Final Report

Midcontinent ISO (MISO) Affected System Studies for Southwest Power Pool (SPP) Projects Phase II

April 2021

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Midcontinent Independent System Operator ("MISO") has contracted with Leidos Engineering, LLC ("Leidos") to perform Affected System Studies ("AFS") for the interconnection requests in the Southwest Power Pool ("SPP") queue (the "Project"). SPP is commencing the Definitive Interconnection System Impact Studies (DISIS) for their DISIS-2017-001 cycle Projects. The MISO AFS is intended to identify the impacts of these Projects on the MISO system.

The study will be done in three phases. Phase I has already been completed by SPP and is not part of this study scope. The report here includes the methodology, assumptions, and results for Phase II analysis. Phase III will commence at a later time and will utilize the data acquired in Phase II. This AFS includes steady state, and dynamic stability analyses. Because of a wide geographical region of the SPP Projects, the MISO AFS was divided in two groups to identify the impacts on the MISO-West and MISO-South regions.

The steady state analysis did not identify any thermal violations in the MISO-West and MISO-South regions due to SPP Projects. The study did not identify any voltage criteria violations in MISO-South region due to SPP Projects. However, there were several low voltage violations identified in the MISO-West region that are impacted by the SPP Projects. Based on the feedback from MISO and affected Transmission Owners, the study identified Network Upgrades to address the voltage criteria violations. These Network Upgrades along with their planning-level cost estimates are summarized below:

- 100 MVAR SVC/Statcom at Montezuma 345 kV ($40M)
- 25 MVAR Capacitor Bank at Deep River 161 kV ($2M)
- 40 MVAR Capacitor at W. Faribault 115 kV and 2x40 MVAR Capacitor Banks at Loon Lake 115 kV ($4M)
- 50 MVAR Capacitor at Blue Lake 230 kV ($2M)
- 75 MVAR Capacitor at Buffalo 345 kV ($4M)
- 150-200 MVAR Capacitor Bank at Hazelton 345 kV ($9M)

Leidos allocated the cost of Network Upgrades among the Projects based on their pro rata impacts on the violations in accordance of the MISO business practices. Table ES-1 shows the responsibility of each Project.

Table ES-1
Cost Allocation Summary for the Network Upgrades

Project	Total Network Upgrade Cost
GEN-2016-103	$6,778,388
GEN-2016-159	$11,263,684
GEN-2017-004	$3,307,961
GEN-2017-010	$5,157,433
GEN-2017-013	$4,136,426
GEN-2017-014	$7,568,336
GEN-2017-030	$3,954,389
GEN-2017-031	$2,514,210
GEN-2017-032	$3,442,645
GEN-2017-048	$7,760,847
GEN-2017-094	$5,115,679
Total	**$61,000,000**

Dynamic stability analysis showed acceptable system performance and did not identify any criteria violations that could be attributed to the study Projects.

Results of this AFS will be revisited in Phase III of the SPP DISIS process and, if required, a restudy will be performed to assess the validity of results and suitability of the Network Upgrades under the revised assumptions as applicable at that time.

Section 1
INTRODUCTION

1.1 Background

Midcontinent Independent System Operator ("MISO") has contracted with Leidos Engineering, LLC ("Leidos") to perform Affected System Studies ("AFS") for the interconnection requests in the Southwest Power Pool ("SPP") queue (the "Projects"). SPP is commencing the Definitive Interconnection System Impact Studies ("DISIS") for their DISIS-2017-001 cycle Projects. The MISO AFS is intended to identify the impacts of these Projects on the MISO system.

The study will be done in three phases. Phase I has already been completed by SPP and is not part of this study scope. The report here includes the methodology, assumptions, and results for Phase II analysis. Phase III will commence at a later time and will utilize the data acquired in Phase II. This Affected System Study includes steady state and dynamic stability analyses.

Because of a wide geographical region of the SPP Projects, the MISO AFS was divided in two groups to identify the impacts on the MISO West and MISO South regions. Table 1-1 shows the specifics of each study group

Table 1-1
MISO Study Groups for the AFS

Group	Total Requests	Total Capacity (MW)	Geographical Region of the Requests
MISO West Region	17	3,701.5	ND, SD, NE, KS, OK, MO
MISO South Region	14	2,194.8	OK, KS, TX, LA, MO

1.2 Project Description

SPP Projects to be studied as part of Phase II analysis for MISO West region are listed in Table 1-2 and for MISO South region in Table 1-3.

Table 1-2
SPP Projects List for MISO West Region

Generator	Fuel	Summer Pgen (MW)	Shoulder Pgen (MW)	Point of Interconnection (POI)	State
GEN-2016-103	Wind	39.1	250.7	Fort Thompson-Leland Olds 345kV	SD
GEN-2016-159	Wind	66.7	427.8	Turtle Creek 345kV	NE
GEN-2017-004	Wind	31.4	201.6	Elm Creek - Summit 345 kV	KS
GEN-2017-008	Solar	305	0	Moore (GEN-2016-096 Tap)-Pauline 345kV	NE
GEN-2017-010	Wind	31.2	200.1	Rhame 230 kV Sub	ND

Generator	Fuel	Summer Pgen (MW)	Shoulder Pgen (MW)	Point of Interconnection (POI)	State
GEN-2017-013	Wind	31.2	200	Mingo 345kV	KS
GEN-2017-014	Wind	46.8	300	Underwood - Philip Tap 230 kV	SD
GEN-2017-030	Wind	31.2	200	Eastown - Iatan 345kV	KS
GEN-2017-031	Wind	15.6	100	Wildhorse - Covalt 115 kV	NE
GEN-2017-032	Wind	31.2	200	Finney - Lamar 345 kV	CO
GEN-2017-048	Wind	46.8	300	Neset 230 kV Substation	ND
GEN-2017-055	Solar	228.3	0	Wagener 115 kV Sub	NE
GEN-2017-064	Solar	110	0	Underwood - Wayside 230 kV	SD
GEN-2017-075	Solar	200	0	Hugo-Sunnyside 345 kV	OK
GEN-2017-090	Solar	150	0	Adrian 161 kV sub	MO
GEN-2017-094	Wind	31.2	200	Fort Thompson-Huron 230 kV	SD
GEN-2017-097	Solar	128	0	Underwood 115 kV Sub	SD

