GEN-2016-126

Impact Restudy for Generator Modification (POI Change)

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REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
12/19/2018	SPP	Report issued.

SUMMARY

The GEN-2016-126 Interconnection Customer has requested a modification to its Interconnection Request. SPP has directed the performance of this system impact restudy to determine the effects of changing the GEN-2016-126 Point of Interconnection (POI). The GEN-2016-126 project remains comprised of fifty (50) Vestas 3.45MW wind turbine generators with a total nameplate capacity of 172.5 MW. The analysis evaluated the impact of moving the GEN-2016-126 POI from a tap of the OKGE Arbuckle to Blue River 138kV transmission line to the OKGE Arbuckle 138kV substation.

This study was performed by Power System Engineering, Inc. to determine whether the request for modification is considered Material. To determine this, study models that included Interconnection Requests through DISIS-2016-002 were used that analyzed the timeframes of 2017 winter, 2018 spring, 2018 summer, 2021 light load, 2021 summer, 2021 winter, and 2026 summer models.

The restudy showed that the stability analysis has determined with all previously assigned Network Upgrades in service, generators in the monitored areas remained stable and within the pre-contingency, voltage recovery, and post fault voltage recovery criterion of 0.7pu to 1.2pu for the entire modeled disturbances. Additionally, the project wind farm was found to stay connected during the contingencies that were studied and, therefore, will meet the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

A power flow analysis was also performed to determine the steady-state effects of the GEN-2016-126 modification on the rest of the projects within the geographical location and to determine if any additional thermal or voltage issues arise due to the modification. The results of the power flow analysis demonstrate that for both the ERIS and NRIS analysis, there are no additional constraints that appear due to the POI modification. It is also worth noting that the DISIS-2016-002 identified G16-126 Tap to Arbuckle 138kV is no longer an issue with the change in POI from Arbuckle to Blue River 138kV transmission line to the Arbuckle 138kV substation. The requested modification is not considered Material.

A power factor analysis was not performed for this restudy. The facility will be required to maintain a 95% lagging (providing VARs) and 95% leading (absorbing VARs) power factor at the POI. A low-wind/no-wind condition analysis was performed identifying a need for 6.6 MVAr of reactive compensation. This is necessary to offset the capacitive effect on the transmission network caused by the project's transmission line and collector system during low-wind/no-wind conditions. Reactive compensation can be provided either by discrete reactive devices or by the generator itself if it possesses that capability.

With the assumptions outlined in this report and with all the required network upgrades from the DISIS-2016-002 in place, GEN-2016-126 with the fifty (50) Vestas 3.45MW wind turbine generators should be able to interconnect reliably to the SPP transmission grid with the new point of interconnection into the OKGE Arbuckle 138kV substation.

It should be noted that this study analyzed many of the most probable contingencies, but it is not an all-inclusive list and cannot account for every operational situation. It is likely that the customer

may be required to reduce its generation output to 0 MW, also known as curtailment, under certain system conditions to allow system operators to maintain the reliability of the transmission network.

Nothing in this study should be construed as a guarantee of transmission service or delivery rights. If the customer wishes to obtain deliverability to final customers, a separate request for transmission service must be requested on Southwest Power Pool's OASIS by the customer.

A: CONSULTANT'S MATERIAL MODIFICATION STUDY REPORT

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

Power System Engineering, Inc.

Full-service consultants

GEN-2016-126 Generator Modification Study (POI Change)

Prepared by:

Power System Engineering, Inc.

December 18, 2018

GEN-2016-126 Generator Modification Study (POI Change)

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1 Executive Summary

PSE was retained by the GEN-2016-126 Interconnection Customer (IC) to perform a Generator Modification Study for Southwest Power Pool (SPP) project GEN-2016-126, a 172.5 MW wind project interconnecting in south central, Oklahoma.

This GEN-2016-126 Generator Modification Study was performed to determine the impact of moving the Point of Interconnection (POI) from the originally requested tap on the Arbuckle – Blue River 138kV transmission line. In the current study, the IC is requesting a change to interconnect at the Arbuckle 138kV substation.

A steady-state power flow and voltage analysis was performed using the DISIS 2016 ERIS and NRIS package provided by SPP. Each of the transfer cases were modified to move the POI for project GEN-2016-126 from a tap of the Arbuckle – Blue River 138kV transmission line to the Arbuckle 138kV substation. The ACCC function of PSS/E was used with these modified cases to analyze the contingencies and monitor the elements defined in the package. The results of the thermal analysis after the POI move were compared to the results provided in Appendix G-T of the sixth posting of the DISIS 2016-002 report. Several contingencies are no longer valid and thus the constraints are no longer an issue. No new constraints or violations were noted as a result of this analysis.

A power factor analysis was not performed during the DISIS study, and was not required during this modification study. The final reactive power requirement in the GEN-2016-126 GIA will be the pro-forma 95% lagging to 95% leading at the high side of the transformer per FERC Order No. 827, Final Rule, Issued June 16, 2016.

A reduced wind generation analysis was conducted to determine the inductive support required to compensate for the capacitive effects of the GEN-2016-126 gen-tie transmission line and collector systems on the bulk transmission system during low or reduced wind conditions. As a result of this analysis, GEN-2016-126 is required to install a reactor or an equivalent means of compensation that can absorb approximately 6.6 MVAR.

A stability analysis was performed on three (3) seasonal cases, including the 2017 Winter Peak (17W), 2018 Summer Peak (18S), and 2026 Summer Peak (26S). These cases are modified versions of the 2016 series of Model Development Working Group (MDWG) dynamic study cases that include the upgrades and Interconnection Requests through DISIS-2016-002.

Utilizing the cases as delivered, our stability analysis has determined that generators in the monitored areas remained stable and within the pre-fault and post-fault voltage recovery criterion of 0.7 per unit to 1.2 per unit during each of the simulated disturbances. Additionally, GEN-2016-126 was found to stay connected during the faults that were studied and, therefore, will meet the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

A short circuit analysis was also conducted using the 17W, 18S, and 26S cases. The maximum fault current calculated for GEN-2016-126 is 42.2kA in 18SP, equal to the maximum fault current calculated before the POI move. The results from the short circuit analysis are shown in Appendix A.

Under the assumptions outlined in this report, GEN-2016-126 should be able to reliably interconnect to the SPP transmission grid at the Arbuckle 138kV substation. The change in POI does not constitute a material modification for this project.

This study was completed as an evaluation of the requested modification to change the project POI; additional power flow analysis beyond that required for this purpose was not performed. This study analyzed many of the most probable stability faults, but it did not utilize an all-inclusive list, and thus did not account for every operational situation. All of the SPP contingency files provided in the power flow package were included in our analysis.

This study does not guarantee delivery or transmission service. If the customer wishes to sell power from the facility, a separate request for transmission service would need to be submitted on Southwest Power Pool's OASIS by the Customer.

2 Facilities

A one-line PSS/E slider drawing of the new POI for GEN-2016-126 from the 26S case is shown in Figure 2-1.

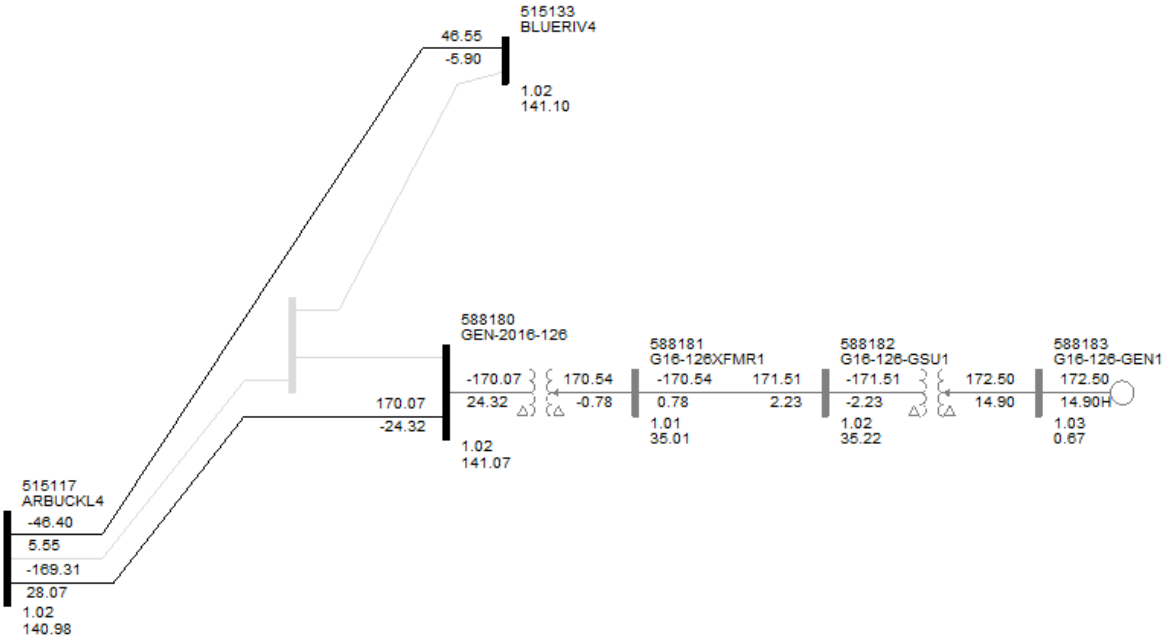

Figure 2-1: GEN-2016-126 One-line Diagram

The thermal units in Table 2-1 and non-thermal units in Table 2-2 were monitored during the stability simulations as requested by SPP.

