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Report Number: R187-24

MISO Affected System Study for SPP DISIS-2017-002 #R1

Prepared for

MISO

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Revision History

Date	Rev.	Description
09/23/2024	A	Initial draft
11/18/2024	B	Sensitivity study based on latest information

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Executive Summary

This report presents restudy results of an Affected System Impact Study (AFSIS) on MISO transmission system performed for generator interconnection requests in the Southwest Power Pool (SPP) queue 2017-002 cluster west region (Study Projects). The AFSIS restudy results are summarized below.

1.1 Study Projects List

The generation projects (Study Projects) in SPP DISIS 2017-002 cluster west region are listed in Table ES-1.

Table ES-1: SPP DISIS 2017-002 Study Projects

Project #	State	Point of Interconnection	Generation Type	Service Request (MW)	SH (MW)	SPK (MW)
GEN-2017-105	NE	Tekamah-Raun 161 kV	Wind	75	75	11.7
GEN-2017-108	MO	Stillwell-Clinton 161 kV	Solar	400	0	400
GEN-2017-115	MO	Holt County 345 kV	Wind	244	244	38.064
GEN-2017-119	KS	Elm Creek 345 kV	Wind	180	180	28.08
GEN-2017-120	KS	Abilene Energy Center-Northview 115 kV	Wind	260	260	40.56
GEN-2017-144	NE	Holt County 345 kV	Wind	200	200	31.2
GEN-2017-175	SD	Vfodnes-Utica Jct 230 kV	Wind	300	300	46.8
GEN-2017-181	NE	Tobias 345 kV	Wind	300	300	46.8
GEN-2017-182	NE	Tobias 345 kV	Wind	128	128	19.968
GEN-2017-183	KS	Nashua-St. Joe 345 kV	Wind	400	400	62.4
GEN-2017-184	KS	Nashua-St. Joe 345 kV	Solar	400	0	400
GEN-2017-188	MO	Asbury 161 kV	Solar	130	0	130
GEN-2017-195	KS	West Gardner 345 kV	Solar	500.4	0	500.4
GEN-2017-196	KS	West Gardner 345 kV	BESS	128	128	128
GEN-2017-201	NE	Hoskins 345 kV	Wind	250	250	39
GEN-2017-202 [2]	MO	New Madrid-Sikeston 161 kV	Solar	200	0	200
GEN-2017-209 [1]	KS	LaCygne-Neosho 345 kV	Hybrid (Solar / BESS)	300	50	300
GEN-2017-210	NE	McCool 345 kV	Hybrid (Solar / BESS)	310	100	310
GEN-2017-214	ND	Logan 230 kV	Wind	100	100	15.6

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Project #	State	Point of Interconnection	Generation Type	Service Request (MW)	SH (MW)	SPK (MW)
GEN-2017-215	ND	Logan 230 kV	Wind	100	100	15.6
GEN-2017-222	IA	Denison 230 kV	Wind	180	180	28.08
GEN-2017-234	NE	Spalding-North Loup 115 kV	Wind	115	115	17.94

Note 1: GEN-2017-209 was withdrawn after the study kick off. This withdrawal was reflected in the sensitivity study.

Note 2: GEN-2017-202 was withdrawn on 11/13/2024. Upon review, MISO has determined the withdrawal has no impact to the result

1.2 MISO AFSIS Restudy Summary

MISO AFSIS restudy steady state models were developed from the final models used in MISO AFSIS study for DISIS-2017-002 West Phase 2 cycle. MISO AFSIS restudy stability package was developed from the final stability package used in MISO AFSIS study for DISIS-2017-002 West Phase 2 cycle.

For this MISO AFSIS restudy, steady state analysis and stability analysis were performed in the summer peak and summer shoulder scenarios.

Steady state thermal and voltage analysis was performed to identify any thermal and voltage violations in the MISO system. Thermal and voltage AFSIS Network Upgrades identified in steady state analysis are listed in Table ES-2 and Table ES-3.

GEN-2016-007 and GEN-2017-209 were withdrawn while the restudy was already underway. Sensitivity analysis was performed to determine if the identified upgrades are still adequate. The tables in the Executive Summary section were updated with the sensitivity result. Details of the sensitivity study can be found in Section 4.

GEN-2017-202 was withdrawn on 11/13/2024. Upon review, MISO has determined the withdrawal has no impact to the result.

Table ES-2: AFSIS Restudy Thermal Network Upgrades Identified for DISIS-2017-002 Study Projects

Constraint	Owner	Scenario	Mitigation	Cost ($)
J611 POI-Maryville 161 kV	MEC GMO	SH	MEC: Existing MEC only rating is 410 MVA, so no MEC upgrade needed. $0 Evergy: Existing Evergy emergency rating is 180 MVA. Line currently limited by conductor and will require a rebuild using 2x 954 Rail ACSR as the conductor. There will also be terminal upgrades required to achieve the needed 300 MVA rating. $22,335,001	$22,335,001
Souris-Mallard 115 kV	XEL	SH	Upgrade equipment at Mallard Substation	$100,000

Table ES-3: AFSIS Restudy Voltage Network Upgrades Identified for DISIS-2017-002 Study Projects

Constraint	Network Upgrades	Owner	Scenario	Cost ($)
Low voltage at J611 POI 161 kV under P2-P7 contingencies	Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	SH	$2,000,000

Transient stability analysis was performed to identify any transient stability violations caused by the SPP DISIS-2017-002 Study Projects. No transient stability constraints were identified in the MISO system. No MISO AFSIS stability NUs were identified in the transient stability analysis.

No contingent MTEP facilities were identified for the Study Projects.

A short circuit screening analysis was conducted by comparing three phase fault currents in the benchmark and study cases for the SPP Study Projects in MISO West. Based on the screening results, MISO Transmission Owners do not plan to conduct additional studies.

1.3 Total MISO AFSIS Network Upgrades

The total cost of MISO AFSIS Network Upgrades (NU) required for the Study Projects in DISIS-2017-002 is listed in Table ES-4. The costs for Network Upgrades are planning level estimates and subject to be revised in the facility studies.

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Table ES-4: Total Cost of MISO AFSIS Network Upgrades for DISIS-2017-002 Study Projects

Project Num	Network Upgrades ($)			Total Network Upgrade Cost ($)
	MISO Thermal & Voltage	Transient Stability	Short Circuit	
GEN-2017-105	$84,302	$0	$0	$84,302
GEN-2017-108	$0	$0	$0	$0
GEN-2017-115	$284,884	$0	$0	$284,884
GEN-2017-119	$0	$0	$0	$0
GEN-2017-120	$0	$0	$0	$0
GEN-2017-144	$178,779	$0	$0	$178,779
GEN-2017-175	$247,093	$0	$0	$247,093
GEN-2017-181	$286,337	$0	$0	$286,337
GEN-2017-182	$132,267	$0	$0	$132,267
GEN-2017-183	$0	$0	$0	$0
GEN-2017-184	$0	$0	$0	$0
GEN-2017-188	$0	$0	$0	$0
GEN-2017-195	$0	$0	$0	$0
GEN-2017-196	$0	$0	$0	$0
GEN-2017-201	$238,372	$0	$0	$238,372
GEN-2017-202	$0	$0	$0	$0
GEN-2017-210	$95,930	$0	$0	$95,930
GEN-2017-214	$113,953	$0	$0	$113,953
GEN-2017-215	$113,953	$0	$0	$113,953
GEN-2017-222	$22,545,757	$0	$0	$22,545,757
GEN-2017-234	$113,372	$0	$0	$113,372
Total ($)	**$24,435,001**	**$0**	**$0**	**$24,435,001**

It should be noted that a restudy may be required should significant changes to the study assumptions occur, including but not limited to, interconnection request withdrawals and/or changes to higher-queued Network Upgrades included in the Base Case.