Table 1-3
SPP Projects List for MISO South Region

Generator	Fuel	Summer Pgen (MW)	Point of Interconnection (POI)	State
GEN-2016-037	Wind	300	Chisholm-Gracemont 345kV	OK
GEN-2017-005	Wind	195	Marmaton - Litchfield 161 kV	OK
GEN-2017-009	Wind	302.5	Neosho - Caney River 345 kV	KS
GEN-2017-023	Solar	85	Hugo Power Plant 138 kV Sub	OK
GEN-2017-024	Solar	50	Frogville 138 kV sub	OK
GEN-2017-027	Wind	140	Pooleville-Ratliff (Carter County) 138kV	OK
GEN-2017-040	Wind	200.1	Canadian River-Muskogee and Muskogee-Seminole 345kV	TX
GEN-2017-057	Solar	72.5	Hosston 69kV	LA
GEN-2017-060	Wind	149.4	LaRussell Energy Center 161kV	MO
GEN-2017-061	Solar	101.5	GRDA1 to CLARMR 5 161kV line	OK
GEN-2017-071	Solar	124.7	Greenwood 138kV sub	OK
GEN-2017-077	Solar	124.7	Explorer Claremore Tap EXCLART4	OK
GEN-2017-082	Wind	149.4	Asbury Plant 161 kV	MO
GEN-2017-092	Solar	200	Canadian River-Muskogee and Muskogee-Seminole 345kV	OK

2.1 Study Models

MISO provided DPP 2017-February Phase 3 Study cases for this AFS. The MISO cases were based on the MISO Transmission Expansion Planning ("MTEP") cases from 2018, built for 2023. MISO provided following cases for the study:

- West Region:
  - Shoulder, MISO18_2023_SH90_2017FebDPP-Ph3_StudyCase_190822.sav
  - Summer Peak, MISO18_2023_SUM_2017FebDPP-Ph3_StudyCase_190822.sav
- South Region:
  - Summer Peak, DPP_FEB_17_2022_SPK_South_Phase3_STUDY_02162018.sav

Summer peak cases had load at 100% of summer peak condition and shoulder case had load scaled down to 70% and 85% of summer peak load. System topology included 2018 MTEP Appendix A Projects as well as other Appendix A Projects approved since the previous cycle.

2.2 Model Development

Various updates were implemented to the models based on the MISO input. This section lists the updates in various categories

2.2.1 Higher Queued Projects

The models for west region also included upgrades from the higher-queued (HQ) Projects in the MISO generator interconnection queue. Twelve (12) higher-queued Projects were added in the south region model. MISO provided the idevs for these higher queued Projects as listed in Table 2-1.

Table 2-1
Higher Queued Projects for South Case

HQ #	Idev
1	15.DIS-16-2_ADD_GEN-2016-036 - xxxx.IDV
2	15.DIS-16-2_ADD_GEN-2016-074 - xxxx (AKA xxxx 200MW in FCS-2016-003) - Copy.IDV
3	15.DIS-16-2_ADD_GEN-2016-087 - xxxx.IDV
4	15.DIS-16-2_ADD_GEN-2016-088 - xxxx.idv
5	15.DIS-16-2_ADD_GEN-2016-092 - xxxx.idv

HQ #	Idev
6	15.DIS-16-2_ADD_GEN-2016-094 - xxxx.IDV
7	15.DIS-16-2_ADD_GEN-2016-106 - xxxx.IDV
8	15.DIS-16-2_ADD_GEN-2016-110 - xxxx.IDV
9	15.DIS-16-2_ADD_GEN-2016-115 - xxxx.IDV
10	15.DIS-16-2_ADD_GEN-2016-130 - xxxx.IDV
11	15.DIS-16-2_ADD_GEN-2016-147 - xxxx.idv
12	15.DIS-16-2_ADD_GEN-2016-151 - xxxx.IDV

2.2.2 DISIS-2016-002 Upgrades

MISO provided a list of DISIS-2016-002 upgrades with associated python script to model the upgrades. The following upgrades were added to the base case by executing the script:

- 150 MVar SVC or STATCOM at Blackhawk 345 (MEC)
- 150 MVar Capacitor at Montezuma 345 (MEC)
- 100 MVAr Capacitor at Grimes 345 (MEC)
- 25 MVAr Capacitor at Monona161 (MEC)
- 2 x 20 MVAr Capacitors at Wahpeton 115 (OTP)
- 2 x 7.5 MVAr Capacitors at Big Sand 69 kV (DPC)

2.2.3 DPP Related Updates

MISO provided additional updates for the base cases based on the withdrawal of some MISO Projects. These updates are summarized below:

- Topology updates associated with DPP-2016-FEB West withdrawals
  - Removed J528
  - Removed 100 MVAR capacitor at Montezuma 345 kV (Bus 635730)
  - Removed 25 MVAR capacitor at Deep River 161 kV (Bus 635862)
- Topology updates associated with DPP-2016-AUG West withdrawals
  - Removed J598
  - Removed 2nd Zachary 345-161 kV Transformer (344000-344010 Ckt 2)
  - Removed 2nd Zachary-Adair 161 kV line (344006-344010 Ckt 2)

2.2.4 Study Project Modeling

MISO also provided the idevs for seventeen (17) SPP Projects for west cases (listed in Table 1-2) and fourteen (14) SPP Projects for south case (listed in Table 1-3) to be studied. Leidos added these Projects to the study cases and kept them offline to create

Pre-Project cases. To create Post-Project cases, Leidos dispatched these Projects according to Load Ratio Share (LRS) of various SPP control areas per the SPP practices. Projects were dispatched based on the fuel type in accordance with the MISO business practices as listed in Table 2-2 below

Table 2-2
Project Dispatch Based on the Fuel Type

Fuel Type	West – Shoulder Case	West – Summer Case	South – Summer Case
Wind	100%	15.6%	100%
Solar	offline	100%	100%

For stability analysis, shoulder case was used to study the Projects' impact.

Dynamic Model Updates

Some Projects caused issues leading to simulation crash when integrated into the base case. This is likely due to either bad parameters or a certain combination of dynamic models causing conflicts in the set up. In the interest of time, Leidos made some assumptions in discussions with MISO in order to obtain a functional post-Project model. These assumptions are summarized below:

- In West region Projects GEN-2017-004, GEN-2016-159, GEN-2017-014 and GEN-2017-097 were represented using generic model from the PSSE library. Data for the generic model was copied from Project GEN-2017-090.
- In South region, Project GEN-2017-060 model was replaced with the generic model from Project GEN-2017-048 (both using Vestas turbines).
- Project GEN-2017-040 data included significant charging within collector system leading to unacceptable voltages within the collector system and POI (over 1.10 pu at the POI and up to 1.4 pu within collector system). Leidos added an inductor of 500 MVAR within collector system to bring the voltages to a more reasonable level (ranging between 1.0 and 1.05 pu).

Since the study scope included identifying overall impact of study Projects on the MISO system and the evaluation of individual Project performance was not within the MISO AFS scope, these assumptions were deemed to be acceptable considering the objective of this AFS.