Table 2-1: Monitored Thermal Units

Bus Number	Bus Name
509416	TURKCOAL
511851	COM1-1
511852	COM2-1
511853	COM3-1
511859	WEL 4-1
511860	WEL 5-1
511861	WEL 6-1
511944	KIOWA G1
511945	KIOWA G2
511946	KIOWA S1
511947	KIOWA S2
511948	KIOWA G3
511949	KIOWA G4
514805	SOONER1G
514806	SOONER2G
514856	MUSTNG1G
514857	MUSTNG2G
514858	MUSTNG3G
514859	MUSTNG4G

Bus Number	Bus Name
514900	REDBUD2S
514905	REDBUD3S
514910	REDBUD1G
514911	REDBUD2G
514912	REDBUD3G
514935	HSL 6G
514936	HSL 7S
514938	HSL 7G
514939	HSL 8G
514940	REDBUD4S
514942	REDBUD4G
514944	HSL 9G
514945	HSL 10G
514997	TINKER5G
514998	MCLN 1S
514999	MCLN 1G
515000	MCLN 2G
515040	SEMINL1G
515041	SEMINL2G

Bus Number	Bus Name
520809	ANADRK3
520811	ANADRK4
520812	ANADRK5
520813	ANADRK6
521101	GENCO1 4
521102	GENCO2 4
521110	ORME1
521111	ORME2
521112	ORME3
525561	TOLK_1 1
525562	TOLK_2 1
530674	GMECG1 1
530675	GMECG2 1
531201	RUBART 1
531202	RUBART 2
531447	HOLCGEN1
532651	JEC U1
532652	JEC U2
532653	JEC U3

Bus Number	Bus Name
514890	SMITH 1G
514897	SMITH 1S
514899	REDBUD1S

Bus Number	Bus Name
515042	SEMINL3G
520807	ANADRK1
520808	ANADRK2

Bus Number	Bus Name
588269	ASGI1611-GEN
588279	ASGI1612-GEN
588289	ASGI1613-GEN

Table 2-2: Monitored Non-Thermal Units

Bus Number	Request
587823	GEN-2016-102 #1
587824	GEN-2016-102 #2
588183	GEN-2016-126
588203	GEN-2016-129
599143	GEN-2011-040
599144	GEN-2012-004
583103	GEN-2011-050
599134	GEN-2013-007
584073	GEN-2014-057
585333	ASGI-2015-006

Bus Number	Request
584783	GEN-2015-036 #1
584786	GEN-2015-036 #2
584862	GEN-2015-045
585284	GEN-2015-092 #2
585283	GEN-2015-092 #1
587183	GEN-2016-028
587203	GEN-2016-030
587433	GEN-2016-063 #1
587436	GEN-2016-063 #2

3 Power Flow Analysis

3.1 Methodology

The transmission power flow was examined using the SPP MDWG 2016 Series ERIS and NRIS power flow packages provided by SPP and built for use with PSS/E v33.7. A PSS/E ACCC analysis was performed using the automation, contingency, monitor, and subsystem files provided by SPP.

3.2 Case Changes

To represent the new POI for GEN-2016-126, each of the Transfer Cases (TC) provided were modified to represent the new POI by removing the old tap, restoring the original Arbuckle – Blue River 138kV transmission line, and building a new 138kV generator tie line to the existing Arbuckle 138kV substation.

- Arbuckle – Blue River 138kV Transmission Line: R = 0.00696 per unit, X = 0.04128 per unit, B = 0.0116 per unit with a length of 10.35 miles.
- Gen-Tie Transmission Line 795 ACSR 26/7 Drake: R = 0.002705 per unit, X = 0.014973 per unit, B = 0.004536 per unit on a 100 MVA base with a length of 4.0 miles.

3.3 Contingencies Studied

PSE reviewed the contingencies provided with the ERIS and NRIS steady-state package. None of the contingencies specified the GEN-2016-126 Arbuckle to Blue River 138kV line tap; thus, it is assumed that all relevant contingencies were included with the SPP automation files and no contingencies were modified or added for the POI change.

4 Dynamic Stability Analysis

4.1 Methodology

The dynamic stability performance of the transmission system was examined using the SPP MDWG 2016 Series 17W, 18S, and 26S stability packages provided by SPP and built for use with PSS/E v33.7.

4.2 Case Changes

For proper simulation of the new POI, the original cases were modified to represent the new POI by removing the old tap, restoring the original Arbuckle – Blue River 138kV transmission line, and building a new 138kV generator tie line to the existing Arbuckle 138kV substation.

- Arbuckle – Blue River 138kV Transmission Line: R = 0.00696 per unit, X = 0.04128 per unit, B = 0.0116 per unit with a length of 10.35 miles.
- Gen-Tie Transmission Line 795 ACSR 26/7 Drake: R = 0.002705 per unit, X = 0.014973 per unit, B = 0.004536 per unit on a 100 MVA base with a length of 4.0 miles.

The following Prior Outage (PO) cases were developed for each year/season and with the existing line tap (LTP) or substation (SUB) POI's in order to simulate specific faults for a PO scenario.

- PO1: SEMINOL4 138 kV (515044) to PARKLN 4 138 kV (515178) line CKT 1
- PO2: ARBUCKL4 138 kV (515117) to SULPHR 4 138 kV (515559) line CKT 1
- PO3: BLUERIV4 138 kV (515133) to PARKLN 4 138 kV (515178) line CKT 1
- PO4: ARBUCKL4 138 kV (515117) to OAKLAW-4 138 kV (515123) line CKT 1

4.3 Faults Studied

Specific Faults for GEN-2016-126 were not provided with the stability package. Therefore, the dynamic performance was evaluated using the faults defined in the DISIS-2016-002 report dated August 20, 2018. A total of 28 three-phase (3PH) or stuck breaker (SB) single-phase (1PH) faults were simulated on each case as appropriate.

The sequence of events for a 3PH line fault is as follows:

1. Run for 2 seconds for stability
2. Apply fault at particular location
3. Continue fault for five (5) cycles, clear the fault by tripping the faulted line
4. Run for twenty (20) cycles, re-close the previous line into the fault
5. Continue fault for five (5) cycles
6. Trip the faulted facility and remove the fault
7. Run to 20 seconds for stability

The sequence of events for 3PH transformer faults is as follows:

1. Run for 2 seconds for stability

2. Apply fault on the 345kV Winding
3. Continue fault for five (5) cycles
4. Clear the fault by tripping the faulted transformer
5. Run to 20 seconds for stability

The sequence of events for SB faults is as follows:

6. Run for 2 seconds for stability
7. Apply 1PH fault at particular location
8. Clear the fault after 16 cycles by tripping the faulted facilities
9. Run to 20 seconds for stability

A detailed description of these faults is provided in Table 4-1. Stability plots for each of these faults are available upon request.

The SPP areas monitored during the stability analysis were:

- 520: American Electric Power (AEPW)
- 524: Oklahoma Gas and Electric Company (OKGE)
- 525: Western Farmers Electric Cooperative (WFEC)
- 526: Southwestern Public Service (SPS)
- 531: Midwest Energy, Inc. (MIDW)
- 534: Sunflower Electric Power Corp. (SUNC)
- 536: Westar Energy, Inc. (WERE)

Table 4-1: Faults

Fault #	Fault File	Description
00	FLT_00_NoFault	No Fault Conditions
34	FLT_34_Blue_Park_138kV_3PH	3 phase fault on BLUERIV4 138 kV (515133) to PARKLN 4 138 kV (515178) line CKT 1, near BLUERIV4. a. Apply fault at the BLUERIV4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
35	FLT_35_G16-126T_Arbuckle_138kV_3PH	3 phase fault on ARBUCKL4 138 kV (515117) to G16-126-TAP 138 kV (588184) line CKT 1, near G16-126-TAP. a. Apply fault at the G16-126-TAP 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Fault #	Fault File	Description
36	FLT_36_G16-126T_Blue_138kV_3PH	3 phase fault on G16-126-TAP 138 kV (588184) to BLUERIV4 138 kV (515133) line CKT 1, near BLUERIV4. a. Apply fault at the BLUERIV4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
37	FLT_37_Arbuckle_Vanoss_138kV_3PH	3 phase fault on ARBUCKL4 138 kV (515117) to VANOSTP4 138 kV (515531) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
38	FLT_38_Park_Vanoss_138kV_3PH	3 phase fault on VANOSS 4 138 kV (515174) to PARKLN 4 138 kV (515178) line CKT 1, near PARKLN 4. a. Apply fault at the PARKLN 4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
39	FLT_39_Seminole_Park_138kV_3PH	3 phase fault on SEMINOL4 138 kV (515044) to PARKLN 4 138 kV (515178) line CKT 1, near PARKLN 4. a. Apply fault at the PARKLN 4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
40	FLT_40_Park_Sothoda_138kV_3PH	3 phase fault on PARKLN 4 138 kV (515178) to SOTHADA4 138 kV (515318) line CKT 1, near PARKLN 4. a. Apply fault at the PARKLN 4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
41	FLT_41_Arbuckle_Slphr_138kV_3PH	3 phase fault on ARBUCKL4 138 kV (515117) to SULPHR 4 138 kV (515559) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Fault #	Fault File	Description
42	FLT_42_Arbuckle_Berwyn_138kV_3PH	3 phase fault on ARBUCKL4 138 kV (515117) to BERWYN 4 138 kV (515173) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
43	FLT_43_Arbuckle_MillCK_138kV_3PH	3 phase fault on ARBUCKL4 138 kV (515117) to MILLCKT4 138 kV (515121) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT_44_Arbuckle_Oaklawn_138kV_3PH	3 phase fault on ARBUCKL4 138 kV (515117) to OAKLAW-4 138 kV (515123) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
45	FLT_45_Park_138kV_XFM1_3PH	3 phase fault on PARKLN 2 69 kV (515177) to PARKLN 4 138 kV (515178) to PARKLN11 13.19 kV (515747) transformer CKT 1, near PARKLN4. a. Apply fault at the PARKLN 4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line.
46	FLT_46_SB_Park_138kV	Stuck Breaker at PARKLN 4 (515178) a. Apply single phase fault at the PARKLN 4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - PARKLN 2 69 kV (515177) to PARKLN 4 138 kV (515178) to PARKLN11 13.19 kV (515747) transformer CKT 1 - PARKLN 2 69 kV (515177) to PARKLN 4 138 kV (515178) to PARKLN21 13.19 kV (515748) transformer CKT 1
47	FLT_47_SB_Arbuckle_138kV	Stuck Breaker at ARBUCKL4 (515117) a. Apply single phase fault at the ARBUCKL4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - ARBUCKL4 138 kV (515117) to SULPHR 4 138 kV (515559) line CKT 1 - ARBUCKL4 138 kV (515117) to MILLCKT4 138 kV (515121) line CKT 1
48	FLT_48_SB_Arbuckle_138kV	Stuck Breaker at ARBUCKL4 (515117) a. Apply single phase fault at the ARBUCKL4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - ARBUCKL4 138 kV (515117) to SULPHR 4 138 kV (515559) line CKT 1 - ARBUCKL4 138 kV (515117) to BERWYN 4 138 kV (515173) line CKT 1