As the next step, MISO will initiate the Network Upgrade Facilities Study (NUFS) with the Transmission Owner(s). If the TO determines no further study is required, MISO will draft Facilities Construction Agreement (FCA) and begin negotiations between MISO, MISO TO and SPP ICs.

1.4 Per Project Summary

This section provides estimated cost of MISO AFSIS Network Upgrades on a per project basis for the Study Projects in SPP DISIS-2017-002 cluster.

The following projects in SPP DISIS-2017-002 cluster west region do not have MISO AFSIS Network Upgrade cost allocated to the projects:

- GEN-2017-108, GEN-2017-119, GEN-2017-120, GEN-2017-183, GEN-2017-184, GEN-2017-188, GEN-2017-195, GEN-2017-196, GEN-2017-202.

MISO AFSIS Network Upgrade costs are allocated to the below projects.

For projects assigned with thermal Network Upgrade(s) only, no injection is allowed for these projects until all the allocated Network Upgrade(s), including conditional upgrades, are in service, except for a revised report provided by MISO removing the requirements, or an interim limit provided for the projects through MISO Annual ERIS or Quarterly Operating Limit studies.

For projects assigned with voltage Network Upgrade(s), no injection is allowed until the allocated voltage Network Upgrade(s) are in service.

1.4.1 GEN-2017-105 Summary

Network Upgrade	Owner	Cost	GEN-2017-105	NUs Type
Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	$2,000,000	$84,302	SH Volt
Total Cost Per Project			**$84,302**	

1.4.2 GEN-2017-115 Summary

Network Upgrade	Owner	Cost	GEN-2017-115	NUs Type
Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	$2,000,000	$284,884	SH Volt
Total Cost Per Project			**$284,884**	

1.4.3 GEN-2017-144 Summary

Network Upgrade	Owner	Cost	GEN-2017-144	NUs Type
Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	$2,000,000	$178,779	SH Volt
Total Cost Per Project			**$178,779**	

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1.4.4 GEN-2017-175 Summary

Network Upgrade	Owner	Cost	GEN-2017-175	NUs Type
Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	$2,000,000	$247,093	SH Volt
Total Cost Per Project			**$247,093**	

1.4.5 GEN-2017-181 Summary

Network Upgrade	Owner	Cost	GEN-2017-181	NUs Type
Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	$2,000,000	$286,337	SH Volt
Total Cost Per Project			**$286,337**	

1.4.6 GEN-2017-182 Summary

Network Upgrade	Owner	Cost	GEN-2017-182	NUs Type
Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	$2,000,000	$132,267	SH Volt
Total Cost Per Project			**$132,267**	

1.4.7 GEN-2017-201 Summary

Network Upgrade	Owner	Cost	GEN-2017-201	NUs Type
Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	$2,000,000	$238,372	SH Volt
Total Cost Per Project			**$238,372**	

1.4.8 GEN-2017-210 Summary

Network Upgrade	Owner	Cost	GEN-2017-210	NUs Type
Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	$2,000,000	$95,930	SH Volt
Total Cost Per Project			**$95,930**	

1.4.9 GEN-2017-214 Summary

Network Upgrade	Owner	Cost	GEN-2017-214	NUs Type
Souris-Mallard 115 kV	XEL	$100,000	$50,000	SH Thermal
Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	$2,000,000	$63,953	SH Volt
Total Cost Per Project			**$113,953**	

1.4.10 GEN-2017-215 Summary

Network Upgrade	Owner	Cost	GEN-2017-215	NUs Type
Souris-Mallard 115 kV	XEL	$100,000	$50,000	SH Thermal
Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	$2,000,000	$63,953	SH Volt
Total Cost Per Project			**$113,953**	

1.4.11 GEN-2017-222 Summary

Network Upgrade	Owner	Cost	GEN-2017-222	NUs Type
J611 POI-Maryville 161 kV	MEC GMO	$22,335,001	$22,335,001	SH Thermal
Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	$2,000,000	$210,756	SH Volt
Total Cost Per Project			**$22,545,757**	

1.4.12 GEN-2017-234 Summary

Network Upgrade	Owner	Cost	GEN-2017-234	NUs Type
Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	$2,000,000	$113,372	SH Volt
Total Cost Per Project			**$113,372**	

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Section

1

Model Development and Study Criteria

1.1 Model Development

Models used in this AFSIS restudy were developed from the final study model used in MISO AFSIS study for DISIS-2017-002 Phase 2 cycle. The MISO AFSIS final study model for DISIS-2017-002 Phase 2 cycle is listed below:

- Summer shoulder study model:
  DISIS-17-2 R1_West_SH_DPP_AUG17_Study_240801.sav
- Summer peak study model:
  DISIS-17-2 R1_West_SPK_DPP_AUG17_Study_240801.sav

1.1.1 MISO AFSIS Study Models

The summer peak and summer shoulder study cases for the AFSIS restudy were created as follows:

- Removed recently withdrawn SPP prior queued generation projects (Table A-1). Added and dispatched several SPP prior queued projects (Table A-2). Corrected and updated the modeling and dispatch of GEN-2017-209 and GEN-2017-210 projects. Corrected dispatch of GEN-2014-001IS project in summer shoulder scenario. Power mismatch was balanced by scaling generation in SPP market (Table A-7) based on the load-ratio share of the Transmission Owner (TO) power flow modeling areas.
- Trued up dispatch of the Study Projects in DISIS-2017-002 cluster (Table ES-1) in both summer peak and summer shoulder scenarios. Power mismatch was balanced by scaling generation in SPP market (Table A-7) based on the load-ratio share of the Transmission Owner (TO) power flow modeling areas.
- Removed recently withdrawn MISO and CIPCO prior queued generation projects (Table A-3). Added MISO AFSIS Network Upgrades assigned to SPP prior queued projects (Table A-4). Power mismatch was balanced by scaling generation in the MISO North (Table A-6).
- Removed SPP Network Upgrades no longer assigned to prior queued projects. Corrected modeling errors. These changes are in Table A-5. Power mismatch was balanced by scaling generation in SPP market (Table A-7) based on the load-ratio share of the TO power flow modeling areas.

1.1.2 MISO AFSIS Benchmark Model

Summer peak (SPK) benchmark case was created by turning off the DISIS-2017-002 Study Projects (Table ES-1) from the summer peak study case.