2.3 Methodology

Leidos performed this study to determine the impact of SPP's Projects on the MISO transmission system. MISO's transmission planning criteria were used to evaluate the results.

2.3.1 Power Flow Analysis

An AC contingency analysis was performed for the selected North American Electric Reliability Corporation (NERC) Reliability Standard TPL-001-4 Category P1 through P7 contingencies within the MISO and external region as previously defined by the MISO transmission owners and available in the MISO model package. MISO facilities of 69 kV and higher voltage levels and relevant third-party facilities were monitored in the study region. Leidos used Siemens PSS/E v33 and PowerGEM TARA v2001 software tools to perform the analysis.

The power flow analysis was performed for the Pre- and Post-Project cases. Leidos used subsystem (SUB), monitored elements (MON), and contingencies (CON) files provided by MISO and updated them for the study as appropriate.

Since there were over 85,000 contingencies in MISO's CON file, Leidos initially performed a DC run in TARA to limit the number of contingencies. A 75% loading cut-off was used for this DC run to select credible contingencies. All MISO facilities listed in the MON file were monitored. Leidos also generated distribution factors (DFs) for the study Projects to identify their impacts on the constraints.

Pre- and Post-Project power flow analyses were conducted and results were compared to identify the impacts of the SPP DISIS-2017-1 cycle Projects on the system performance.

Results were screened based on the following MISO criteria:

- Thermal Loading Criteria
  - Branch loading is >100% applicable normal or emergency rating and generator has:
    - P0 (No Contingency): 5% DF Cutoff, or
    - P1 & P2 (Single Contingency): 20% DF Cutoff, or
    - P4 (Fault plus stuck breaker): 20% DF Cutoff, or
    - P7 (Common Structure): 20% DF Cutoff, or
  - MW Impact from study generator greater than or equal to 20% of the applicable line rating (normal or emergency), or
  - Overloaded facility or overload-causing contingency at generator's outlet
  - Cumulative MW Impact from study generators greater than or equal to 20% of the applicable line rating (normal or emergency), where study generators whose individual MW Impact is greater than 5% of the rating and has DFAX of greater than 5% will be responsible to mitigate the cumulative MW Impact Constraint
  - Any Transmission Owner (TO) planning criteria

- Voltage Criteria
  - Bus voltage is outside of applicable normal or emergency limits, and
  - Voltage degradation is greater than 1%
  - Any TO planning criteria (Not applicable for this AFS)

MISO Outlet Facilities

For the purpose of applying the outlet criteria, MISO defines outlet facility as facilities within three-bus circle from each Project POI. For this AFS, three of the study Projects in West region have MISO outlet facilities. Projects in South region do not have any MISO outlet facilities based on the representations in the power flow cases. Table 2-3 lists the MISO buses that fall under this three-bus radius used to define MISO facilities.

Table 2-3
MISO Buses within Three-Bus Circle from the Project POIs

Projects	Bus no.	Bus Name	Base kV	Area	Area Name
GEN-2016-159	65400	J506 POI	345	635	MEC
GEN-2016-159	87486	J748GENTIE	345	635	MEC
GEN-2016-159	87487	J748POI	345	635	MEC
GEN-2016-159	635200	RAUN 3	345	635	MEC
GEN-2016-159	635201	RAUN 5	161	635	MEC
GEN-2016-159	635202	NEAL S 5	161	635	MEC
GEN-2016-159	635203	NEAL N 5	161	635	MEC
GEN-2016-159	635205	RAUN1XT9	13.8	635	MEC
GEN-2016-159	635206	IDA CO 3	345	635	MEC
GEN-2016-159	635213	NEAL 3G	22	635	MEC
GEN-2016-159	635214	NEAL 4G	24	635	MEC
GEN-2016-159	635220	INTCHG 5	161	635	MEC
GEN-2016-159	635230	LIBERTY5	161	635	MEC
GEN-2016-159	635252	J412 POI 3	345	635	MEC
GEN-2016-159	635254	J412 B1 9	34.5	635	MEC
GEN-2016-159	635255	J412 B2 9	34.5	635	MEC
GEN-2017-010	661004	BAKER 4	230	652	WAPA
GEN-2017-010	661005	BAKER 7	115	661	MDU
GEN-2017-010	661047	HETINGR4	230	652	WAPA
GEN-2017-010	661048	HETINGR7	115	661	MDU
GEN-2017-010	661901	BAKER 9	13.8	661	MDU
GEN-2017-010	661902	HETINGR9	13.8	661	MDU
GEN-2017-010	661988	THDRSPTCLC 9	34.5	661	MDU
GEN-2017-048	85931	J593	230	661	MDU
GEN-2017-048	85932	J593 COL1	34.5	661	MDU

Projects	Bus no.	Bus Name	Base kV	Area	Area Name
GEN-2017-048	661080	STANLEY7	115	661	MDU
GEN-2017-048	661084	TIOGA4 4	230	652	WAPA
GEN-2017-048	661085	TIOGA4 7	115	661	MDU
GEN-2017-048	661086	TIOGA7 7	115	661	MDU
GEN-2017-048	661900	TIOGA4 9	13.8	661	MDU

2.3.2 Dynamic Stability Analysis

Stability analysis was performed using Siemens PSS/E v33. While all West region Projects from Table 1-2 were modeled for stability analysis, only GEN-2017-040 and GEN-2017-060 from South region were modeled in stability analysis. Based on MISO's review of electrical proximity of South region Projects, it was determined that remaining projects were remote from the MISO seams and not expected to cause stability impacts on the MISO system. All Projects were evaluated on the West Shoulder case dispatched at full output level. Leidos simulated transmission faults on MISO's system as well as local faults close to some Project POIs to assess their impacts on the MISO system. Transmission Faults were provided by MISO as part of the study package. The West region Projects included some MISO facilities within the three-bus radius in PSSE from the Project POI as shown in Table 2-3. Therefore, Project-specific faults (near the POI) for such Projects were obtained from SPP and selected faults on these MISO facilities were simulated for West region study.

For West region Projects, other regional faults from MISO stability package for NERC Categories P1 to P7 were simulated in GRE, ALTW, MDU, MEC, MP, MRES, OPPD, OTP, and XEL areas. Similarly, for South region also, selected faults in EES-EAI (Area 327) were simulated in the study. Faults were selected based on the electrical proximity from SPP seams and Project locations. A list of these faults is provided in Appendix A.

Leidos performed non-disturbance simulation to check the overall response of the MISO system. Non-disturbance plots for West and South regions are included as part of the plot package for the fault events.