Fault #	Fault File	Description
49	FLT_49_SB_Park_138kV	Stuck Breaker at PARKLN 4 (515178) a. Apply single phase fault at the PARKLN 4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - VANOSS 4 138 kV (515174) to PARKLN 4 138 kV (515178) line CKT 1 - SEMINOL4 138 kV (515044) to PARKLN 4 138 kV (515178) line CKT 1
50	FLT_50_Seminole_Vanoss_138kV_3PH	3 phase fault on SEMINOL4 138 kV (515044) to VANOSTP4 138 kV (515531) line CKT 1, near VANOSTP4. a. Apply fault at the VANOSTP4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
51	FLT_51_SB_SunnySide_138kV	Stuck Breaker at SUNNYSD4 (515135) a. Apply single phase fault at the SUNNYSD4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - SUNNYSD4 138 kV (515135) to SUNNYSD7 345 kV (515136) to SUNNYSD1 13.8 kV (515762) transformer CKT 1 - SUNNYSD7 345 kV (515136) to SUNNYSD4 138 kV (515135) to SUNYSD 1 13.8 kV (515405) transformer CKT 1
52	FLT_52_SB_Arbuckle_138kV	Stuck Breaker at ARBUCKL4 (515117) a. Apply single phase fault at the ARBUCKL4 138 kV bus. b. Clear fault after 16 cycles and trip the following elements. - ARBUCKL4 138 kV (515117) to MILLCKT4 138 kV (515121) line CKT 1 - ARBUCKL4 138 kV (515117) to OAKLAW-4 138 kV (515123) line CKT 1
53	FLT_35_G16-126T_Arbuckle_138kV_3PH	**Prior Outage of SEMINOL4 138 kV (515044) to PARKLN 4 138 kV (515178) line CKT 1;** 3 phase fault on ARBUCKL4 138 kV (515117) to G16-126-TAP 138 kV (588184) line CKT 1, near G16-126-TAP. a. Apply fault at the G16-126-TAP 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
54	FLT_38_Park_Vanoss_138kV_3PH	**Prior Outage of SEMINOL4 138 kV (515044) to PARKLN 4 138 kV (515178) line CKT 1;** 3 phase fault on VANOSS 4 138 kV (515174) to PARKLN 4 138 kV (515178) line CKT 1, near PARKLN 4. a. Apply fault at the PARKLN 4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Fault #	Fault File	Description
55	FLT_37_Arbuckle_Vanoss_138kV_3PH	**Prior Outage of SEMINOL4 138 kV (515044) to PARKLN 4 138 kV (515178) line CKT 1;** 3 phase fault on ARBUCKL4 138 kV (515117) to VANOSTP4 138 kV (515531) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
56	FLT_42_Arbuckle_Berwyn_138kV_3PH	**Prior Outage of ARBUCKL4 138 kV (515117) to SULPHR 4 138 kV (515559) line CKT 1;** 3 phase fault on ARBUCKL4 138 kV (515117) to BERWYN 4 138 kV (515173) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
57	FLT_34_Blue_Park_138kV_3PH	**Prior Outage of BLUERIV4 138 kV (515133) to PARKLN 4 138 kV (515178) line CKT 1;** 3 phase fault on ARBUCKL4 138 kV (515117) to VANOSTP4 138 kV (515531) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
58	FLT_43_Arbuckle_MillCK_138kV_3PH	**Prior Outage of ARBUCKL4 138 kV (515117) to OAKLAW-4 138 kV (515123) line CKT 1;** 3 phase fault on ARBUCKL4 138 kV (515117) to MILLCKT4 138 kV (515121) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
84	FLT_84_Blue_Arbuckle_138kV_3PH	3 phase fault on Arbuckle 138 kV (515117) to BLUERIV4 138 kV (515133) line CKT 1, near BLUERIV4. a. Apply fault at the BLUERIV4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
85	FLT_85_Arbuckle_Blue_138kV_3PH	3 phase fault on ARBUCKL4 138 kV (515117) to BLUERIV4 138 kV (515133) line CKT 1, near ARBUCKL4. a. Apply fault at the ARBUCKL4 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Fault #	Fault File	Description
86	FLT_85_Arbuckle_Blue_138kV_3PH	**Prior Outage of SEMINOL4 138 kV (515044) to PARKLN 4 138 kV (515178) line CKT 1;** 3 phase fault on ARBUCKL4 138 kV (515117) to Blue River 138 kV (515177) line CKT 1, near Arbuckle. a. Apply fault at the Arbuckle 138 kV bus. b. Clear fault after 5 cycles and trip the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

5 Results

5.1 Steady-State ER/NR Screening

PSE compared the ACCC results from this analysis with the new POI modeled to the original study results in Appendix G-T posted with the DISIS report. In this workbook, 480 records are applicable to GEN-2016-102 and GEN-2016-126. 473 of these records are due to an overload of or the loss of the Arbuckle - GEN-2016-126 Tap 138kV transmission line. After moving the POI for GEN-2016-126 to the Arbuckle 138kV substation, there are seven remaining applicable overloads observed in the "00NR" cases; a comparison of these records are provided in Table 5-1 and Table 5-2.

It is our understanding that mitigation of the Tupelo – Tupelo Tap 138kV transmission line has been assigned to prior queued generators and is not the responsibility of GEN-2016-126. SPP has indicated that in the event that the previously assigned upgrade becomes the cost responsibility of the DISIS-2016-002 customers, the cost allocation calculation will be based on the original studied POI for GEN-2016-126 of Arbuckle to Blue River Tap to avoid adverse impacts on the GEN-2016-102 customer which would be considered a Material Modification.

No overloads of the Arbuckle – Blue River 138kV transmission line were observed in our results.

Table 5-1: GEN-2016-102 Thermal Screening Comparison

				DISIS Report		PSE POI Change		
SEASON	MONITORED ELEMENT	RATEA (MVA)	RATEB (MVA)	TDF	LOADING (% MVA)	TDF	LOADING (% MVA)	CONTINGENCY
21WP	Tupelo – Tupelo Tap 138kV	132.0	163.0	0.06852	100.6911	0.06856	98.7	P23:345:AEPW:PITTSBURG CB 3429A NBTB
17WP	Tupelo – Tupelo Tap 138kV	143.0	143.0	0.06838	100.9005	0.06843	98.7	P23:345:AEPW:PITTSBURG CB 3429A NBTB
17WP	Tupelo – Tupelo Tap 138kV	143.0	143.0	0.07101	99.8	0.07108	97.6	P23:345:AEPW:VALLIANT CB 3409A NBTB
17WP	Tupelo – Tupelo Tap 138kV	143.0	143.0	0.07106	99.6	0.07113	97.4	PITTSBURG - VALLIANT 345KV CKT 1
21WP	Tupelo – Tupelo Tap 138kV	132.0	163.0	0.07558	105.0861	0.07567	102.362	P23:345:AEPW:PITTSBURG CB 3425A NBTB
17WP	Tupelo – Tupelo Tap 138kV	143.0	143.0	0.07556	104.237	0.0757	102.9768	P23:345:AEPW:PITTSBURG CB 3425A NBTB

Table 5-2: GEN-2016-126 Thermal Screening Comparison

				DISIS Report		PSE POI Change		
SEASON	MONITORED ELEMENT	RATEA (MVA)	RATEB (MVA)	TDF	LOADING (% MVA)	TDF	LOADING (% MVA)	CONTINGENCY
21WP	Tupelo – Tupelo Tap 138kV	132.0	163.0	0.04963	100.6911	0.03078	98.7	P23:345:AEPW:PITTSBURG CB 3429A NBTB
17WP	Tupelo – Tupelo Tap 138kV	143.0	143.0	0.04948	100.9005	0.03063	98.7	P23:345:AEPW:PITTSBURG CB 3429A NBTB
17WP	Tupelo – Tupelo Tap 138kV	143.0	143.0	0.05255	99.8	0.03416	97.6	P23:345:AEPW:VALLIANT CB 3409A NBTB
17WP	Tupelo – Tupelo Tap 138kV	143.0	143.0	0.05259	99.6	0.0342	97.4	PITTSBURG - VALLIANT 345KV CKT 1

				DISIS Report		PSE POI Change		
SEASON	MONITORED ELEMENT	RATEA (MVA)	RATEB (MVA)	TDF	LOADING (% MVA)	TDF	LOADING (% MVA)	CONTINGENCY
21WP	Tupelo – Tupelo Tap 138kV	132.0	163.0	0.05739	104.237	0.03932	102.362	P23:345:AEPW:PITTSBURG CB 3425A NBTB
17WP	Tupelo – Tupelo Tap 138kV	143.0	143.0	0.05740	105.0861	0.03934	102.9768	P23:345:AEPW:PITTSBURG CB 3425A NBTB

The only result posted in Appendix G-T which was assigned to GEN-2016-129 for mitigation was an overload of the Northeast Station – Tulsa North 345kV transmission line in the "00NR" case as shown in Table 5-3. After moving the POI for GEN-2016-126 to the Arbuckle 138kV substation, the DF for GEN-2016-129 still meets the 3% TDF requirement for mitigation.

Table 5-3: GEN-2016-129 Thermal Screening Comparison

				DISIS Report		PSE POI Change		
SEASON	MONITORED ELEMENT	RATEA (MVA)	RATEB (MVA)	TDF	LOADING (% MVA)	TDF	LOADING (% MVA)	CONTINGENCY
21SP	Northeast Station – Tulsa North 345kV	901	1055	0.03006	106.3312	0.03303	106.3312	P23:345:AEPW:TULSA NORTH CB 3405A NBTB

Project GEN-2016-166 was also reported with a DF > 3% on the Northeast Station – Tulsa North 345kV transmission line in the "00NR" case as shown in Table 5-4. After moving the POI for GEN-2016-126 to the Arbuckle 138kV substation, the DF for GEN-2016-166 still meets the 3% TDF requirement for mitigation.

Table 5-4: GEN-2016-166 Thermal Screening Comparison

				DISIS Report		PSE POI Change		
SEASON	MONITORED ELEMENT	RATEA (MVA)	RATEB (MVA)	TDF	LOADING (% MVA)	TDF	LOADING (% MVA)	CONTINGENCY
21SP	Northeast Station – Tulsa North 345kV	901	1055	0.05233	106.3312	0.0553	106.3312	P23:345:AEPW:TULSA NORTH CB 3405A NBTB
26SP	Northeast Station – Tulsa North 345kV	901	1055	0.03966	112.3613	0.04129	112.3616	P23:345:AEPW:TULSA NORTH CB 3405A NBTB

In order to demonstrate the impact of this POI change on the local power flow, a comparison of the line flows on the Arbuckle to Park Lane 138kV transmission lines in the 14ALL 21L steady-state case is provided in Table 5-5.

Table 5-5: Arbuckle to Park Lane 138kV Line Loading Comparison

MONITORED ELEMENT	RATEB (MVA)	DISIS Report (%MVA)	PSE POI Change (%MVA)	CONTINGENCY
Blue River – Park Lane 138kV	191	N/A	76.21	Arbuckle – Blue River 138kV
Blue River – Park Lane 138kV	191	165.489	N/A	Arbuckle – G16-126 Tap 138kV
Arbuckle – Blue River 138kV	191	N/A	76.42	Blue River – Park Lane 138kV
Arbuckle – G16-126 Tap 138kV	191	165.603	N/A	Blue River – Park Lane 138kV

5.2 Reduced Wind Generation

A low wind analysis was performed for GEN-2016-126 to determine the capacitive reactive power injected at the POI from the project's gen-tie transmission line and collector systems. GEN-2016-126 will be required to install a reactor or an equivalent means of compensation for the capacitive reactive power injected at the POI.