Summer shoulder (SH) benchmark model was created by turning off the DISIS-2017-002 Study Projects (Table ES-1) from the summer shoulder study case.

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Power mismatch was balanced by scaling generation in SPP market (Table A-7) based on the load-ratio share of the TO power flow modeling areas.

Both study and benchmark power flow cases were solved with transformer tap adjustment enabled, area interchange disabled, phase shifter adjustment enabled and switched shunt adjustment enabled.

1.2 Contingency Criteria

The following contingencies were considered in the steady-state analysis:

- NERC Category P0 (system intact - no contingencies)
- NERC Category P1 contingencies
  - Single element outages, at buses with a nominal voltage of 57 kV and above.
  - Multiple-element NERC Category P1 contingencies.
  - NERC Category P2, P4, P5, P7 contingencies.
    -

The detailed list of contingency files is in Appendix A.8

For all contingency and post-disturbance analyses, cases were solved with transformer tap adjustment enabled, area interchange adjustment disabled, phase shifter adjustment disabled (fixed) and switched shunt adjustment enabled.

1.3 Monitored Elements

The study area is defined in Table 1-1. Facilities in the study area were monitored for system intact and contingency conditions. Under NERC category P0 conditions (system intact) branches were monitored for loading above the normal (PSS®E rate A) rating. Under NERC category P1-P7 conditions, branches were monitored for loading as shown in the column labeled "Post-Disturbance Thermal Limits".

Table 1-1: Monitored Elements

Owner / Area	Thermal Limits [1]		Voltage Limits [2]	
	Pre-Disturbance	Post-Disturbance	Pre-Disturbance	Post-Disturbance
EES	100% of Rate A	100% of Rate B	1.05/0.975/0.95	1.05//0.95/0.92/0.90
EES-EMI	100% of Rate A	100% of Rate B	1.05/0.975/0.95	1.05//0.95/0.92/0.90
EES-EAI	100% of Rate A	100% of Rate B	1.05/0.975/0.95	1.05//0.95/0.92/0.90
AMIL	100% of Rate A	100% of Rate B	1.05/0.95	1.075/0.90
AMMO	100% of Rate A	100% of Rate B	1.05/0.95	1.075/0.90
CWLD	100% of Rate A	100% of Rate B	1.05/0.95	1.10/0.90
CWLP	100% of Rate A	100% of Rate B	1.05/0.95	1.075/0.90
SIPC	100% of Rate A	100% of Rate B	1.07/0.95	1.09/0.91
GLH	100% of Rate A	100% of Rate B	1.05/0.95	1.05/0.90
ATCLLC	100% of Rate A	100% of Rate B	1.05/0.95	1.10/0.90

Owner / Area	Thermal Limits [1]		Voltage Limits [2]	
	Pre-Disturbance	Post-Disturbance	Pre-Disturbance	Post-Disturbance
BEPC-MISO	100% of Rate A	100% of Rate B	1.05/0.95	1.10/0.90
CMMPA	100% of Rate A	100% of Rate B	1.05/0.95	1.07/0.90
DPC	100% of Rate A	100% of Rate B	1.05/0.95	1.10/0.90
GRE	100% of Rate A	100% of Rate B	1.05/0.95	1.10/0.92/0.90
ITCM	100% of Rate A	100% of Rate B	1.07/1.05/0.95	1.10/0.93
MDU	100% of Rate A	100% of Rate B	1.05/0.95	1.10/0.90
MEC	100% of Rate A	100% of Rate B	1.05/0.96/0.95	1.05/0.96/0.95/0.94/0.93[3]
MMPA	100% of Rate A	100% of Rate B	1.05/0.95	1.10/0.90
MP	100% of Rate A	100% of Rate B	1.05/1.00	1.10/0.95
MPC	100% of Rate A	100% of Rate B	1.05/0.97	1.10/0.92
MPW	100% of Rate A	100% of Rate B	1.05/0.95	1.06/0.92
MRES	100% of Rate A	100% of Rate B	1.05/0.97	1.05/0.92
OTP	100% of Rate A	100% of Rate B	1.07/1.05/0.97	1.10/0.92
RPU	100% of Rate A	100% of Rate B	1.05/0.95	1.10/0.92
SMMPA	100% of Rate A	100% of Rate B	1.05/0.95	1.10/0.90
XEL	100% of Rate A	100% of Rate B	1.05/0.95	1.05/0.92

Notes

1. PSS®E Rate A, Rate B or Rate C
2: Limits dependent on nominal bus voltage
3: For facilities in Cedar Falls Utilities or Ames Municipal Utilities, post-contingency voltage limits are 1.05/0.94 for >200 kV, and 1.05/0.93 for others.

1.4 MISO Steady State Performance Criteria

A branch is considered as a thermal injection constraint if the branch is loaded above its applicable normal or emergency rating for the post-change case, and any of the following conditions are met:

1) the generator (NR/ER) has a larger than 20% DF on the overloaded facility under post contingent condition or 5% DF under system intact condition, or
2) the megawatt impact due to the generator is greater than or equal to 20% of the applicable rating (normal or emergency) of the overloaded facility, or
3) the overloaded facility or the overload-causing contingency is at generator's outlet, or
4) for any other constrained facility, where none of the study generators meet one of the above criteria in 1), 2), or 3), however, the cumulative megawatt impact of the group of study generators (NR/ER) is greater than 20% of the applicable rating, then only those study generators whose individual MW impact is greater than 5% of the

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applicable rating and has DF greater than 5% (OTDF or PTDF) will be responsible for mitigating the cumulative MW impact constraint.

A bus is considered a voltage constraint if both of the following conditions are met. All voltage constraints must be resolved before a project can receive interconnection service.

1) the bus voltage is outside of applicable normal or emergency limits for the post-change case, and
2) the change in bus voltage is greater than 0.01 per unit.

All Study Projects must mitigate thermal injection constraints and voltage constraints in order to obtain unconditional Interconnection Service.

Section
2

MISO Steady-State Thermal and Voltage Analysis

Nonlinear (AC) contingency analysis was performed on the benchmark and study cases, and the incremental impact of the DISIS-2017-002 Study Projects was evaluated by comparing the steady-state performance of the transmission system in the benchmark and study cases. Network upgrades were identified to mitigate any steady state thermal and voltage constraints.

Steady-state analysis was performed in summer peak and summer shoulder scenarios. PSS®E version 34.9.3 and PSS®MUST version 12.4.1 were used in the study.

2.1 MISO Contingency Analysis for Summer Peak Condition

Steady state AC contingency analysis was performed on the MISO AFSIS summer peak (SPK) study and benchmark cases developed in Section 1.1. The summer peak MISO AFSIS thermal and voltage results are in Appendix B.1.

2.1.1 Summer Peak System Intact Conditions

For NERC category P0 (system intact) conditions, no thermal constraints (Table B-1) or voltage constraints (Table B-2) were identified.

2.1.2 Summer Peak Post Contingency Conditions

The results in this Section are for analysis of conditions following NERC category P1-P7 contingencies.

For P1 contingencies, no thermal constraints (Table B-3) or voltage constraints (Table B-4) were identified.