Stability study was conducted on the Post-Project case and the fault scenarios that result in the MISO or applicable Transmission Owners' planning criteria violations, were re-run on the base case (Pre-Projects case) to identify whether the violation is caused by the SPP DISIS-2017-1 cycle Projects. The study results were screened based on the following MISO criteria:

- All on-line generating units are stable
- No unexpected generator tripping
- Post-fault transient voltage limits:
  - Max: 1.2 pu
  - Min: 0.7 pu

- All machine rotor angle oscillations must be positively damped with a minimum damping ratio of 0.81633% for disturbances with a fault or 1.6766% for line trips without a fault
- Any applicable local planning criteria

Pertinent channels for voltage, frequency, rotor angle, active and reactive power were monitored in the study area. Primary focus of the analysis was to analyze system stability and post disturbance voltage recovery in MISO system.

Section 3
STEADY STATE ANALYSIS

3.1 West Region

3.1.1 Thermal Results

As per the planning criteria listed in Section 2 of this report, no thermal violations were identified as impacted by the SPP Projects in both summer and shoulder cases.

3.1.2 Voltage Results

For summer case no violations were identified per the MISO criteria. However, shoulder case showed several violations impacted by the study Projects. Few low voltage violations were identified in following areas – XEL (600), OTP (620), ALTW (627), and MEC (635). Several remote area violations were ignored based on the discussions with MISO as they appeared to be "noise" rather than legitimate impacts from the Projects. MISO shared the results with the affected Transmission Owners and received their inputs on potential mitigations and validity of results. A detailed list of violations that require mitigations is provided in Appendix B.

3.1.3 Network Upgrades

There are several Network Upgrades identified to address the voltage violations based on the feedback from the Transmission Owners. MISO also received planning-level cost estimates for these Network Upgrades. Table 3-1 shows the required upgrades and their planning-level cost estimates

Table 3-1
Network Upgrades Required to Address Voltage Violations

Item#	Description	Planning Level Cost Estimate ($M)	Area	Area Name
1	100 MVAR SVC/Statcom at Montezuma 345 kV	40.0	635	MEC
2	25 MVAR Capacitor Bank at Deep River 161 kV	2.0	635	MEC
3	40 MVAR Capacitor at W. Faribault 115 kV 2x40 MVAR Capacitor Banks at Loon Lake 115 kV	4.0	600	XEL
4	50 MVAR Capacitor at Blue Lake 230 kV	2.0	600	XEL
5	75 MVAR Capacitor at Buffalo 115 kV	4.0	620	OTP
6	150-200 MVAR Capacitor Bank at Hazelton 345 kV	9.0	627	ALTW

MISO will further review these Network Upgrades for validity in Phase III of the study and update the requirements if needed.

Cost Allocation

Leidos performed cost allocation of Network Upgrades identified in Table 3-1 in accordance with the MISO business practices. Projects impacting the worst violation were turned off one at a time to identify the impact of each project on the voltage violation, and cost allocation was performed based on their pro rata impacts. Table 3-2 presents the share of each Project on each Network Upgrade. The numbering for the upgrades in the table heading corresponds to the item numbers in Table 3-1.

Table 3-2
Network Upgrades Cost Allocation

Project	NU1	NU2	NU3	NU4	NU5	NU6	Total
GEN-2016-103	$4,234,405	$217,469	$500,000	$257,962	$495,706	$1,072,848	$6,778,388
GEN-2016-159	$7,788,280	$399,287	$798,507	$280,255	$358,282	$1,639,073	$11,263,684
GEN-2017-004	$2,419,660	$99,822	$216,418	$76,433	$88,344	$407,285	$3,307,961
GEN-2017-010	$2,948,960	$153,298	$335,821	$222,930	$711,656	$784,768	$5,157,433
GEN-2017-013	$2,948,960	$146,168	$238,806	$98,726	$127,607	$576,159	$4,136,426
GEN-2017-014	$4,763,705	$245,989	$522,388	$280,255	$603,681	$1,152,318	$7,568,336
GEN-2017-030	$2,948,960	$131,907	$194,030	$79,618	$93,252	$506,623	$3,954,389
GEN-2017-031	$1,739,130	$92,692	$126,866	$70,064	$107,975	$377,483	$2,514,210
GEN-2017-032	$2,495,274	$110,517	$194,030	$82,803	$103,067	$456,954	$3,442,645
GEN-2017-048	$4,461,248	$228,164	$485,075	$324,841	$1,109,202	$1,152,318	$7,760,847
GEN-2017-094	$3,251,418	$174,688	$388,060	$226,115	$201,227	$874,172	$5,115,679
Total	**$40,000,000**	**$2,000,000**	**$4,000,000**	**$2,000,000**	**$4,000,000**	**$9,000,000**	**$61,000,000**

It should be noted that the Network Upgrades are required to address the voltage violations observed only in shoulder case where solar PV projects were offline per the MISO dispatch methodology. Therefore, none of the solar PV projects were part of this cost allocation.

3.2 South Region

3.2.1 Thermal Results

As per the planning criteria listed in Section 2 of this report, no thermal violations were identified as impacted by the study Projects.

3.2.2 Voltage Results

No voltage violations were identified as impacted by the study Projects.

3.2.3 Network Upgrades

The study did not identify any constraints that would require Network Upgrades in south region as per MISO's planning criteria.

4.1 West Region

4.1.1 Stability Analysis Results

Leidos simulated a total of 112 faults in the study in consultation with MISO. The performance of the MISO transmission system electrically closer to the SPP seams was monitored for these fault scenarios. The study did not identify any loss of synchronism or tripping for the monitored MISO units under the fault events that could be attributed to the study Projects. Post-fault voltages recovered to acceptable voltage levels within the simulation time. There were no sustained oscillations identified for on the MISO transmission system and the oscillations appear to be sufficiently damped within the simulation time frame. Overall, MISO's transmission system was found to be stable for the studied fault scenarios with no significant impacts from the study Projects. Simulation plots for the studied faults are reported in Appendix C.

4.1.2 Network Upgrades

No Network Upgrades were identified for West region to meet the stability performance criteria.

4.2 South Region

4.2.1 Stability Analysis Results

Leidos simulated a total of nine (9) faults in consultation with MISO close to the two Projects evaluated in the study. The performance of the MISO transmission system electrically closer to the SPP seams was monitored for these fault scenarios. The study did not identify loss of synchronism or tripping for the monitored MISO units under the fault events that could be attributed to the study Projects. Post-fault voltages recovered to acceptable voltage levels within the simulation time. There were no sustained oscillations identified for on the MISO transmission system and the oscillations appear to be sufficiently damped within the simulation time frame. Overall, MISO's transmission system was found to be stable for the studied fault scenarios with no significant impacts from the study Projects. Simulation plots for the studied faults are reported in Appendix D.