In order to make this determination, the study generator was turned off in the 21SP case. In this state, approximately 6.8MVAR is observed at the POI from the GEN-2016-126 collector systems and transmission line (see Figure 5-1). To offset this capacitive injection, a reactor totaling 6.6MVAR was installed on the low side of the project's 138/34.5kV main station transformer (see Figure 5-2). With this reactor installed, the capacitive reactive power injected at the POI is zero.

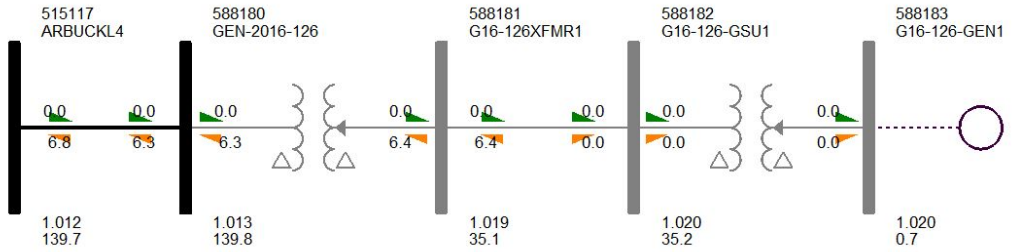

Figure 5-1: GEN-2016-126 Offline

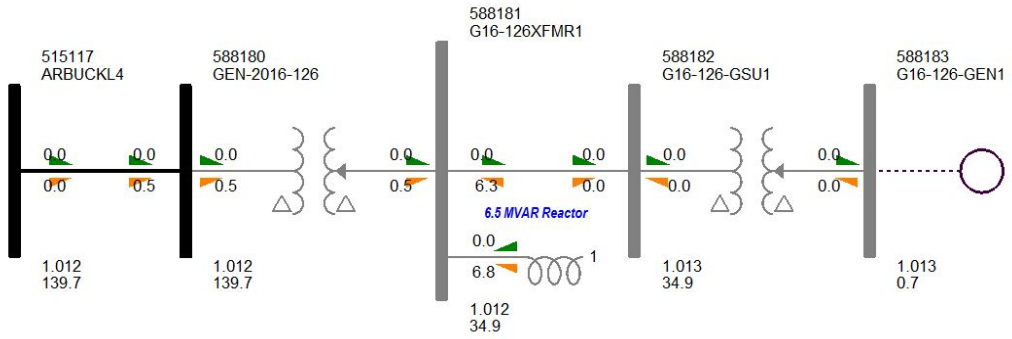

Figure 5-2: GEN-2016-126 Offline with Reactor

5.3 Stability Fault Summary

The summary of the transient stability results for each fault are provided in Table 5-6. Fault 35, 36, 53, 84, 85, and 86 were simulated as 3PH faults involving the GEN-2016-126 POI. Plots of faults 35 and 85, 36 and 84, and 53 and 86 are provided as a comparison to demonstrate the impact of the POI change involving these similar faults.

Table 5-6: GEN-2016-126 Stability Fault Summary

		Stability Status (Line Tap)			Stability Status (Substation)		
Fault	**Fault Description**	**16WP**	**17SP**	**25SP**	**16WP**	**17SP**	**25SP**
FLT_00	No Fault	Stable	Stable	Stable	Stable	Stable	Stable
FLT_34	3PH @ Blue River trip Blue River - Park Ln 138KV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_35	3PH @ G16-126 POI trip G16-126 POI - Blue River 138KV	Stable	Stable	Stable	N/A	N/A	N/A
FLT_85	3PH @ Arbuckle trip Arbuckle - Blue River 138KV	N/A	N/A	N/A	Stable	Stable	Stable

		Stability Status (Line Tap)			Stability Status (Substation)		
Fault	**Fault Description**	**16WP**	**17SP**	**25SP**	**16WP**	**17SP**	**25SP**
FLT_36	3PH @ Blue River trip Blue River - G16-126 Tap 138KV	Stable	Stable	Stable	N/A	N/A	N/A
FLT_84	3PH @ Blue River trip Blue River - Arbuckle 138KV	N/A	N/A	N/A	Stable	Stable	Stable
FLT_37	3PH @ Arbuckle trip Vanoss - Arbuckle 138KV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_38	3PH @ Park Ln trip Park Ln - Vanoss 138KV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_39	3PH @ Seminole trip Seminole - Park Ln 138KV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_40	3PH @ Park Ln trip Park Ln - Sothada 138KV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_41	3PH @ Arbuckle trip Arbuckle - Sulphur 138KV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_42	3PH @ Arbuckle trip Arbuckle - Berwyn 138KV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_43	3PH @ Arbuckle trip Arbuckle - MillCrk 138KV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_44	3PH @ Arbuckle trip Arbuckle - Oaklawn 138KV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_45	3PH @ Park Ln XFMR1 trip Park Ln XFMR1	Stable	Stable	Stable	Stable	Stable	Stable
FLT_46	SB @ Park Ln trip Park Ln XFMR 1 & 2	Stable	Stable	Stable	Stable	Stable	Stable
FLT_47	SB @ Arbuckle trip Sulphur - Arbuckle - MillCrk 138kV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_48	SB @ Arbuckle trip Sulphur - Arbuckle - Berwyn 138kV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_49	SB @ Park Ln trip Vanoss - Park Ln - Seminole 138kV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_50	3PH @ Seminole trip Seminole - Vanoss 138KV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_51	SB @ Sunny Side trip Sunny Side XFMR 2 & 3	Stable	Stable	Stable	Stable	Stable	Stable
FLT_52	SB @ Arbuckle trip Oaklawn - Arbuckle - MillCrk 138kV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_53	PO1 3PH @ G16-126 Tap trip G16-126 Tap - Arbuckle 138KV	Stable	Stable	Stable	N/A	N/A	N/A
FLT_86	PO1 3PH @ Arbuckle trip Arbuckle - Blue River 138KV	N/A	N/A	N/A	Stable	Stable	Stable
FLT_54	PO1 3PH @ Park Ln trip Park Ln - Vanoss 138KV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_55	PO1 3PH @ Arbuckle trip Vanoss - Arbuckle 138KV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_56	PO2 3PH @ Arbuckle trip Arbuckle - Berwyn 138KV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_57	PO3 3PH @ Arbuckle trip Vanoss - Arbuckle 138KV	Stable	Stable	Stable	Stable	Stable	Stable
FLT_58	PO4 3PH @ Arbuckle trip Arbuckle - MillCrk 138KV	Stable	Stable	Stable	Stable	Stable	Stable

5.4 Low Voltage Ride Through (LVRT)

LVRT is demonstrated by plotting the real power output of the wind turbine generators and the corresponding voltage at the POI. For this modification study, the plots compare the real power response and the per unit voltage at the Arbuckle 138kV substation and demonstrate that project GEN-2016-126 remains "in-service" during each fault as required in FERC Order 661A. LVRT plots for each of the faults defined in Table 4-1 are available upon request.

5.5 Short Circuit Analysis

The short circuit analysis was performed on the 17W, 18S, and 26S power flow cases using the PSS/E Automatic Sequencing (ASCC) program. Since the power flow case does not contain negative and zero sequence data, only three-phase symmetrical fault current levels were calculated at the POI and other buses up to and including buses five levels away from the POI.

The short circuit analysis was conducting using flat conditions with the following PSS/E ASCC program settings:

- Bus Voltages set to 1 per unit at 0 phase angle
- Generator P = 0, Q = 0
- Transformer tap ratios = 1.0 per unit and phase angles = 0.0
- Line charging = 0.0 in positive/negative/zero sequence
- Load = 0.0 in positive/negative/zero sequence, considered in zero sequence

- Line/fixed/switched shunts = 0.0 and magnetizing admittance = 0.0 in positive/negative/zero sequence
- DC lines and facts devices blocked
- Transformer zero sequence impedance corrections ignored.

The maximum fault current calculated for GEN-2016-126 is 42.2kA in 18SP, equal to the maximum fault current calculated before the POI move. The complete results of the short circuit analysis are shown in Appendix A for 17WP, 18S, and 26S.

5.6 Stability Plots

All disturbances studied achieved satisfactory performance without significant differences being observed when the POI is moved from a new tap on the Arbuckle – Blue River 138kV transmission line to the Arbuckle 138kV substation.

Each fault includes multiple comparison plots with multiple traces. Note that fault 35 and fault 85 are similar and compared in one set of plots and fault 36 and fault 84 are also similar and compared in one set of plots. These stability plots are available upon request.

For each fault, the first plot compares the real power output of GEN-2016-126 and the voltage at the Arbuckle 138kV bus to demonstrate LVRT. The magenta trace represents the voltage response at the Arbuckle 138kV bus with the GEN-2016-126 connecting at the Arbuckle 138kV bus (SUB.out). The blue trace represents the voltage response at the Arbuckle 138kV bus with the GEN-2016-126 connecting at the tap of the Arbuckle – Blue River 138kV transmission line (LTP.out). The red trace represents the real power response of project GEN-2016-126 with the project connecting at the Arbuckle 138kV bus. The black trace represents the real power response of the project connecting at a tap of the Arbuckle – Blue River 138kV transmission line.

The second plot compares the real power response of project GEN-2016-126 on a 0 to 2 per unit scale and from 0 to 20 seconds. The blue trace represents the response with GEN-2016-126 connecting at the Arbuckle 138kV bus and the black trace represents the project interconnecting at a tap of the Arbuckle – Blue River 138kV transmission line.

The third plot compares the reactive power response of project GEN-2016-126 on a -2 to 2 per unit scale and from 0 to 20 seconds. The blue trace represents the response with GEN-2016-126 connecting at the Arbuckle 138kV bus and the black trace represents the project interconnecting at a tap of the Arbuckle – Blue River 138kV transmission line.

The fourth plot compares the terminal voltage (ETRM) of project GEN-2016-126 on a 0.5 to 1.5 per unit scale and from 0 to 20 seconds. The blue trace represents the response with GEN-2016-126 connecting at the Arbuckle 138kV bus and the black trace represents the project interconnecting at a tap of the Arbuckle – Blue River 138kV transmission line.

The fifth plot compares the speed deviation of project GEN-2016-126 from 0 to 20 seconds. The blue trace represents the response with GEN-2016-126 connecting at the Arbuckle 138kV bus and the black trace represents the project interconnecting at a tap of the Arbuckle – Blue River 138kV transmission line.

The sixth plot compares the voltage response at the Arbuckle 138kV bus on a 0.7 to 1.2 per unit scale and from 0 to 20 seconds. The blue trace represents the response with GEN-2016-126

connecting at the Arbuckle 138kV bus and the black trace represents the project interconnecting at a tap of the Arbuckle – Blue River 138kV transmission line.