For P2-P7 converged contingencies, no thermal constraints (Table B-5) or voltage constraints (Table B-6) were identified.

2.1.3 Summer Peak Worst Constraints

In the summer peak scenario, no thermal constraints or voltage constraints were identified in the MISO AFSIS.

2.2 MISO Contingency Analysis for Summer Shoulder Condition

Steady state AC contingency analysis was performed on the MISO AFSIS summer shoulder (SH) study and benchmark cases developed in Section 1.1. The summer shoulder MISO AFSIS thermal and voltage results are in Appendix B.2.

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The shoulder case result has been updated in the sensitivity analysis. Please refer to Section 4 for the details.

Below are the original summer shoulder steady state analysis results which are no longer valid.

2.2.1 Summer Shoulder System Intact Conditions

For NERC category P0 (system intact) conditions, no thermal constraints (Table B-7) or voltage constraints (Table B-8) were identified.

2.2.2 Summer Shoulder Post Contingency Conditions

The results in this Section are for analysis of conditions following NERC category P1-P7 contingencies.

For P1 contingencies, thermal constraints are listed in Table B-9, and voltage constraints are listed in Table B-10.

For P2-P7 contingencies, thermal constraints are listed in Table B-11, and voltage constraints are listed in Table B-12.

2.2.3 Summer Shoulder Worst Constraints

In the summer shoulder scenario, MISO AFSIS worst thermal constraints are listed in Table 2-1, and MISO AFSIS worst voltage constraints are listed in Table 2-2.

Table 2-1: Summer Shoulder MISO AFSIS Thermal Constraints, Maximum Screened Loading

Constraint	Rating	Owner	Worst Loading		Contingency	Cont Type
			(MVA)	(%)		
~~J611 POI-Maryville 161 kV~~	~~180.0~~	~~MEC GMO~~	~~297.4~~	~~165.2~~	CEII Redacted	~~P1~~
~~J611 POI-Maryville 161 kV~~	~~180.0~~	~~MEC GMO~~	~~300.2~~	~~166.8~~	CEII Redacted	~~P2-P7~~
~~Souris-Mallard 115 kV~~	~~120.3~~	~~XEL~~	~~139.3~~	~~115.8~~	CEII Redacted	~~P2-P7~~
~~Mallard-Logan 115 kV~~	~~212.0~~	~~XEL BEPC~~	~~214.9~~	~~101.4~~	CEII Redacted	~~P1~~

Table 2-2: Summer Shoulder MISO AFSIS Voltage Constraints, Worst Voltage Violations

Bus			Owner	Vlow	Vhi	Benchmark	StudyCase	Delta (> 0.01 p.u.)	Contingency Details	Cont Type
						VCONT	VCONT			
~~86111~~	~~J611 POI~~	~~161.0~~	~~MEC~~	~~0.95~~	~~1.05~~	~~0.9778~~	~~0.9164~~	~~-0.0614~~	CEII Redacted	~~P2-P7~~
~~635017~~	~~ATCHSN 3~~	~~345.0~~	~~MEC~~	~~0.96~~	~~1.05~~	~~1.0051~~	~~0.9557~~	~~-0.0494~~	CEII Redacted	~~P1~~

2.3 Summary of MISO AFSIS Steady State Analysis

MISO AFSIS steady state analyses were performed on the MISO summer peak and summer shoulder scenarios. The steady state thermal constraints and required Network Upgrades are listed in Table 2-3, and voltage constraints and required Network Upgrades are listed in Table 2-4.

The steady state result has been updated in the sensitivity analysis, please refer to Section 4 for the details.

Table 2-3: MISO AFSIS Thermal Constraints and Network Upgrades

Generator	Constraint	Owner	Scenario	Mitigation	Cost ($)
~~GEN-2017-222~~	~~J611 POI-Maryville 161 kV~~	~~MEC~~ ~~GMO~~	~~SH~~	~~MEC: Existing MEC only rating is 410 MVA, so no MEC upgrade needed. $0~~ ~~Evergy: Existing Evergy emergency rating is 180 MVA. Line currently limited by conductor and will require a rebuild using 2x 954 Rail ACSR as the conductor. There will also be terminal upgrades required to achieve the needed 300 MVA rating. $22,335,001~~	~~$22,335,001~~
~~GEN-2017-214, GEN-2017-215~~	~~Souris-Mallard 115 kV~~	~~XEL~~	~~SH~~	~~Reconductor the line and terminal equipment~~	~~$40,000,000~~
~~GEN-2017-214, GEN-2017-215~~	~~Mallard-Logan 115 kV~~	~~XEL~~ ~~BEPC~~	~~SH~~	~~XEL: BEPC Equipment. $0~~ ~~BEPC: BEPC will be performing a full upgrade of our Logan 115-kV substation starting in the Spring of 2025 with a current projected completion date at the end of 2025. This work will appear to result in a future line rating of 219/253/282/307 – SN/SE/WN/WE then due to BEPC's transmission line. This future line rating will alleviate both the P12 and P55 contingencies causing the overload seen. $0~~ ~~The BEPC upgrade is conditional to the projects that otherwise would be responsible for the mitigation~~	~~$0~~

Table 2-4: MISO AFSIS Voltage Constraints and Network Upgrades

Constraint	Network Upgrades	Owner	Scenario	Cost ($)
~~Low voltage at J611 POI 161 kV under P2-P7 contingencies~~	~~Add 1×20 Mvar switched cap at J611 POI 161 kV (86111)~~	~~MEC~~	~~SH~~	~~$2,000,000~~

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Section 3

Stability Analysis

Stability analysis was performed to evaluate transient stability and impact on the region of the Study Projects in SPP DISIS-2017-002 Cluster.

3.1 Procedure

3.1.1 Computer Programs

Stability analysis was performed using TSAT revision 23.0.

3.1.2 Methodology

Stability package representing summer peak (SPK) and summer shoulder (SH) scenarios with generating facilities in the SPP DISIS-2017-002 Cluster was created from the final stability package used in MISO AFSIS study for DISIS-2017-002 Phase 2 cycle. Disturbances were simulated to evaluate the transient stability and impact on the region of the DISIS-2017-002 Study Projects. MISO transient stability criteria and local TOs' planning criteria were adopted for checking stability violations.

3.2 Model Development

Summer peak and summer shoulder stability power flow models are the same as the correspondent steady state models, which were developed as specified in Section 1.1.

3.3 Disturbance Criteria

The stability simulations performed as part of this study considered all the regional and local contingencies listed in Table 3-1. Regional contingencies with pre-defined switching sequences were selected from the MISO MTEP study; switching sequences for local contingencies were developed based on the generic clearing times shown in Table 3-2. The admittance for local single line-to-ground (SLG) faults were estimated by assuming that the Thevenin impedance of the positive, negative and zero sequence networks at the fault point are equal.