4.2.2 Network Upgrades

No Network Upgrades were identified for South region to meet the stability performance criteria.

Appendix A
Fault Lists

Table A-1
Fault Events Simulated in Stability Study – West Region

Simulation No.	Simulation Filename	NERC TPL Category	Source
1	sim_0001_w_spp_p12.idv	P1	SPP
2	sim_0002_w_spp_p12.idv	P1	SPP
3	sim_0003_w_spp_p12.idv	P1	SPP
4	sim_0004_w_spp_p42.idv	P4	SPP
5	sim_0005_w_spp_p42.idv	P4	SPP
6	sim_0006_w_spp_p12.idv	P1	SPP
7	sim_0007_w_spp_p13.idv	P1	SPP
8	sim_0008_w_spp_p12.idv	P1	SPP
9	sim_0009_w_spp_p42.idv	P4	SPP
10	sim_0010_w_spp_p42.idv	P4	SPP
11	sim_0011_w_spp_p12.idv	P1	SPP
12	sim_0012_w_spp_p61.idv	P6	SPP
13	sim_0013_w_spp_p61.idv	P6	SPP
14	sim_0014_w_spp_p42.idv	P4	SPP
15	sim_0015_w_spp_p42.idv	P4	SPP
16	sim_0016_w_spp_p12.idv	P1	SPP
17	sim_0017_w_spp_p42.idv	P4	SPP
18	sim_0018_w_spp_p42.idv	P4	SPP
19	sim_0019_w_spp_p12.idv	P1	SPP
20	sim_0682_w_gre_p72_ei2_coalcreek.idv	P7	MISO
21	sim_0683_w_gre_p72_eis_coalcreek.idv	P7	MISO
22	sim_0689_w_gre_p43_eq1_coalcreek.idv	P4	MISO
23	sim_0690_w_gre_p23.idv	P2	MISO
24	sim_0692_w_gre_p42_er1_coalcreek-stkbrk.idv	P4	MISO
25	sim_0699_w_itcm_p11.idv	P1	MISO
26	sim_0700_w_itcm_p11.idv	P1	MISO
27	sim_0753_w_mec_p12.idv	P1	MISO
28	sim_0754_w_mec_p12.idv	P1	MISO
29	sim_0768_w_mec_p42.idv	P4	MISO
30	sim_0771_w_mec_p42.idv	P4	MISO
31	sim_0800_w_mp_p12_fds_sqbutte.idv	P1	MISO
32	sim_0822_w_otp_p12_eb3_center.idv	P1	MISO
33	sim_0823_w_otp_p12_ec3_center.idv	P1	MISO

Simulation No.	Simulation Filename	NERC TPL Category	Source
34	sim_0824_w_otp_p12_el3_center.idv	P1	MISO
35	sim_0826_w_otp_p42_eb4_center.idv	P4	MISO
36	sim_0828_w_otp_p43.idv	P4	MISO
37	sim_0830_w_otp_p42_fd4_sqbutte.idv	P4	MISO
38	sim_0831_w_otp_p42_ec1_center.idv	P4	MISO
39	sim_0832_w_otp_p42.idv	P4	MISO
40	sim_0858_w_xel_p12.idv	P1	MISO
41	sim_0864_w_xel_p12.idv	P1	MISO
42	sim_0869_w_xel_p12.idv	P1	MISO
43	sim_0871_w_xel_p12.idv	P1	MISO
44	sim_0872_w_xel_p12.idv	P1	MISO
45	sim_0874_w_xel_p12.idv	P1	MISO
46	sim_0887_w_xel_p12.idv	P1	MISO
47	sim_0897_w_xel_p23.idv	P2	MISO
48	sim_0910_w_xel_p43.idv	P4	MISO
49	sim_0911_w_xel_p43.idv	P4	MISO
50	sim_0918_w_xel_p43.idv	P4	MISO
51	sim_0967_x_oppd_p43.idv	P4	MISO
52	sim_0968_x_oppd_p43.idv	P4	MISO
53	sim_1207_w_mec_p11.idv	P1	MISO
54	sim_1424_w_mres_p42.idv	P4	MISO
55	sim_1434_w_otp_p12.idv	P1	MISO
56	sim_1436_w_otp_p12.idv	P1	MISO
57	sim_1677_w_otp_p12_fds_sqbutte.idv	P1	MISO
58	sim_1681_w_otp_p42_fl4_sqbutte.idv	P4	MISO
59	sim_1682_w_xel_p12.idv	P1	MISO
60	sim_2104_w_itcm_p12.idv	P1	MISO
61	sim_2117_P42_Obrien-Lakefield&Obrien-Highland_345.idv	P4	MISO
62	sim_2118_P42_Kossuth-Ledyard&Kossuth-Webster_345.idv	P4	MISO
63	sim_2122_P42_Montezuma-Hills&OGS-Montezuma_345.idv	P4	MISO
64	sim_2123_P42_Hills-Sub T-Louisa&Hills-Montezuma_345.idv	P4	MISO
65	sim_2144_w_MDU_P12.idv	P1	MISO
66	sim_2155_w_MDU_P42.idv	P4	MISO
67	sim_2255_w_xel_p42_nls.idv	P4	MISO
68	sim_2270_w_xel_SLG.idv	P4	MISO
69	sim_2277_w_xel_sns.idv	P4	MISO
70	sim_2279_w_xel_wss.idv	P4	MISO
71	sim_2281_w_mec_P42.idv	P4	MISO
72	sim_2282_w_mec_P42.idv	P4	MISO
73	sim_2283_w_mec_P42.idv	P4	MISO