The seventh plot compares the voltage response at the Blue River 138kV bus on a 0.7 to 1.2 per unit scale and from 0 to 20 seconds. The blue trace represents the response with GEN-2016-126 connecting at the Arbuckle 138kV bus and the black trace represents the project interconnecting at a tap of the Arbuckle – Blue River 138kV transmission line.

Page eight begins the non-thermal responses during the applicable fault for each of the non-thermal units' requested by SPP (see Table 2-2). On each page, pre-change and post-change traces are provided for each generator. The magenta trace represents the terminal voltage response (ETRM), the red trace represents the reactive power response, the blue trace represents the speed deviation, and the black trace represents the real power response.

Comparison plots of the voltage response at the requested buses begin on page 17 for each fault and are traced on a 0.7 to 1.2 per unit scale and from 0 to 20 seconds. In addition, comparison plots of the frequency deviation at the requested buses begin on page 18.

Comparison plots of the rotor angle for the requested thermal units (see Table 2-1) begin on page 20 for each fault and are traced on a -180 to 180 degree scale and from 0 to 20 seconds.

These plots demonstrate that the project and system response with the project interconnecting at the Arbuckle 138kV bus is similar or superior to the previously studied tap on the Arbuckle – Blue River 138kV transmission line. Thus, system performance is not degraded as a result of this POI change; it should not be considered a material change.

6 Conclusion

The GEN-2016-126 Interconnection Customer has requested a modification to its Generator Interconnection Request (GIR) to change its Point of Interconnection (POI). Previously, project GEN-2016-126 applied for interconnection at a new tap of the Arbuckle – Blue River 138kV transmission line. The requested change is to build a gen-tie line directly to the Arbuckle 138kV substation.

The stability analysis performed to compare the pre- and post-POI change system performance has determined that the generators in the monitored areas remain stable and within the pre-fault and post-fault voltage recovery criterion of 0.7 per unit to 1.2 per unit during each of the simulated disturbances. Additionally, the project was found to remain "in-service" during the faults that were studied and, therefore, will meet the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

A steady-state power flow and voltage analysis was performed using the DISIS 2016 ERIS and NRIS package provided by SPP. The results of the thermal analysis after the POI move were compared to the results provided in Appendix G-T of the sixth posting of the DISIS 2016-002 report. Several contingencies are no longer valid and thus the related constraints are no longer an issue. No new constraints or violations were noted as a result of this analysis. A power factor analysis was not performed during the DISIS study, and was not required during this modification study. The final reactive power requirement in the GEN-2016-126 GIA will be the pro-forma 95% lagging to 95% leading at the high side of the transformer per FERC Order No. 827, Final Rule, Issued June 16, 2016.

A reduced wind generation analysis was conducted to determine the inductive support required to compensate for the capacitive effects caused by the GEN-2016-126 gen-tie transmission line and collector systems on the bulk transmission system during low or reduced wind conditions. GEN-2016-126 is required to install a reactor or equivalent compensation that can inject approximately 6.6Mvar.

A short circuit analysis was also conducted using the 17WP, 18SP, and 26SP cases. The maximum fault current calculated for GEN-2016-126 is 42.2kA in 18SP, equal to the maximum fault current calculated before the POI move. The results from the short circuit analysis are shown in Appendix A.

Under the assumptions outlined in this report, GEN-2016-126 should be able to reliably interconnect to the SPP transmission grid at the new POI. The change in POI's does not represent a Material Modification.

This study was completed as a requested modification to change the POI; additional power flow analysis beyond that required for this purpose was not performed. This study analyzed many of the most probable stability faults, but it did not utilize an all-inclusive list, and thus did not account for every operational situation.

This study does not guarantee delivery or transmission service. If the customer wishes to sell power from the facility, a separate request for transmission service must be submitted on Southwest Power Pool's OASIS by the Customer.

Appendix A – Short Circuit Results

2017WP GEN-2016-126 Short Circuit Analysis Results

2016 MDWG FINAL WITH 2015 SERIES MMWG FINAL
MDWG 2017W WITH MMWG 2017W

GEN-2016-126 @ Arbuckle 138kV Bus

OPTIONS USED:
- SET PRE-FAULT VOLTAGE ON ALL BUSES TO 1.00 PU AT 0 PHASE SHIFT ANGLE
- SET SYNCHRONOUS/ASYNCHRONOUS MACHINE POWER OUTPUTS TO P=0.0, Q=0.0
- SET GENERATOR POSITIVE SEQUENCE REACTANCES TO SUBTRANSIENT
- SET TRANSFORMER TAP RATIOS=1.0 PU AND PHASE SHIFT ANGLES=0.0
- SET LINE CHARGING=0.0 IN +/-/0 SEQUENCES
- SET LINE/FIXED/SWITCHED SHUNTS=0.0 AND TRANSFORMER MAGNETIZING ADMITTANCE=0.0 IN +/-/0 SEQUENCES
- SET LOAD=0.0 IN +/- SEQUENCES
- DC LINES AND FACTS DEVICES BLOCKED
- IMPEDANCE CORRECTIONS NOT APPLIED TO TRANSFORMER ZERO SEQUENCE IMPEDANCES

THREE PHASE FAULT

X---------- BUS ----------X	/I+/	AN(I+)
509745 [CLARKSV7 345.00]	AMP	19811.4 -85.87
510877 [FIXCT4 138.00]	AMP	6994.1 -71.77
510907 [PITTSB-7 345.00]	AMP	13503.1 -84.63
510911 [VALIANT7 345.00]	AMP	13308.1 -85.42
510925 [KIOWA 7 345.00]	AMP	13267.6 -84.67
510948 [EARLSBORO 4138.00]	AMP	7386.4 -72.26
511449 [CORNVIL4 138.00]	AMP	15286.9 -77.80
511508 [BLANCHD4 138.00]	AMP	5723.9 -68.48
514808 [JOHNCO 4 138.00]	AMP	14922.4 -83.00
514809 [JOHNCO 7 345.00]	AMP	9763.6 -84.64
514814 [PRICESF4 138.00]	AMP	8853.0 -80.93
514880 [NORTWST7 345.00]	AMP	29737.4 -85.93
514901 [CIMARON7 345.00]	AMP	31029.6 -85.88
514907 [ARCADIA4 138.00]	AMP	39432.9 -85.62
514908 [ARCADIA7 345.00]	AMP	25196.8 -86.43
514909 [REDBUD 7 345.00]	AMP	24468.3 -86.80
514933 [DRAPER 4 138.00]	AMP	37573.0 -85.17
514934 [DRAPER 7 345.00]	AMP	20200.4 -85.10
515044 [SEMINOL4 138.00]	AMP	39287.5 -85.75
515045 [SEMINOL7 345.00]	AMP	25900.6 -86.19
515055 [MAUD 4 138.00]	AMP	19259.0 -79.42
515075 [FRSTHIL4 138.00]	AMP	12982.6 -77.10
515097 [WLNUTCK4 138.00]	AMP	9138.9 -80.49
515100 [PAOLI- 4 138.00]	AMP	10152.2 -79.37
515114 [CHIGLEY4 138.00]	AMP	8051.4 -79.99
515117 [ARBUCKL4 138.00]	AMP	15681.5 -80.38
515118 [JOLLYVL4 138.00]	AMP	9102.1 -80.86
515120 [RUSSET-4 138.00]	AMP	11128.5 -77.81
515121 [MILLCKT4 138.00]	AMP	10808.5 -79.77
515122 [SXMLCKT4 138.00]	AMP	10949.0 -79.95
515123 [OAKLAW-4 138.00]	AMP	12674.7 -80.38
515124 [MAYSVIL4 138.00]	AMP	6077.9 -74.58
515133 [BLUERIV4 138.00]	AMP	10463.7 -81.39

515136 [SUNNYSD7 345.00] AMP 10686.1 -84.73
515138 [CARTER 4 138.00] AMP 12285.3 -79.54
515147 [GLASSES4 138.00] AMP 8021.3 -75.39
515149 [MADINDT4 138.00] AMP 8011.8 -75.44
515150 [CANEYCK4 138.00] AMP 8469.4 -77.47
515151 [LTLCITY4 138.00] AMP 7041.1 -77.17
515161 [AIRPARK4 138.00] AMP 7329.0 -76.83
515162 [FNDTION4 138.00] AMP 11423.6 -78.33
515165 [TOTAL 4 138.00] AMP 10865.6 -78.36
515169 [AIRPRKT4 138.00] AMP 8516.7 -77.30
515171 [CHIKSAW4 138.00] AMP 12031.5 -78.82
515172 [SPRNDAL4 138.00] AMP 11247.2 -78.04
515173 [BERWYN 4 138.00] AMP 8148.9 -77.16
515174 [VANOSS 4 138.00] AMP 13143.0 -78.65
515178 [PARKLN 4 138.00] AMP 16260.9 -81.61
515196 [MILLCRK4 138.00] AMP 8905.9 -78.93
515224 [MUSKOGE7 345.00] AMP 28445.0 -86.76
515235 [PECANCK7 345.00] AMP 21225.7 -85.54
515286 [STRLGTP4 138.00] AMP 12758.0 -77.01
515302 [FTSMITH7 345.00] AMP 9910.6 -85.98
515318 [SOTHADA4 138.00] AMP 11250.4 -80.92
515362 [HARDEN 4 138.00] AMP 8187.9 -80.22
515422 [C-RIVER7 345.00] AMP 9574.8 -84.36
515475 [PURCELL4 138.00] AMP 9699.9 -80.60
515531 [VANOSTP4 138.00] AMP 13267.6 -78.67
515559 [SULPHR 4 138.00] AMP 14274.6 -80.44
515570 [MAYSVLT4 138.00] AMP 5710.4 -74.19
515575 [ARBWIND4 138.00] AMP 8968.2 -81.06
515643 [HONEYCK4 138.00] AMP 8974.2 -81.05
521019 [OAKLAWN4 138.00] AMP 12471.0 -80.37
521044 [RUSSETT4 138.00] AMP 11059.0 -77.79
521067 [TEXOMAJ4 138.00] AMP 8412.9 -77.37
521122 [HOWE 4 138.00] AMP 10846.2 -79.89
584780 [GEN-2015-036345.00] AMP 7665.0 -84.59
587820 [GEN-2016-102138.00] AMP 9587.1 -81.70
588180 [GEN-2016-126138.00] AMP 10361.0 -80.49