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Table 3-1: Regional and Local Disturbance Descriptions

CEII Redacted

Table 3-2: Generic Clearing Time Assumption

Voltage Level (kV)	Primary Clearing Time (cycle)	Backup Clearing Time (cycle)
345 kV	4	11
230 kV	5	13
161/138 kV	6	18
115 kV	6	20
69 kV	8	24

3.4 Performance Criteria

MISO transient stability criteria and local TOs' planning criteria were adopted. All Study Generators in SPP DISIS-2017-002 Cluster must mitigate the stability constraints to obtain any type of Interconnection Service.

3.5 Summer Peak Stability Results

The contingencies listed in Table 3-1 were simulated using the summer peak stability model developed in Section 1.1.

Appendix C.1.2 contains plots of generator rotor angles, generator power output, and bus voltages for each simulation. Simulations were performed with a 0.5 seconds steady-state run followed by the appropriate disturbance. Simulations were run for a 10-second duration.

Summer peak stability study results summary is in Appendix C.1.1, Table C-1.

The following stability related issues were identified in the summer peak stability study.

3.5.1 Generation Tripping Due to Angle Instability in SPK

Under one NERC Category P6 contingency (Table 3-3), Independence SES (ISES) units #1 and #2 were tripped due to angle instability. The same generators were also tripped due to angle instability under the same contingency in the benchmark model. Therefore, the SPP Study Projects are not responsible for the generation tripping.

Table 3-3: Generation Tripping Due to Angle Instability

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3.5.2 GEN-2017-108 Active Power Curtailment and Low Voltages within the Plant in SPK

Under two contingencies (Table 3-4), study project GEN-2017-108 had active power curtailment after the fault, and its post-fault voltages within the plant settled below 0.85 pu.

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After the fault was cleared, the GEN-2017-108 project was radially connected to Stillwell 161 kV bus through a 52 miles long radial line. This resulted in low voltages inside the GEN-2017-108 plant. GEN-2017-108 terminal voltage dropped to below 0.85 pu and its active power output was curtailed. Since the active power curtailment and low voltages occurred at GEN-2017-108 plant, MISO AFSIS Network Upgrades are not required.

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Table 3-4: GEN-2017-108 Active Power Curtailment and Low Voltages

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3.6 Stability Network Upgrades Identified in Summer Peak

In summary, no MISO Affected System stability constraints were identified in the summer peak scenario. No MISO AFSIS stability NUs are required in summer peak stability study.

3.7 Summer Shoulder Stability Results

The contingencies listed in Table 3-1 were simulated using the summer shoulder stability study case as developed in Section 1.1.

Appendix C.2.2 contains plots of generator rotor angles, generator power output, and bus voltages for each simulation. Simulations were performed with a 0.5 seconds steady-state run followed by the appropriate disturbance. Simulations were run for a 10-second duration.

Summer shoulder stability study results summary is in Appendix C.2.1, Table C-2.

The following stability related issues were identified in the summer shoulder stability study.

3.7.1 Generation Tripping Due to Angle Instability in SH

Under P6 contingency of "4948_S_EES_P6" (Table 3-5), Arkansas Nuclear One units #1 and #2 were tripped due to angle instability. The same generators were also tripped due to angle instability under the same contingency in the benchmark model. Therefore, the SPP Study Projects are not responsible for the generation tripping.

Under P6 contingency of "4950_S_EES_P6" (Table 3-5), Independence SES (ISES) units #1 and #2 were tripped due to angle instability. The same generators were also tripped due to angle instability under the same contingency in the benchmark model. Therefore, the SPP Study Projects are not responsible for the generation tripping.

Table 3-5: Generation Tripping Due to Angle Instability

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3.8 Stability Network Upgrades Identified in Summer Shoulder

In summary, no MISO Affected System stability constraints were identified in the summer shoulder scenario. No MISO AFSIS stability NUs are required in summer shoulder stability study.

3.9 Summary of Transient Stability Analysis

Based on the MISO summer peak and summer shoulder transient stability analysis, no MISO AFSIS stability Network Upgrades are required for the DISIS-2017-002 Study Projects.

Based on the above result, no additional sensitivity analysis is needed for the stability analysis due to withdrawal of GEN-2016-007 and GEN-2017-209.

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Section

4

Summer Shoulder Sensitivity Study

Due to withdrawal of generation projects GEN-2016-007 and GEN-2017-209, summer shoulder steady state sensitivity analysis was performed on the updated summer shoulder models.

4.1 Models Updates

Summer Shoulder models were updated as follows:

- Incorporate J611 modeling update that was previously considered as mitigation
- Remove withdrawn project GEN-2016-007
- Remove withdrawn project GEN-2017-209
- Add in service 115 kV line E.RUTHVL-CP7 - SW.MINOT-CP7 (655655 – 655657).
- Update SOURIS 7 - MALLARD7 115 kV line ratings to 96.7 / 112.6 MVA (rate A/B).
- Power mismatch was balanced by scaling generation in SPP market (Table A-7) based on the load-ratio share of the Transmission Owner (TO) power flow modeling areas.

4.2 Summer Shoulder Steady State Sensitivity Analysis

Steady state AC contingency analysis was performed on the updated summer shoulder study and benchmark cases developed in Section 4.1. The same steady state performance criteria specified in Section 1.4 were adopted.

Summer shoulder sensitivity analysis results are in Appendix D and are summarized below.

4.2.1 Summer Shoulder Sensitivity Analysis Results

For NERC category P0 (system intact) conditions, no thermal constraints (Table D-1) or voltage constraints (Table D-2) were identified.

For P1 contingencies, thermal constraints are listed in Table D-3, and voltage constraints are listed in Table D-4.

For P2-P7 contingencies, thermal constraints are listed in Table D-5, and voltage constraints are listed in Table D-6.

4.2.2 Summer Shoulder Sensitivity Worst Constraints

In the summer shoulder sensitivity study, MISO AFSIS worst thermal constraints are listed in Table 4-1, and MISO AFSIS worst voltage constraints are listed in Table 4-2.

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Table 4-1: Summer Shoulder Sensitivity Thermal Constraints, Maximum Screened Loading

Constraint	Rating	Owner	Worst Loading		Contingency	Cont Type
			(MVA)	(%)		
J611 POI-Maryville 161 kV	180.0	MEC GMO	236.4	131.3	CEII Redacted	P1
J611 POI-Maryville 161 kV	180.0	MEC GMO	287.7	159.8	CEII Redacted	P2-P7
Souris-Mallard 115 kV	112.6	XEL	117.1	104.0	CEII Redacted	P2-P7

Table 4-2: Summer Shoulder Sensitivity Voltage Constraints, Worst Voltage Violations

Bus			Owner	Vlow	Vhi	StudyCase VCONT	Delta (> 0.01 p.u.)	Contingency Details	Cont Type
86111	J611 POI	161.0	MEC	0.95	1.05	0.9389	-0.0534	CEII Redacted	P2-P7
635017	ATCHSN 3	345.0	MEC	0.96	1.05	0.9589	-0.0508	CEII Redacted	P1

4.2.3 Summary of Summer Shoulder Sensitivity Analysis Results

Based on the summer shoulder sensitivity analysis, the steady state thermal constraints and required Network Upgrades are listed in Table 4-3, and voltage constraints and required Network Upgrades are listed in Table 4-4.

