip

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