Simulation No.	Simulation Filename	NERC TPL Category	Source
74	sim_2285_w_mec_P42.idv	P4	MISO
75	sim_2310_w_gre_P7_GRE_CCK_DCBLOCK_NOGENTRIP.idv	P7	MISO
76	sim_2317_w_MDU_P42.idv	P4	MISO
77	sim_2318_w_MDU_P42.idv	P4	MISO
78	sim_2319_w_MDU_P42.idv	P4	MISO
79	sim_2320_w_MDU_P42.idv	P4	MISO
80	sim_2321_w_itcm_p42.idv	P4	MISO
81	sim_3000_w_otp_p12_gc3_rghrdr.idv	P1	MISO
82	sim_3001_w_MDU_P12_Ellendale-Oakes230.idv	P1	MISO
83	sim_3002_w_MDU_P42_Ellendale_Breaker4907.idv	P4	MISO
84	sim_5004_J748-POI_3ph_HIGHLND_345.idv	P1	MISO
85	sim_5005_J748-POI_3ph_J506-POI_345.idv	P1	MISO
86	sim_5006_J748-POI_SLG_HIGHLND_345.idv	P2	MISO
87	sim_5007_J748-POI_SLG_J506-POI_345.idv	P2	MISO
88	sim_5008_mec_p42_lehigh_0350.idv	P4	MISO
89	sim_5009_mec_p42_lehigh_0360.idv	P4	MISO
90	sim_5010_mec_p42_obrien_906.idv	P4	MISO
91	sim_5011_mec_p42_sub93_924.idv	P4	MISO
92	sim_5012_mec_p55_hills.idv	P5	MISO
93	sim_5013_P11_230_OTP_BigStone_Gen.idv	P1	MISO
94	sim_5014_P11_345_OTP_Coyote_Gen.idv	P1	MISO
95	sim_5015_P12_230_OTP_BigStone-BigStoneSouth-ckt1.idv	P1	MISO
96	sim_5016_P12_230_OTP_BigStone-Blair.idv	P1	MISO
97	sim_5017_P12_230_OTP_BigStone-Hankinson.idv	P1	MISO
98	sim_5018_P12_345_OTP_BigStoneSouth-BrookingsCo.idv	P1	MISO
99	sim_5019_P12_345_OTP_BigStoneSouth-Ellendale.idv	P1	MISO
100	sim_5020_P13_230_OTP_BigStone_IntXfmr.idv	P1	MISO
101	sim_5021_P13_345_OTP_BigStoneSouth_Xfmr1.idv	P1	MISO
102	sim_5022_P42_230_OTP_BigStone-BigStoneSouth-ckt1_2635stk.idv	P4	MISO
103	sim_5023_P42_230_OTP_BigStone-BigStoneSouth-ckt1_2655stk.idv	P4	MISO
104	sim_5024_P42_230_OTP_BigStone-BigStoneSouth-ckt2_2685stk.idv	P4	MISO
105	sim_5025_P42_230_OTP_BigStone-BigStoneSouth-ckt2_2695stk.idv	P4	MISO
106	sim_5026_P42_230_OTP_BigStone-Blair_2645stk.idv	P4	MISO
107	sim_5027_P42_230_OTP_BigStone-Hankinson_2655stk.idv	P4	MISO
108	sim_5028_P42_230_OTP_BigStone-Hankinson_2665stk.idv	P4	MISO
109	sim_5029_P42_345_OTP_BigStoneSouth-BrookingsCo_3715stk.idv	P4	MISO
110	sim_5030_P43_230_OTP_BigStone_IntXfmr_2635stk.idv	P4	MISO
111	sim_5031_P43_230_OTP_BigStone_IntXfmr_2645stk.idv	P4	MISO
112	sim_5032_P43_345_OTP_BigStoneSouth_Xfmr1_2415stk.idv	P4	MISO

Table A-2
Fault Events Simulated in Stability Study – South Region

Simulation No.	Simulation Filename	NERC TPL Category	Source
1	sim_1318_s_ees_p11_1ANO_U1_22kV.idv	P1	MISO
2	sim_1319_s_ees_p11_1ANO_U2_22kV.idv	P1	MISO
3	sim_1331_s_ees_p12_At_ANO_ANO_to_Ft_Smith_500kV.idv	P1	MISO
4	sim_1332_s_ees_p12_At_ANO_ANO_to_Mabelvale_500kV.idv	P1	MISO
5	sim_1333_s_ees_p12_At_Mabelvale_ANO_to_Mabelvale_500kV.idv	P1	MISO
6	sim_1334_s_ees_p41_SLG_bf_2.idv	P4	MISO
7	sim_1346_s_ees_p42_SLG_bf_1_2.idv	P4	MISO
8	sim_1408_s_eai_p55_SLG_psf_6.idv	P5	MISO
9	sim_1653_s_eai_p611_11-3PH-8ANO-8ANO.idv	P6	MISO

Appendix B
Steady State Voltage Results – West Region

Table B-1
Steady State Voltage Violations – West Region

Bus #	Bus Name	kV	Area	Vlow	Vhi	Bench mark Contingency Voltage	Study Case Contingency Voltage	Delta	Contingency Details
75730	J530 POI	345	635	1	1.05	1.01	0.9922	-0.01	P12:345:AMMO-ALTW::ZACKARY:OTTUMWA:1
75730	J530 POI	345	635	1	1.05	1.01	0.9922	-0.01	P12:345:AMMO-ALTW::ZACKARY:OTTUMWA:1_Dup1
75730	J530 POI	345	635	1	1.05	1.01	0.9922	-0.01	P12:345:AMMO-MEC::ADAIR:OTTUMWA:1
75730	J530 POI	345	635	1	1.05	1.01	0.9930	-0.02	541201 SIBLEY 7 345 541500 KETCHEM7 345 1
635730	MNTZUMA3	345	635	1	1.05	1.02	0.9935	-0.02	541201 SIBLEY 7 345 541500 KETCHEM7 345 1
635862	DEEP RIVER5	161	635	1	1.05	1.01	0.9904	-0.02	P12:345:MEC:BONDRNT:MNTZUMA:1
603121	LOON LK7	115	600	0.92	1.05	0.91	0.8976	-0.01	P12:345:XEL:WILMART3:SHEASLK3:1 MEC RAS - ON
603121	LOON LK7	115	600	0.92	1.05	0.91	0.8976	-0.01	P12:345:XEL:WLM-SSL SPS:WILMAR:SHEASLAKE:1
603122	LOONLKTP	115	600	0.92	1.05	0.91	0.8977	-0.02	P12:345:XEL:WILMART3:SHEASLK3:1 MEC RAS - ON
603122	LOONLKTP	115	600	0.92	1.05	0.91	0.8977	-0.02	P12:345:XEL:WLM-SSL SPS:WILMAR:SHEASLAKE:1
603121	LOON LK7	115	600	0.92	1.05	0.91	0.8997	-0.01	P12:345:XEL:HELENA3:SHEASLK3:1:MEC RAS - ON
603121	LOON LK7	115	600	0.92	1.05	0.91	0.8997	-0.01	P12:345:XEL:HNA-SSL SPS:HELENA:SHEASLAKE:1
603122	LOONLKTP	115	600	0.92	1.05	0.91	0.9005	-0.01	P12:345:XEL:HELENA3:SHEASLK3:1:MEC RAS - ON
603122	LOONLKTP	115	600	0.92	1.05	0.91	0.9005	-0.01	P12:345:XEL:HNA-SSL SPS:HELENA:SHEASLAKE:1
603121	LOON LK7	115	600	0.92	1.05	0.93	0.9116	-0.02	P12:345:XEL:HELENA3:SCOTTCO3:1
603001	W FARIB7	115	600	0.92	1.05	0.93	0.9133	-0.02	P12:345:XEL:WILMART3:SHEASLK3:1 MEC RAS - ON
603001	W FARIB7	115	600	0.92	1.05	0.93	0.9133	-0.02	P12:345:XEL:WLM-SSL SPS:WILMAR:SHEASLAKE:1
603247	W FAIRB CAP7	115	600	0.92	1.05	0.93	0.9134	-0.02	P12:345:XEL:WILMART3:SHEASLK3:1 MEC RAS - ON
603247	W FAIRB CAP7	115	600	0.92	1.05	0.93	0.9134	-0.02	P12:345:XEL:WLM-SSL SPS:WILMAR:SHEASLAKE:1
603121	LOON LK7	115	600	0.92	1.05	0.93	0.9136	-0.02	P71:345:XEL:BLL-IVH-RRK RRK-PRI
602014	BLUE LK4	230	600	0.92	1.05	0.93	0.9088	-0.02	P71:345-345:GRE:CMT-HLE CKT 1 - 2
602014	BLUE LK4	230	600	0.92	1.05	0.93	0.9089	-0.02	P71:345-161:XEL-ITC:LAJ-LCN LAJ-NOB(3)
620180	CSLTNET7	115	620	0.92	1.1	0.94	0.9023	-0.03	P53:230:XEL:SHY TR6
620260	ENDERLN7	115	620	0.92	1.1	0.94	0.9059	-0.03	P53:230:XEL:SHY TR6
620259	ALICE 7	115	620	0.92	1.1	0.94	0.9089	-0.03	P53:230:XEL:SHY TR6
620258	BUFFALO7	115	620	0.92	1.1	0.95	0.9119	-0.03	P53:230:XEL:SHY TR6
636199	BLACKHAWK 3	345	635	0.96	1.05	0.97	0.9410	-0.03	P12:345:MEC:BONDRNT:MNTZUMA:1
2	BLACKH SVC	345	635	0.96	1.05	0.97	0.9411	-0.03	P12:345:MEC:BONDRNT:MNTZUMA:1
636199	BLACKHAWK 3	345	635	0.96	1.05	0.97	0.9472	-0.02	75730 J530 POI 345 636400 HILLS 3 345 1