2016 MDWG FINAL WITH 2015 SERIES MMWG FINAL
MDWG 2017W WITH MMWG 2017W

GEN-2016-126 @ Arbuckle - Blue River 138kV Line

OPTIONS USED:
- SET PRE-FAULT VOLTAGE ON ALL BUSES TO 1.00 PU AT 0 PHASE SHIFT ANGLE
- SET SYNCHRONOUS/ASYNCHRONOUS MACHINE POWER OUTPUTS TO P=0.0, Q=0.0
- SET GENERATOR POSITIVE SEQUENCE REACTANCES TO SUBTRANSIENT
- SET TRANSFORMER TAP RATIOS=1.0 PU AND PHASE SHIFT ANGLES=0.0
- SET LINE CHARGING=0.0 IN +/-/0 SEQUENCES
- SET LINE/FIXED/SWITCHED SHUNTS=0.0 AND TRANSFORMER MAGNETIZING ADMITTANCE=0.0 IN +/-/0 SEQUENCES
- SET LOAD=0.0 IN +/- SEQUENCES
- DC LINES AND FACTS DEVICES BLOCKED
- IMPEDANCE CORRECTIONS NOT APPLIED TO TRANSFORMER ZERO SEQUENCE IMPEDANCES

THREE PHASE FAULT

X---------- BUS ----------X	/I+/	AN(I+)
509745 [CLARKSV7 345.00] AMP	19811.4	-85.87
510877 [FIXCT4 138.00] AMP	6994.5	-71.77
510907 [PITTSB-7 345.00] AMP	13501.1	-84.62
510911 [VALIANT7 345.00] AMP	13307.2	-85.42
510925 [KIOWA 7 345.00] AMP	13265.7	-84.67
510948 [EARLSBORO 4138.00] AMP	7386.9	-72.26
511449 [CORNVIL4 138.00] AMP	15286.8	-77.80
511508 [BLANCHD4 138.00] AMP	5723.9	-68.48
514808 [JOHNCO 4 138.00] AMP	14900.4	-83.00
514809 [JOHNCO 7 345.00] AMP	9756.2	-84.64
514814 [PRICESF4 138.00] AMP	8824.4	-80.90
514880 [NORTWST7 345.00] AMP	29737.5	-85.93
514901 [CIMARON7 345.00] AMP	31029.6	-85.88
514907 [ARCADIA4 138.00] AMP	39433.2	-85.62
514908 [ARCADIA7 345.00] AMP	25197.1	-86.43
514909 [REDBUD 7 345.00] AMP	24468.5	-86.80
514933 [DRAPER 4 138.00] AMP	37573.1	-85.17
514934 [DRAPER 7 345.00] AMP	20201.1	-85.10
515044 [SEMINOL4 138.00] AMP	39315.6	-85.76
515045 [SEMINOL7 345.00] AMP	25904.1	-86.19
515055 [MAUD 4 138.00] AMP	19263.6	-79.42
515075 [FRSTHIL4 138.00] AMP	12983.6	-77.10
515097 [WLNUTCK4 138.00] AMP	9136.8	-80.48
515100 [PAOLI- 4 138.00] AMP	10143.7	-79.36
515114 [CHIGLEY4 138.00] AMP	8029.9	-79.96
515117 [ARBUCKL4 138.00] AMP	15519.8	-80.26
515118 [JOLLYVL4 138.00] AMP	9067.8	-80.82
515120 [RUSSET-4 138.00] AMP	11118.3	-77.82
515121 [MILLCKT4 138.00] AMP	10781.8	-79.76
515122 [SXMLCKT4 138.00] AMP	10923.1	-79.94
515123 [OAKLAW-4 138.00] AMP	12577.9	-80.30
515124 [MAYSVIL4 138.00] AMP	6075.2	-74.58
515133 [BLUERIV4 138.00] AMP	10660.7	-81.53

515136 [SUNNYSD7 345.00] AMP 10678.1 -84.72
515138 [CARTER 4 138.00] AMP 12261.8 -79.53
515147 [GLASSES4 138.00] AMP 8016.8 -75.39
515149 [MADINDT4 138.00] AMP 8007.3 -75.44
515150 [CANEYCK4 138.00] AMP 8464.9 -77.47
515151 [LTLCITY4 138.00] AMP 7038.9 -77.17
515161 [AIRPARK4 138.00] AMP 7315.4 -76.82
515162 [FNDTION4 138.00] AMP 11404.1 -78.32
515165 [TOTAL 4 138.00] AMP 10844.5 -78.35
515169 [AIRPRKT4 138.00] AMP 8498.3 -77.29
515171 [CHIKSAW4 138.00] AMP 12008.0 -78.81
515172 [SPRNDAL4 138.00] AMP 11230.9 -78.03
515173 [BERWYN 4 138.00] AMP 8130.2 -77.14
515174 [VANOSS 4 138.00] AMP 13143.0 -78.64
515178 [PARKLN 4 138.00] AMP 16330.5 -81.64
515196 [MILLCRK4 138.00] AMP 8887.7 -78.92
515224 [MUSKOGE7 345.00] AMP 28445.0 -86.76
515235 [PECANCK7 345.00] AMP 21225.7 -85.54
515286 [STRLGTP4 138.00] AMP 12758.8 -77.01
515302 [FTSMITH7 345.00] AMP 9910.6 -85.98
515318 [SOTHADA4 138.00] AMP 11278.2 -80.93
515362 [HARDEN 4 138.00] AMP 8196.8 -80.23
515422 [C-RIVER7 345.00] AMP 9574.4 -84.36
515475 [PURCELL4 138.00] AMP 9698.1 -80.60
515531 [VANOSTP4 138.00] AMP 13266.6 -78.66
515559 [SULPHR 4 138.00] AMP 14145.5 -80.34
515570 [MAYSVLT4 138.00] AMP 5708.0 -74.19
515575 [ARBWIND4 138.00] AMP 8945.2 -81.03
515643 [HONEYCK4 138.00] AMP 8951.1 -81.03
521019 [OAKLAWN4 138.00] AMP 12377.3 -80.28
521044 [RUSSETT4 138.00] AMP 11048.9 -77.79
521067 [TEXOMAJ4 138.00] AMP 8408.5 -77.37
521122 [HOWE 4 138.00] AMP 10820.8 -79.88
584780 [GEN-2015-036345.00] AMP 7660.6 -84.59
587820 [GEN-2016-102138.00] AMP 9750.0 -81.83
588180 [GEN-2016-126138.00] AMP 11549.9 -80.90
588184 [G16-126-TAP 138.00] AMP 11782.3 -81.22

2018SP GEN-2016-126 Short Circuit Analysis Results

2016 MDWG FINAL WITH 2015 SERIES MMWG FINAL
MDWG 2018S WITH MMWG 2017S

GEN-2016-126 @ Arbuckle 138kV Bus

OPTIONS USED:
- SET PRE-FAULT VOLTAGE ON ALL BUSES TO 1.00 PU AT 0 PHASE SHIFT ANGLE
- SET SYNCHRONOUS/ASYNCHRONOUS MACHINE POWER OUTPUTS TO P=0.0, Q=0.0
- SET GENERATOR POSITIVE SEQUENCE REACTANCES TO SUBTRANSIENT
- SET TRANSFORMER TAP RATIOS=1.0 PU AND PHASE SHIFT ANGLES=0.0
- SET LINE CHARGING=0.0 IN +/-/0 SEQUENCES
- SET LINE/FIXED/SWITCHED SHUNTS=0.0 AND TRANSFORMER MAGNETIZING ADMITTANCE=0.0 IN +/-/0 SEQUENCES
- SET LOAD=0.0 IN +/- SEQUENCES
- DC LINES AND FACTS DEVICES BLOCKED
- IMPEDANCE CORRECTIONS NOT APPLIED TO TRANSFORMER ZERO SEQUENCE IMPEDANCES

THREE PHASE FAULT

X---------- BUS ----------X	/I+/	AN(I+)
509745 [CLARKSV7 345.00]	AMP	20258.9 -85.86
510877 [FIXCT4 138.00]	AMP	7048.5 -71.67
510907 [PITTSB-7 345.00]	AMP	13586.7 -84.59
510911 [VALIANT7 345.00]	AMP	13338.0 -85.40
510925 [KIOWA 7 345.00]	AMP	13348.3 -84.64
510948 [EARLSBORO 4138.00]	AMP	7450.0 -72.16
511449 [CORNVIL4 138.00]	AMP	16222.3 -77.60
511508 [BLANCHD4 138.00]	AMP	5812.1 -68.26
514808 [JOHNCO 4 138.00]	AMP	14976.9 -82.97
514809 [JOHNCO 7 345.00]	AMP	9813.4 -84.61
514814 [PRICESF4 138.00]	AMP	8871.9 -80.90
514880 [NORTWST7 345.00]	AMP	32215.0 -86.08
514901 [CIMARON7 345.00]	AMP	32737.3 -85.93
514907 [ARCADIA4 138.00]	AMP	42232.1 -85.68
514908 [ARCADIA7 345.00]	AMP	26360.6 -86.51
514909 [REDBUD 7 345.00]	AMP	25375.5 -86.85
514933 [DRAPER 4 138.00]	AMP	39253.8 -85.12
514934 [DRAPER 7 345.00]	AMP	20901.0 -85.08
515044 [SEMINOL4 138.00]	AMP	40015.3 -85.65
515045 [SEMINOL7 345.00]	AMP	26542.2 -86.12
515055 [MAUD 4 138.00]	AMP	19797.5 -79.24
515075 [FRSTHIL4 138.00]	AMP	13803.6 -76.95
515097 [WLNUTCK4 138.00]	AMP	9207.5 -80.43
515100 [PAOLI- 4 138.00]	AMP	10215.0 -79.31
515114 [CHIGLEY4 138.00]	AMP	8079.7 -79.95
515117 [ARBUCKL4 138.00]	AMP	15755.2 -80.32
515118 [JOLLYVL4 138.00]	AMP	9122.9 -80.83
515120 [RUSSET-4 138.00]	AMP	11160.1 -77.77
515121 [MILLCKT4 138.00]	AMP	10838.4 -79.74
515122 [SXMLCKT4 138.00]	AMP	10979.4 -79.91
515123 [OAKLAW-4 138.00]	AMP	12725.8 -80.33
515124 [MAYSVIL4 138.00]	AMP	6095.4 -74.54
515133 [BLUERIV4 138.00]	AMP	10497.7 -81.35