Table 4-3: MISO AFSIS Thermal Constraints and Network Upgrades

Generator	Constraint	Owner	Mitigation	Cost ($)
GEN-2017-222	J611 POI-Maryville 161 kV	MEC GMO	MEC: Existing MEC only rating is 410 MVA, so no MEC upgrade needed. $0 Evergy: Existing Evergy emergency rating is 180 MVA. Line currently limited by conductor and will require a rebuild using 2x 954 Rail ACSR as the conductor. There will also be terminal upgrades required to achieve the needed 300 MVA rating. $22,335,001	$22,335,001
GEN-2017-214, GEN-2017-215	Souris-Mallard 115 kV	XEL	Upgrade equipment at Mallard Substation	$100,000

Table 4-4: MISO AFSIS Voltage Constraints and Network Upgrades

Constraint	Network Upgrades	Owner	Cost ($)
Low voltage at J611 POI 161 kV under P2-P7 contingencies	Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	$2,000,000

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Section
5

Network Upgrades and Cost Allocation

5.1 Cost Assumptions for Network Upgrades

The cost estimate for each network upgrade was provided by the corresponding transmission owning company.

5.2 Cost Allocation Methodology

Costs of AFSIS Network Upgrades are allocated based on MISO Network Upgrade cost allocation methodology, which is detailed in the MISO Generation Interconnection Business Practices Manual BPM-015.

5.3 AFSIS Network Upgrades Required for the DISIS-2017-002 Study Projects

Based on the MISO summer peak and summer shoulder steady state analysis, thermal constraints and voltage constraints were identified in MISO system for the DISIS-2017-002 Study Projects; MISO AFSIS thermal and voltage NUs are required for the DISIS-2017-002 Study Projects.

Based on the MISO summer peak and summer shoulder transient stability analysis, no MISO AFSIS stability Network Upgrades are required for the DISIS-2017-002 Study Projects.

A short circuit screening analysis was conducted by comparing three phase fault currents in the benchmark and study cases for the SPP Study Projects in MISO West. Based on the screening results, MISO Transmission Owners do not plan to conduct additional studies.

No contingent MTEP facilities were identified for the Study Projects.

The result in this section has been updated for the sensitivity study due to withdrawal of GEN-2016-007 and GEN-2017-209.

The total costs of MISO AFSIS Network Upgrades for DISIS-2017-002 Study Projects are summarized in Table 5-1.

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Table 5-1: Summary of MISO AFSIS Network Upgrades

Category of Network Upgrades	Cost ($)
Thermal Network Upgrades Identified in MISO Steady-State Analysis	$22,435,001
Voltage Network Upgrades Identified in MISO Steady-State Analysis	$2,000,000
Network Upgrades Identified in Stability Analysis	$0
Network Upgrades Identified in Short Circuit Analysis	$0
Total	**$24,435,001**

MISO AFSIS Network Upgrades for DISIS-2017-002 Study Projects are listed below.

Table 5-2: MISO Thermal Network Upgrades and Cost

Constraint	Owner	Mitigation	Cost ($)
J611 POI-Maryville 161 kV	MEC GMO	MEC: Existing MEC only rating is 410 MVA, so no MEC upgrade needed. $0 Evergy: Existing Evergy emergency rating is 180 MVA. Line currently limited by conductor and will require a rebuild using 2x 954 Rail ACSR as the conductor. There will also be terminal upgrades required to achieve the needed 300 MVA rating. $22,335,001	$22,335,001
Souris-Mallard 115 kV	XEL	Upgrade equipment at Mallard Substation	$100,000

Table 5-3: MISO Steady-State Voltage Network Upgrades and Cost

Constraint	Network Upgrades	Owner	Cost ($)
Low voltage at J611 POI 161 kV under P2-P7 contingencies	Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	MEC	$2,000,000

Table 5-4: MISO Transient Stability Network Upgrades and Cost

Network Upgrades	Cost ($)
No MISO stability constraints	$0

Table 5-5: Short Circuit Network Upgrades

NUs	Cost ($)
No short circuit NUs	$0

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It should be noted that a restudy may be required should significant changes to the study assumptions occur, including but not limited to, interconnection request withdrawals and/or changes to higher-queued Network Upgrades included in the Base Case.

For projects assigned with thermal Network Upgrade(s) only, no injection is allowed for these projects until all the allocated Network Upgrade(s), including conditional upgrades, are in service, except for a revised report provided by MISO removing the requirements, or an interim limit provided for the projects through MISO Annual ERIS or Quarterly Operating Limit studies.

For projects assigned with voltage Network Upgrade(s), no injection is allowed until the allocated voltage Network Upgrade(s) are in service.

5.4 MISO AFSIS Cost Allocation

The calculated Distribution Factor (DF) results, voltage impact, and MW contribution on each MISO Affected System constraint are in Appendix E.1. The cost allocation for each NU is calculated based on the contribution of each generating facility, as detailed in Appendix E.2.

Assuming all generation projects in the DISIS-2017-002 cluster advance, a summary of the costs for total MISO AFSIS NUs allocated to each generation project is listed in Table 5-6.

No injection is allowed for the projects until the allocated Network Upgrade(s) are in service, except for a revised report provided by MISO removing the requirements, or an interim limit provided for the projects through MISO Annual ERIS or Quarterly Operating Limit studies.

Table 5-6: Summary of MISO AFSIS NU Costs Allocated to the DISIS-2017-002 Study Projects

Project Num	Network Upgrades ($)			Total Network Upgrade Cost ($)
	MISO Thermal & Voltage	Transient Stability	Short Circuit	
GEN-2017-105	$84,302	$0	$0	$84,302
GEN-2017-108	$0	$0	$0	$0
GEN-2017-115	$284,884	$0	$0	$284,884
GEN-2017-119	$0	$0	$0	$0
GEN-2017-120	$0	$0	$0	$0
GEN-2017-144	$178,779	$0	$0	$178,779
GEN-2017-175	$247,093	$0	$0	$247,093
GEN-2017-181	$286,337	$0	$0	$286,337
GEN-2017-182	$132,267	$0	$0	$132,267
GEN-2017-183	$0	$0	$0	$0
GEN-2017-184	$0	$0	$0	$0
GEN-2017-188	$0	$0	$0	$0

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Project Num	Network Upgrades ($)			Total Network Upgrade Cost ($)
	MISO Thermal & Voltage	Transient Stability	Short Circuit	
GEN-2017-195	$0	$0	$0	$0
GEN-2017-196	$0	$0	$0	$0
GEN-2017-201	$238,372	$0	$0	$238,372
GEN-2017-202	$0	$0	$0	$0
GEN-2017-210	$95,930	$0	$0	$95,930
GEN-2017-214	$113,953	$0	$0	$113,953
GEN-2017-215	$113,953	$0	$0	$113,953
GEN-2017-222	$22,545,757	$0	$0	$22,545,757
GEN-2017-234	$113,372	$0	$0	$113,372
Total ($)	**$24,435,001**	**$0**	**$0**	**$24,435,001**