Bus #	Bus Name	kV	Area	Vlow	Vhi	Bench mark Conting ency Voltage	Study Case Continge ncy Voltage	Delta	Contingency Details
2	BLACKH SVC	345	635	0.96	1.05	0.97	0.9473	-0.02	75730 J530 POI 345 636400 HILLS 3 345 1
636199	BLACKHAW K 3	345	635	0.96	1.05	0.98	0.9515	-0.03	P12:345:ATC:ASKING3:EAUCL3: EAU_MCCC RAS ON
2	BLACKH SVC	345	635	0.96	1.05	0.98	0.9516	-0.03	P12:345:ATC:ASKING3:EAUCL3: EAU_MCCC RAS ON
636199	BLACKHAW K 3	345	635	0.96	1.05	0.98	0.9522	-0.03	631139 HAZLTON3 345 631144 MITCHLCO3 345 1
2	BLACKH SVC	345	635	0.96	1.05	0.98	0.9523	-0.03	631139 HAZLTON3 345 631144 MITCHLCO3 345 1
636199	BLACKHAW K 3	345	635	0.96	1.05	0.98	0.9546	-0.03	75730 J530 POI 345 635730 MNTZUMA3 345 1
2	BLACKH SVC	345	635	0.96	1.05	0.98	0.9547	-0.03	75730 J530 POI 345 635730 MNTZUMA3 345 1
636302	CH CITY S 8	69	635	1	1.05	1.00	0.9869	-0.01	1 FRANKLIN 3 345 636199 BLACKHAWK 3 345 1
636302	CH CITY S 8	69	635	1	1.05	1.00	0.9883	-0.02	1 FRANKLIN 3 345 631206 QUINN3 345 1
631206	QUINN3	345	627	0.93	1.1	0.96	0.9241	-0.04	P12:345:MEC:BONDRNT:MNTZUMA:1
638036	STRTR P8	69	635	1	1.05	0.98	0.9542	-0.03	P71:345-161:MEC:GDMEC:BONDURANT:1:ALTOONA:BONDURANT:1
638033	UNI GEN8	69	635	1	1.05	0.98	0.9548	-0.03	P71:345-161:MEC:GDMEC:BONDURANT:1:ALTOONA:BONDURANT:1
638036	STRTR P8	69	635	1	1.05	0.98	0.9553	-0.03	P12:345:MEC:BONDRNT:MNTZUMA:1
638033	UNI GEN8	69	635	1	1.05	0.98	0.9560	-0.03	P12:345:MEC:BONDRNT:MNTZUMA:1
638032	GT SUB 8	69	635	1	1.05	0.98	0.9561	-0.03	P12:345:MEC:BONDRNT:MNTZUMA:1
638036	STRTR P8	69	635	1	1.05	0.98	0.9582	-0.03	P61:345-345:MEC:RAUN-J412 POI + GRIMES-LEHIGH
638033	UNI GEN8	69	635	1	1.05	0.98	0.9588	-0.02	P61:345-345:MEC:RAUN-J412 POI + GRIMES-LEHIGH
638032	GT SUB 8	69	635	1	1.05	0.98	0.9589	-0.02	P61:345-345:MEC:RAUN-J412 POI + GRIMES-LEHIGH
638036	STRTR P8	69	635	1	1.05	0.98	0.9620	-0.02	75730 J530 POI 345 636400 HILLS 3 345 1
638033	UNI GEN8	69	635	1	1.05	0.98	0.9626	-0.02	75730 J530 POI 345 636400 HILLS 3 345 1
638032	GT SUB 8	69	635	1	1.05	0.98	0.9627	-0.02	75730 J530 POI 345 636400 HILLS 3 345 1
638036	STRTR P8	69	635	1	1.05	0.99	0.9662	-0.02	631139 HAZLTON3 345 631144 MITCHLCO3 345 1
638033	UNI GEN8	69	635	1	1.05	0.99	0.9670	-0.02	631139 HAZLTON3 345 631144 MITCHLCO3 345 1
638032	GT SUB 8	69	635	1	1.05	0.99	0.9671	-0.02	631139 HAZLTON3 345 631144 MITCHLCO3 345 1
638036	STRTR P8	69	635	1	1.05	0.99	0.9696	-0.02	75730 J530 POI 345 635730 MNTZUMA3 345 1
638036	STRTR P8	69	635	1	1.05	0.99	0.9696	-0.02	P61:161-161:CFU-MEC:DEERE ENGINE-CFU INDUSTRIAL + BLACK HAWK-UNION-BUTLER
638032	GT SUB 8	69	635	1	1.05	0.99	0.9702	-0.02	75730 J530 POI 345 635730 MNTZUMA3 345 1
638033	UNI GEN8	69	635	1	1.05	0.99	0.9702	-0.02	75730 J530 POI 345 635730 MNTZUMA3 345 1
638036	STRTR P8	69	635	1	1.05	0.99	0.9703	-0.02	1 FRANKLIN 3 345 636199 BLACKHAWK 3 345 1
638033	UNI GEN8	69	635	1	1.05	0.99	0.9708	-0.02	P61:161-161:CFU-MEC:DEERE ENGINE-CFU INDUSTRIAL + BLACK HAWK-UNION-BUTLER
638032	GT SUB 8	69	635	1	1.05	0.99	0.9709	-0.02	P61:161-161:CFU-MEC:DEERE ENGINE-CFU INDUSTRIAL + BLACK HAWK-UNION-BUTLER
638033	UNI GEN8	69	635	1	1.05	0.99	0.9721	-0.02	1 FRANKLIN 3 345 636199 BLACKHAWK 3 345 1