515136 [SUNNYSD7 345.00] AMP 10757.3 -84.69
515138 [CARTER 4 138.00] AMP 12320.9 -79.50
515147 [GLASSES4 138.00] AMP 8039.6 -75.35
515149 [MADINDT4 138.00] AMP 8030.1 -75.40
515150 [CANEYCK4 138.00] AMP 8491.6 -77.43
515151 [LTLCITY4 138.00] AMP 7054.3 -77.14
515161 [AIRPARK4 138.00] AMP 7342.3 -76.80
515162 [FNDTION4 138.00] AMP 11454.8 -78.29
515165 [TOTAL 4 138.00] AMP 10894.1 -78.32
515169 [AIRPRKT4 138.00] AMP 8534.7 -77.27
515171 [CHIKSAW4 138.00] AMP 12066.1 -78.78
515172 [SPRNDAL4 138.00] AMP 11277.5 -77.99
515173 [BERWYN 4 138.00] AMP 8165.6 -77.12
515174 [VANOSS 4 138.00] AMP 13206.3 -78.58
515178 [PARKLN 4 138.00] AMP 16361.2 -81.54
515196 [MILLCRK4 138.00] AMP 8926.0 -78.89
515224 [MUSKOGE7 345.00] AMP 29003.5 -86.73
515235 [PECANCK7 345.00] AMP 21742.0 -85.51
515286 [STRLGTP4 138.00] AMP 13738.3 -76.86
515302 [FTSMITH7 345.00] AMP 9963.1 -85.97
515318 [SOTHADA4 138.00] AMP 11296.3 -80.87
515362 [HARDEN 4 138.00] AMP 8210.2 -80.18
515422 [C-RIVER7 345.00] AMP 9618.9 -84.34
515475 [PURCELL4 138.00] AMP 9780.3 -80.54
515531 [VANOSTP4 138.00] AMP 13332.0 -78.60
515559 [SULPHR 4 138.00] AMP 14334.7 -80.38
515570 [MAYSVLT4 138.00] AMP 5724.8 -74.15
515575 [ARBWIND4 138.00] AMP 8986.2 -81.03
515643 [HONEYCK4 138.00] AMP 8992.2 -81.03
521019 [OAKLAWN4 138.00] AMP 12520.4 -80.31
521044 [RUSSETT4 138.00] AMP 11090.2 -77.75
521067 [TEXOMAJ4 138.00] AMP 8434.9 -77.34
521122 [HOWE 4 138.00] AMP 10876.1 -79.85
584780 [GEN-2015-036345.00] AMP 7694.2 -84.56
587820 [GEN-2016-102138.00] AMP 9615.3 -81.66
588180 [GEN-2016-126138.00] AMP 10391.6 -80.45

2016 MDWG FINAL WITH 2015 SERIES MMWG FINAL
MDWG 2018S WITH MMWG 2017S

GEN-2016-126 @ Arbuckle - Blue River 138kV Line

OPTIONS USED:
- SET PRE-FAULT VOLTAGE ON ALL BUSES TO 1.00 PU AT 0 PHASE SHIFT ANGLE
- SET SYNCHRONOUS/ASYNCHRONOUS MACHINE POWER OUTPUTS TO P=0.0, Q=0.0
- SET GENERATOR POSITIVE SEQUENCE REACTANCES TO SUBTRANSIENT
- SET TRANSFORMER TAP RATIOS=1.0 PU AND PHASE SHIFT ANGLES=0.0
- SET LINE CHARGING=0.0 IN +/-/0 SEQUENCES
- SET LINE/FIXED/SWITCHED SHUNTS=0.0 AND TRANSFORMER MAGNETIZING ADMITTANCE=0.0 IN +/-/0 SEQUENCES
- SET LOAD=0.0 IN +/- SEQUENCES
- DC LINES AND FACTS DEVICES BLOCKED
- IMPEDANCE CORRECTIONS NOT APPLIED TO TRANSFORMER ZERO SEQUENCE IMPEDANCES

THREE PHASE FAULT

X---------- BUS ----------X		/I+/	AN(I+)
509745	[CLARKSV7 345.00]	AMP	20258.9 -85.86
510877	[FIXCT4 138.00]	AMP	7048.9 -71.67
510907	[PITTSB-7 345.00]	AMP	13584.7 -84.59
510911	[VALIANT7 345.00]	AMP	13337.1 -85.40
510925	[KIOWA 7 345.00]	AMP	13346.4 -84.64
510948	[EARLSBORO 4138.00]	AMP	7450.4 -72.16
511449	[CORNVIL4 138.00]	AMP	16222.2 -77.60
511508	[BLANCHD4 138.00]	AMP	5812.1 -68.26
514808	[JOHNCO 4 138.00]	AMP	14955.0 -82.96
514809	[JOHNCO 7 345.00]	AMP	9806.0 -84.60
514814	[PRICESF4 138.00]	AMP	8843.3 -80.87
514880	[NORTWST7 345.00]	AMP	32215.1 -86.08
514901	[CIMARON7 345.00]	AMP	32737.3 -85.93
514907	[ARCADIA4 138.00]	AMP	42232.3 -85.68
514908	[ARCADIA7 345.00]	AMP	26360.8 -86.51
514909	[REDBUD 7 345.00]	AMP	25375.6 -86.85
514933	[DRAPER 4 138.00]	AMP	39253.9 -85.12
514934	[DRAPER 7 345.00]	AMP	20901.7 -85.08
515044	[SEMINOL4 138.00]	AMP	40043.4 -85.66
515045	[SEMINOL7 345.00]	AMP	26545.6 -86.13
515055	[MAUD 4 138.00]	AMP	19802.0 -79.24
515075	[FRSTHIL4 138.00]	AMP	13804.6 -76.95
515097	[WLNUTCK4 138.00]	AMP	9205.4 -80.43
515100	[PAOLI- 4 138.00]	AMP	10206.5 -79.30
515114	[CHIGLEY4 138.00]	AMP	8058.2 -79.92
515117	[ARBUCKL4 138.00]	AMP	15592.8 -80.20
515118	[JOLLYVL4 138.00]	AMP	9088.7 -80.79
515120	[RUSSET-4 138.00]	AMP	11149.9 -77.77
515121	[MILLCKT4 138.00]	AMP	10811.7 -79.72
515122	[SXMLCKT4 138.00]	AMP	10953.6 -79.90
515123	[OAKLAW-4 138.00]	AMP	12628.8 -80.24
515124	[MAYSVIL4 138.00]	AMP	6092.7 -74.54
515133	[BLUERIV4 138.00]	AMP	10694.9 -81.49

515136 [SUNNYSD7 345.00] AMP 10749.3 -84.69
515138 [CARTER 4 138.00] AMP 12297.5 -79.49
515147 [GLASSES4 138.00] AMP 8035.1 -75.35
515149 [MADINDT4 138.00] AMP 8025.6 -75.40
515150 [CANEYCK4 138.00] AMP 8487.2 -77.43
515151 [LTLCITY4 138.00] AMP 7052.0 -77.14
515161 [AIRPARK4 138.00] AMP 7328.8 -76.79
515162 [FNDTION4 138.00] AMP 11435.4 -78.28
515165 [TOTAL 4 138.00] AMP 10873.0 -78.31
515169 [AIRPRKT4 138.00] AMP 8516.4 -77.25
515171 [CHIKSAW4 138.00] AMP 12042.7 -78.77
515172 [SPRNDAL4 138.00] AMP 11261.3 -77.99
515173 [BERWYN 4 138.00] AMP 8146.9 -77.11
515174 [VANOSS 4 138.00] AMP 13206.2 -78.57
515178 [PARKLN 4 138.00] AMP 16430.8 -81.57
515196 [MILLCRK4 138.00] AMP 8907.9 -78.89
515224 [MUSKOGE7 345.00] AMP 29003.5 -86.73
515235 [PECANCK7 345.00] AMP 21742.0 -85.51
515286 [STRLGTP4 138.00] AMP 13739.1 -76.86
515302 [FTSMITH7 345.00] AMP 9963.1 -85.97
515318 [SOTHADA4 138.00] AMP 11323.9 -80.89
515362 [HARDEN 4 138.00] AMP 8219.1 -80.19
515422 [C-RIVER7 345.00] AMP 9618.5 -84.34
515475 [PURCELL4 138.00] AMP 9778.5 -80.54
515531 [VANOSTP4 138.00] AMP 13331.0 -78.60
515559 [SULPHR 4 138.00] AMP 14205.2 -80.28
515570 [MAYSVLT4 138.00] AMP 5722.5 -74.15
515575 [ARBWIND4 138.00] AMP 8963.3 -81.00
515643 [HONEYCK4 138.00] AMP 8969.2 -81.00
521019 [OAKLAWN4 138.00] AMP 12426.5 -80.23
521044 [RUSSETT4 138.00] AMP 11080.2 -77.75
521067 [TEXOMAJ4 138.00] AMP 8430.5 -77.34
521122 [HOWE 4 138.00] AMP 10850.7 -79.84
584780 [GEN-2015-036345.00] AMP 7689.9 -84.56
587820 [GEN-2016-102138.00] AMP 9778.3 -81.79
588180 [GEN-2016-126138.00] AMP 11588.7 -80.85
588184 [G16-126-TAP 138.00] AMP 11822.9 -81.17

2026SP GEN-2016-126 Short Circuit Analysis Results

2016 MDWG FINAL WITH 2015 SERIES MMWG FINAL
MDWG 2026S WITH MMWG 2026S

GEN-2016-126 @ Arbuckle 138kV Bus

OPTIONS USED:
- SET PRE-FAULT VOLTAGE ON ALL BUSES TO 1.00 PU AT 0 PHASE SHIFT ANGLE
- SET SYNCHRONOUS/ASYNCHRONOUS MACHINE POWER OUTPUTS TO P=0.0, Q=0.0
- SET GENERATOR POSITIVE SEQUENCE REACTANCES TO SUBTRANSIENT
- SET TRANSFORMER TAP RATIOS=1.0 PU AND PHASE SHIFT ANGLES=0.0
- SET LINE CHARGING=0.0 IN +/-/0 SEQUENCES
- SET LINE/FIXED/SWITCHED SHUNTS=0.0 AND TRANSFORMER MAGNETIZING ADMITTANCE=0.0 IN +/-/0 SEQUENCES
- SET LOAD=0.0 IN +/- SEQUENCES
- DC LINES AND FACTS DEVICES BLOCKED
- IMPEDANCE CORRECTIONS NOT APPLIED TO TRANSFORMER ZERO SEQUENCE IMPEDANCES