Appendix A

Model Development for Steady-State and Stability Analysis

A.1 Withdrawn SPP Prior Queued Projects

Table A-1: Withdrawn SPP Prior Queued Project

Prj #	Bus Number	Bus Name	Id	Status
ASGI-2017-014	761546	AS17-014GEN10.5500	1	Withdrawn
GEN-2007-023	652345	G07_023IS_2 0.6900	W	WITHDRAWN
GEN-2009-001	652173	G09_001IS_2 0.6900	1	WITHDRAWN
GEN-2010-041	560326	G10-41 0.6900	1	TERMINATED
GEN-2012-014	659031	G12_014IS_4 0.6900	1	WITHDRAWN
GEN-2013-001	652004	G13_001IS_3 0.6900	1	WITHDRAWN
GEN-2014-010	659141	G14_010IS_2 0.6900	1	WITHDRAWN
GEN-2014-039	562547	G14_039_3 0.6900	1	WITHDRAWN
GEN-2015-076	563113	G15076_4 0.6500	1	WITHDRAWN
GEN-2015-076	563114	G15076_5 0.6500	1	WITHDRAWN
GEN-2016-023	587093	G16-023-GEN10.6900	1	WITHDRAWN
GEN-2016-023	587095	G16-023-GEN20.6900	1	WITHDRAWN
GEN-2016-029	587193	G16-029-GEN10.6900	1	WITHDRAWN
GEN-2016-029	587195	G16-029-GEN20.6900	1	WITHDRAWN
GEN-2016-055	587363	G16-055-GEN10.6900	1	WITHDRAWN
GEN-2016-063	587433	G16-063-GEN10.6900	1	TERMINATED
GEN-2016-064	587443	G16-064-GEN10.6900	1	WITHDRAWN
GEN-2016-088	587733	G16-088-GEN10.6900	1	TERMINATED
GEN-2016-092	587753	G16-092-GEN10.6900	1	WITHDRAWN
GEN-2016-096	587783	G16-096-GEN10.6900	1	WITHDRAWN
GEN-2016-096	587787	G16-096-GEN20.6900	1	WITHDRAWN
GEN-2016-103	587833	G16-103-GEN10.6900	1	WITHDRAWN
GEN-2016-106	587853	G16-106-GEN10.6900	1	WITHDRAWN
GEN-2016-110	587873	G16-110-GEN10.6900	1	WITHDRAWN

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Prj #	Bus Number	Bus Name	Id	Status
GEN-2016-159	588383	G16-159-GEN10.6900	1	WITHDRAWN
GEN-2016-159	588386	G16-159-GEN20.6900	1	WITHDRAWN
GEN-2016-165	588343	G16-165-GEN10.6900	1	WITHDRAWN
GEN-2016-166	588393	G16-166-GEN10.6900	1	WITHDRAWN
GEN-2017-032	588753	G17-032-GEN10.6900	1	WITHDRAWN
GEN-2017-090	589283	G17-090-GEN10.6900	1	WITHDRAWN
GEN-2017-090	589287	G17-090-GEN20.6900	1	WITHDRAWN
GEN-2017-111	762009	G17-111-GEN10.6300	1	WITHDRAWN
GEN-2017-112	760140	G17-112-GEN10.6900	1	WITHDRAWN
GEN-2017-112	760143	G17-112-GEN20.6900	1	WITHDRAWN
GEN-2017-113	761106	G17-113GEN1 0.6500	1	WITHDRAWN
GEN-2017-114	760350	G17-114-GEN10.6500	1	WITHDRAWN
GEN-2017-114	760353	G17-114-GEN20.6500	1	WITHDRAWN
GEN-2017-114	760356	G17-114-GEN30.6500	1	WITHDRAWN
GEN-2017-118	760560	G17-118-GEN10.6900	1	WITHDRAWN
GEN-2017-123	761778	G17-123GEN1 0.6900	1	WITHDRAWN
GEN-2017-125	761904	G17-125GEN1 0.6900	1	TERMINATED
GEN-2017-128	761925	G17-128GEN1 0.6900	1	WITHDRAWN
GEN-2017-132	760035	G17-132-GEN10.6900	1	TERMINATED
GEN-2017-132	760038	G17-132-GEN20.6900	1	TERMINATED
GEN-2017-142	761988	G17-142GEN1 0.6900	1	WITHDRAWN
GEN-2017-147	761715	G17-147GEN1 0.6900	1	WITHDRAWN
GEN-2017-148	760896	G17-148GEN1 0.6900	1	WITHDRAWN
GEN-2017-152	761128	G17-152GEN1 0.6900	1	TERMINATED
GEN-2017-153	761148	G17-153GEN1 0.6900	1	WITHDRAWN
GEN-2017-155	761337	G17-155GEN1 0.6900	1	WITHDRAWN
GEN-2017-156	761484	G17-156GEN1 0.6900	1	WITHDRAWN
GEN-2017-157	761505	G17-157GEN1 0.6900	1	WITHDRAWN
GEN-2017-166	761862	G17-166GEN1 0.6900	1	WITHDRAWN
GEN-2017-168	761168	G17-168GEN1 0.5500	1	TERMINATED
GEN-2017-191	761946	G17-191GEN1 0.6900	1	WITHDRAWN
GEN-2017-193	762030	G17-193GEN1 0.6900	1	WITHDRAWN
GEN-2017-199	760686	G17-199GEN1 0.6900	1	WITHDRAWN

Prj #	Bus Number	Bus Name	Id	Status
GEN-2017-200	760706	G17-200GEN1 0.6900	1	WITHDRAWN
GEN-2017-213	760371	G17-213-GEN10.6300	1	WITHDRAWN
GEN-2017-213	760371	G17-213-GEN10.6300	2	WITHDRAWN
GEN-2017-213	760374	G17-213-GEN20.6300	1	WITHDRAWN
GEN-2017-213	760374	G17-213-GEN20.6300	2	WITHDRAWN
GEN-2017-216	761043	G17-216GEN1 0.6900	1	WITHDRAWN
GEN-2017-224	760434	G17-224-GEN10.5500	1	WITHDRAWN
GEN-2017-225	760454	G17-225-GEN10.5500	1	WITHDRAWN
GEN-2017-228	761736	G17-228GEN1 0.6900	1	WITHDRAWN
GEN-2017-229	761757	G17-229GEN1 0.6900	1	WITHDRAWN
GEN-2017-235	761064	G17-235GEN1 0.6900	1	WITHDRAWN
GEN-2017-236	761085	G17-236GEN1 0.6900	1	WITHDRAWN
GEN-2017-237	761673	G17-237GEN1 0.6900	1	WITHDRAWN
GEN-2017-240	760161	G17-240-GEN10.5500	1	WITHDRAWN

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A.2 Added SPP Prior Queued Projects

Table A-2: SPP Prior Queued Projects to be Added

Project #	State	Point of Interconnection	Generation Type	Service Request (MW)
GEN-2015-089	SD	Utica 230 kV	Wind	200
GEN-2016-075	NE	Grand Prairie 345kV	Wind	50