Bus #	Bus Name	kV	Area	Vlow	Vhi	Bench mark Contingency Voltage	Study Case Contingency Voltage	Delta	Contingency Details
638032	GT SUB 8	69	635	1	1.05	0.99	0.9722	-0.02	1 FRANKLIN 3 345 636199 BLACKHAWK 3 345 1
638033	UNI GEN8	69	635	1	1.05	1.00	0.9799	-0.02	541201 SIBLEY 7 345 541500 KETCHEM7 345 1
638032	GT SUB 8	69	635	1	1.05	1.00	0.9800	-0.02	541201 SIBLEY 7 345 541500 KETCHEM7 345 1
638033	UNI GEN8	69	635	1	1.05	1.00	0.9842	-0.01	P71:115-345:ATC:W-23:L-GDP181
638032	GT SUB 8	69	635	1	1.05	1.00	0.9843	-0.01	P71:115-345:ATC:W-23:L-GDP181
638032	GT SUB 8	69	635	1	1.05	1.00	0.9853	-0.01	P12:161:ITCM:WELSBRG:M-TOWN:1
638032	GT SUB 8	69	635	1	1.05	1.00	0.9853	-0.01	P12:345:ATC:ARPINB3:ROCKYRNB8:POE RAS ON
638036	STRTR P8	69	635	1	1.05	1.00	0.9856	-0.01	P71:115-345:ATC:S-71:L-GDP181
638036	STRTR P8	69	635	1	1.05	1.00	0.9856	-0.01	P71:161-345:ATC:MP-762B:651
638036	STRTR P8	69	635	1	1.05	1.00	0.9856	-0.01	P71:161-345:MP:ARD-SLK:STN-GOR
638033	UNI GEN8	69	635	1	1.05	1.00	0.9857	-0.01	P55:161:MEC:SYCAMORE 161 BUS 1 OR 2-TRIP AMES TIE
638033	UNI GEN8	69	635	1	1.05	1.00	0.9857	-0.01	P55:161:MEC:SYCAMORE:161 BUS 1 OR 2:TRIP AMES TIE
638036	STRTR P8	69	635	1	1.05	1.00	0.9857	-0.01	P71:161-345:ATC:MP-762A:651
638036	STRTR P8	69	635	1	1.05	1.00	0.9857	-0.01	P71:345-345:ATC:L-GDP181:V-308
638032	GT SUB 8	69	635	1	1.05	1.00	0.9858	-0.01	P55:161:MEC:SYCAMORE 161 BUS 1 OR 2-TRIP AMES TIE
638032	GT SUB 8	69	635	1	1.05	1.00	0.9858	-0.01	P55:161:MEC:SYCAMORE:161 BUS 1 OR 2:TRIP AMES TIE
638033	UNI GEN8	69	635	1	1.05	1.00	0.9858	-0.01	P71:115-345:ATC-XEL:L3305:L-GDP181
638032	GT SUB 8	69	635	1	1.05	1.00	0.9859	-0.01	P71:115-345:ATC-XEL:L3305:L-GDP181
638036	STRTR P8	69	635	1	1.05	1.00	0.9859	-0.01	P71:161-345:MP:ARD-SLK:GOR-SLK
638033	UNI GEN8	69	635	1	1.05	1.00	0.9860	-0.01	006-45-BT3-4__
638033	UNI GEN8	69	635	1	1.05	1.00	0.9860	-0.01	P71:115-345:ATC:S-71:L-GDP181
638032	GT SUB 8	69	635	1	1.05	1.00	0.9861	-0.01	006-45-BT3-4__
638033	UNI GEN8	69	635	1	1.05	1.00	0.9861	-0.01	P71:345-345:ATC:L-GDP181:V-308
638036	STRTR P8	69	635	1	1.05	1.00	0.9861	-0.01	P71:69-345:ATC-XEL:L3472:L-GDP181
638033	UNI GEN8	69	635	1	1.05	1.00	0.9864	-0.01	P71:161-345:ATC-XEL:L3488:L-GDP181
638032	GT SUB 8	69	635	1	1.05	1.00	0.9865	-0.01	P71:161-345:ATC-XEL:L3488:L-GDP181
638036	STRTR P8	69	635	1	1.05	1.00	0.9870	-0.01	P23:161:HAR 9QB8 BREAKER FAILURE
638033	UNI GEN8	69	635	1	1.05	1.00	0.9874	-0.01	P14:345:ITCM-MEC:KILLDEER3-QUINN3 55MVAR:IA-SS
638032	GT SUB 8	69	635	1	1.05	1.00	0.9875	-0.01	P14:345:ITCM-MEC:KILLDEER3-QUINN3 55MVAR:IA-SS
638036	STRTR P8	69	635	1	1.05	1.01	0.9940	-0.01	Base Case
638033	UNI GEN8	69	635	1	1.05	1.01	0.9944	-0.01	Base Case
638032	GT SUB 8	69	635	1	1.05	1.01	0.9945	-0.01	Base Case
638033	UNI GEN8	69	635	1	1.05	1.01	0.9991	-0.01	P12:161:MEC:FRANKLIN:WALL LAKE:1
638036	STRTR P8	69	635	1	1.05	1.01	0.9997	-0.01	P11:230:MP:BOS:U4

Appendix C
Simulation Plots – West Region

Available upon request

Appendix D
Simulation Plots – South Region

Available upon request