THREE PHASE FAULT

X---------- BUS ----------X	/I+/	AN(I+)
509745 [CLARKSV7 345.00]	AMP	20034.3 -85.87
510877 [FIXCT4 138.00]	AMP	7116.2 -71.60
510907 [PITTSB-7 345.00]	AMP	13597.6 -84.60
510911 [VALIANT7 345.00]	AMP	13347.3 -85.40
510925 [KIOWA 7 345.00]	AMP	13358.8 -84.65
510948 [EARLSBORO 4138.00]	AMP	7502.0 -72.09
511449 [CORNVIL4 138.00]	AMP	16571.9 -77.49
511508 [BLANCHD4 138.00]	AMP	5840.1 -68.18
514808 [JOHNCO 4 138.00]	AMP	14991.0 -82.96
514809 [JOHNCO 7 345.00]	AMP	9825.3 -84.61
514814 [PRICESF4 138.00]	AMP	8874.7 -80.90
514880 [NORTWST7 345.00]	AMP	32110.0 -86.08
514901 [CIMARON7 345.00]	AMP	32663.3 -85.92
514907 [ARCADIA4 138.00]	AMP	41937.6 -85.72
514908 [ARCADIA7 345.00]	AMP	26463.2 -86.55
514909 [REDBUD 7 345.00]	AMP	25705.0 -86.82
514933 [DRAPER 4 138.00]	AMP	39014.6 -85.12
514934 [DRAPER 7 345.00]	AMP	20829.4 -85.07
515044 [SEMINOL4 138.00]	AMP	40008.6 -85.65
515045 [SEMINOL7 345.00]	AMP	26504.3 -86.12
515055 [MAUD 4 138.00]	AMP	19797.2 -79.22
515075 [FRSTHIL4 138.00]	AMP	13719.3 -76.96
515097 [WLNUTCK4 138.00]	AMP	9203.6 -80.43
515100 [PAOLI- 4 138.00]	AMP	10213.6 -79.31
515114 [CHIGLEY4 138.00]	AMP	8080.6 -79.95
515117 [ARBUCKL4 138.00]	AMP	15763.5 -80.31
515118 [JOLLYVL4 138.00]	AMP	9125.9 -80.83
515120 [RUSSET-4 138.00]	AMP	11170.2 -77.76
515121 [MILLCKT4 138.00]	AMP	10844.6 -79.73
515122 [SXMLCKT4 138.00]	AMP	10985.9 -79.91
515123 [OAKLAW-4 138.00]	AMP	12730.8 -80.33
515124 [MAYSVIL4 138.00]	AMP	6095.5 -74.54
515133 [BLUERIV4 138.00]	AMP	10501.6 -81.35

515136 [SUNNYSD7 345.00] AMP 10778.0 -84.69
515138 [CARTER 4 138.00] AMP 12328.6 -79.49
515147 [GLASSES4 138.00] AMP 8045.9 -75.35
515149 [MADINDT4 138.00] AMP 8036.5 -75.39
515150 [CANEYCK4 138.00] AMP 8499.7 -77.43
515151 [LTLCITY4 138.00] AMP 7060.0 -77.14
515161 [AIRPARK4 138.00] AMP 7344.9 -76.79
515162 [FNDTION4 138.00] AMP 11461.9 -78.28
515165 [TOTAL 4 138.00] AMP 10900.2 -78.32
515169 [AIRPRKT4 138.00] AMP 8538.1 -77.26
515171 [CHIKSAW4 138.00] AMP 12073.8 -78.77
515172 [SPRNDAL4 138.00] AMP 11284.8 -77.99
515173 [BERWYN 4 138.00] AMP 8168.7 -77.12
515174 [VANOSS 4 138.00] AMP 13210.9 -78.58
515178 [PARKLN 4 138.00] AMP 16373.8 -81.55
515196 [MILLCRK4 138.00] AMP 8930.3 -78.89
515224 [MUSKOGE7 345.00] AMP 28796.9 -86.74
515235 [PECANCK7 345.00] AMP 21614.3 -85.54
515286 [STRLGTP4 138.00] AMP 13628.6 -76.87
515302 [FTSMITH7 345.00] AMP 9595.8 -85.75
515318 [SOTHADA4 138.00] AMP 11306.8 -80.88
515362 [HARDEN 4 138.00] AMP 8222.5 -80.21
515422 [C-RIVER7 345.00] AMP 9632.3 -84.39
515475 [PURCELL4 138.00] AMP 9775.4 -80.54
515531 [VANOSTP4 138.00] AMP 13336.6 -78.60
515559 [SULPHR 4 138.00] AMP 14341.7 -80.38
515570 [MAYSVLT4 138.00] AMP 5725.1 -74.15
515575 [ARBWIND4 138.00] AMP 8989.3 -81.02
515643 [HONEYCK4 138.00] AMP 8995.2 -81.02
521019 [OAKLAWN4 138.00] AMP 12525.2 -80.31
521044 [RUSSETT4 138.00] AMP 11100.1 -77.74
521067 [TEXOMAJ4 138.00] AMP 8442.9 -77.33
521122 [HOWE 4 138.00] AMP 10882.4 -79.85
584780 [GEN-2015-036345.00] AMP 7701.2 -84.56
587820 [GEN-2016-102138.00] AMP 9618.5 -81.66
588180 [GEN-2016-126138.00] AMP 10395.1 -80.45

PSS(R)E-33.7.0 ASCC SHORT CIRCUIT CURRENTS TUE, OCT 16 2018 12:15
2016 MDWG FINAL WITH 2015 SERIES MMWG FINAL
MDWG 2026S WITH MMWG 2026S

GEN-2016-126 @ Arbuckle - Blue River 138kV Line

OPTIONS USED:
- SET PRE-FAULT VOLTAGE ON ALL BUSES TO 1.00 PU AT 0 PHASE SHIFT ANGLE
- SET SYNCHRONOUS/ASYNCHRONOUS MACHINE POWER OUTPUTS TO P=0.0, Q=0.0
- SET GENERATOR POSITIVE SEQUENCE REACTANCES TO SUBTRANSIENT
- SET TRANSFORMER TAP RATIOS=1.0 PU AND PHASE SHIFT ANGLES=0.0
- SET LINE CHARGING=0.0 IN +/-/0 SEQUENCES
- SET LINE/FIXED/SWITCHED SHUNTS=0.0 AND TRANSFORMER MAGNETIZING ADMITTANCE=0.0 IN +/-/0 SEQUENCES
- SET LOAD=0.0 IN +/- SEQUENCES
- DC LINES AND FACTS DEVICES BLOCKED
- IMPEDANCE CORRECTIONS NOT APPLIED TO TRANSFORMER ZERO SEQUENCE IMPEDANCES

THREE PHASE FAULT

X---------- BUS ----------X	/I+/	AN(I+)
509745 [CLARKSV7 345.00]	AMP	20034.3 -85.87
510877 [FIXCT4 138.00]	AMP	7116.6 -71.60
510907 [PITTSB-7 345.00]	AMP	13595.6 -84.60
510911 [VALIANT7 345.00]	AMP	13346.4 -85.40
510925 [KIOWA 7 345.00]	AMP	13356.9 -84.65
510948 [EARLSBORO 4138.00]	AMP	7502.4 -72.09
511449 [CORNVIL4 138.00]	AMP	16571.9 -77.49
511508 [BLANCHD4 138.00]	AMP	5840.1 -68.18
514808 [JOHNCO 4 138.00]	AMP	14969.0 -82.96
514809 [JOHNCO 7 345.00]	AMP	9818.0 -84.60
514814 [PRICESF4 138.00]	AMP	8846.2 -80.87
514880 [NORTWST7 345.00]	AMP	32110.1 -86.08
514901 [CIMARON7 345.00]	AMP	32663.3 -85.92
514907 [ARCADIA4 138.00]	AMP	41937.9 -85.72
514908 [ARCADIA7 345.00]	AMP	26463.4 -86.55
514909 [REDBUD 7 345.00]	AMP	25705.2 -86.82
514933 [DRAPER 4 138.00]	AMP	39014.7 -85.12
514934 [DRAPER 7 345.00]	AMP	20830.1 -85.07
515044 [SEMINOL4 138.00]	AMP	40036.7 -85.65
515045 [SEMINOL7 345.00]	AMP	26507.8 -86.13
515055 [MAUD 4 138.00]	AMP	19801.7 -79.22
515075 [FRSTHIL4 138.00]	AMP	13720.3 -76.96
515097 [WLNUTCK4 138.00]	AMP	9201.5 -80.43
515100 [PAOLI- 4 138.00]	AMP	10205.1 -79.30
515114 [CHIGLEY4 138.00]	AMP	8059.1 -79.92
515117 [ARBUCKL4 138.00]	AMP	15601.0 -80.19
515118 [JOLLYVL4 138.00]	AMP	9091.7 -80.79
515120 [RUSSET-4 138.00]	AMP	11160.0 -77.77
515121 [MILLCKT4 138.00]	AMP	10817.9 -79.72
515122 [SXMLCKT4 138.00]	AMP	10960.1 -79.90
515123 [OAKLAW-4 138.00]	AMP	12633.7 -80.24
515124 [MAYSVIL4 138.00]	AMP	6092.8 -74.54
515133 [BLUERIV4 138.00]	AMP	10698.9 -81.49

515136 [SUNNYSD7 345.00] AMP 10770.1 -84.68
515138 [CARTER 4 138.00] AMP 12305.2 -79.48
515147 [GLASSES4 138.00] AMP 8041.5 -75.35
515149 [MADINDT4 138.00] AMP 8032.1 -75.40
515150 [CANEYCK4 138.00] AMP 8495.3 -77.43
515151 [LTLCITY4 138.00] AMP 7057.8 -77.14
515161 [AIRPARK4 138.00] AMP 7331.3 -76.78
515162 [FNDTION4 138.00] AMP 11442.5 -78.27
515165 [TOTAL 4 138.00] AMP 10879.1 -78.31
515169 [AIRPRKT4 138.00] AMP 8519.8 -77.25
515171 [CHIKSAW4 138.00] AMP 12050.4 -78.76
515172 [SPRNDAL4 138.00] AMP 11268.6 -77.99
515173 [BERWYN 4 138.00] AMP 8150.0 -77.10
515174 [VANOSS 4 138.00] AMP 13210.9 -78.57
515178 [PARKLN 4 138.00] AMP 16443.5 -81.57
515196 [MILLCRK4 138.00] AMP 8912.1 -78.88
515224 [MUSKOGE7 345.00] AMP 28796.9 -86.74
515235 [PECANCK7 345.00] AMP 21614.3 -85.54
515286 [STRLGTP4 138.00] AMP 13629.4 -76.87
515302 [FTSMITH7 345.00] AMP 9595.8 -85.75
515318 [SOTHADA4 138.00] AMP 11334.4 -80.89
515362 [HARDEN 4 138.00] AMP 8231.4 -80.22
515422 [C-RIVER7 345.00] AMP 9631.9 -84.39
515475 [PURCELL4 138.00] AMP 9773.6 -80.54
515531 [VANOSTP4 138.00] AMP 13335.7 -78.59
515559 [SULPHR 4 138.00] AMP 14212.0 -80.28
515570 [MAYSVLT4 138.00] AMP 5722.7 -74.15
515575 [ARBWIND4 138.00] AMP 8966.3 -81.00
515643 [HONEYCK4 138.00] AMP 8972.3 -81.00
521019 [OAKLAWN4 138.00] AMP 12431.3 -80.22
521044 [RUSSETT4 138.00] AMP 11090.1 -77.75
521067 [TEXOMAJ4 138.00] AMP 8438.6 -77.34
521122 [HOWE 4 138.00] AMP 10857.1 -79.84
584780 [GEN-2015-036345.00] AMP 7696.9 -84.56
587820 [GEN-2016-102138.00] AMP 9781.6 -81.79
588180 [GEN-2016-126138.00] AMP 11593.1 -80.85
588184 [G16-126-TAP 138.00] AMP 11827.5 -81.17