A.3 Withdrawn MISO and CIPCO Prior Queued Projects

Table A-3: Withdrawn MISO and CIPCO Prior Queued Project

Prj #	Status	Bus Number	Bus Name	Id
J478	Withdrawn	84780	J478 GEN 0.6900	1
J478	Withdrawn	84781	J478 GEN1 0.6900	1
J628	Withdrawn	86287	J628 G1 0.6000	1
J628	Withdrawn	86288	J628 G2 0.6000	1
J714	Withdrawn	87140	J714 GEN 0.6900	1
J740	Withdrawn	87400	J740 GEN 0.6500	1
J801	Withdrawn	88011	J801 0.5500	PV
J803	Withdrawn	88035	J803 0.6000	PV
J824	Withdrawn	88240	J824 GEN 0.5500	1
J824	Withdrawn	88241	J824 GEN1 0.5500	1
J832	Withdrawn	88320	J832 G 0.5500	1
J833	Withdrawn	88330	J833 G 0.5500	1
J835	Withdrawn	88350	J835 GEN 0.6900	1
J835	Withdrawn	88351	J835 GEN1 0.6900	1
J839	Withdrawn	88390	J839 G 0.5500	1
J841	Withdrawn	88410	J841 STG1 18.000	1
J841	Withdrawn	88411	J841 CTG1 18.000	1
J841	Withdrawn	88412	J841 CTG2 18.000	1
J842	Withdrawn	88420	J842 GEN 0.6900	1
J842	Withdrawn	88421	J842 GEN1 0.6900	1
J843	Withdrawn	88430	J843 GEN 0.6900	1
J843	Withdrawn	88431	J843 GEN1 0.6900	1
J856	Withdrawn	88560	J856 GEN 0.5500	1
J883	Withdrawn	88830	J883 GEN 0.6900	1
J884	Withdrawn	88840	J884 GEN 0.6000	1
J897	Withdrawn	88977	J897 G1 0.6900	W
J897	Withdrawn	88978	J897 G2 0.6900	W
J901	Withdrawn	89015	J901 0.6900	W
J906	Withdrawn	89063	J906_G 0.6500	1
J906	Withdrawn	89065	J906_V110 0.6900	1

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Prj #	Status	Bus Number	Bus Name	Id
J937	Withdrawn	89371	J937_G 22.000	1
J946	Withdrawn	89466	J946 G1 0.6900	PV
J946	Withdrawn	89467	J946 G2 0.6900	PV
J952	Withdrawn	89520	J952 GEN 0.6500	1
J957	Withdrawn	89570	J957 GEN 0.6900	1
J957	Withdrawn	89571	J957 GEN1 0.6900	1
J957	Withdrawn	89572	J957 GEN2 0.6900	1
J957	Withdrawn	89573	J957 GEN3 0.6900	1
J957	Withdrawn	89580	J957 COL 34.500	1
J960	Withdrawn	89600	J960 GEN 0.6900	1
J973	Withdrawn	89730	J973 GEN 0.6900	1
J978	Withdrawn	89780	J978 GEN 0.6900	1
J979	Withdrawn	89790	J979 GEN 0.6900	1
J979	Withdrawn	89791	J979 GEN1 0.6900	1
J980	Withdrawn	89800	J980 GEN 0.6900	1
J980	Withdrawn	89801	J980 GEN1 0.6900	1
J985	Withdrawn	89850	J985 GEN 0.6000	1
J989	Withdrawn	89890	J989 GEN 0.6000	1
J995	Withdrawn	89950	J995 GEN 0.6000	1
J446	Withdrawn	251908	J446 CLINTON0.6000	1
J446	Withdrawn	251908	J446 CLINTON0.6000	2
J849	Withdrawn	700200	J849 SOLAR 0.5500	PV
IR27	Withdrawn	800115	IR27_GEN 0.7000	1
IR30	Withdrawn	800127	IR30_GEN 0.7000	1
IR34	Withdrawn	800143	IR34_GEN 0.7000	1

A.4 MISO AFSIS NUs Assigned to SPP Prior Queued Projects

Table A-4: MISO AFSIS NUs Assigned to SPP Prior Queued Projects

Python/ Idev File Name	Summer Shoulder	Summer Peak	Comments
Capacitor at Bagley 115: 1x20 Mvar	×	×	DISIS-2016-002
100 MVAR Capacitor Bank at Montezuma 345 (MEC)	×	×	DISIS-2017-001
100 MVAR switched cap at Blackhawk 345 kV (MEC)	×	×	DISIS-2017-001
40 MVar switched cap at Wahpeton 230 kV (620329)	×	×	DISIS-2017-001
60 MVar switched cap at Buffalo 345 kV (620358)	×	×	DISIS-2017-001

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A.5 SPP Model Updates

Table A-5: SPP Model Updates

Company	Python/ Idev File Name	Summer Shoulder	Summer Peak
SPTI	Correct Bus Name.py	×	×
SPTI	SPP Topology.py	×	×
SPTI	SPP Change-Add1.py	×	×

A.6 MISO North for Power Balance

Table A-6. MISO North for Power Balance

Area #	Area Name
207	HE
208	DEI
210	SIGE
216	IPL
217	NIPS
218	METC
219	ITC
295	WEC
296	MIUP
314	BREC
333	CWLD
356	AMMO
357	AMIL
360	CWLP
361	SIPC
362	EEI

Area #	Area Name
600	Xcel
608	MP
613	SMMPA
615	GRE
620	OTP
627	ALTW
633	MPW
635	MEC
661	MDU
663	BEPC-MISO
680	DPC
694	ALTE
696	WPS
697	MGE
698	UPPC
701	Classic Prior

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A.7 SPP Market for Power Balance

Table A-7. SPP Market for Power Balance

Area #	Area Name
515	SWPA
520	AEPW
523	GRDA
524	OKGE
525	WFEC
526	SPS
527	OMPA
531	MIDW
534	SUNC
536	WERE
540	GMO
541	KCPL

Area #	Area Name
542	KACY
544	EMDE
545	INDN
546	SPRM
640	NPPD
641	HAST
642	GRIS
645	OPPD
650	LES
652	WAPA
659	BEPC-SPP

A.8 Contingency Files used in Steady-State Analysis

Table A-8: List of Contingencies used in the Steady-State Analysis

Contingency File Name	Description
Automatic single element contingencies	Single element outages at buses 57 kV and above in the study region
MISO18_2023_SUM_TA_P1_AMEREN.con	Specified category P1 contingencies in Ameren
MISO18_2023_SUM_TA_P1_ATC.con	Specified category P1 contingencies in ATC
MISO18_2023_SUM_TA_P1_IOWA.con	Specified category P1 contingencies in Iowa
MISO18_2023_SUM_TA_P1_MINN-DAKS.con	Specified category P1 contingencies in IMinnesota, Dakotas
MEC-DPP2017AUG West Ph3 2023 Cat P1 2021.02.04.con	Specified category P1 contingencies in MEC
MEC-DPP2017AUG West Ph3 2023 Cat P2 2021.02.04.con	Specified category P2 contingencies in MEC
MEC-DPP2017AUG West Ph3 2023 Cat P5 2021.02.04.con	Specified category P5 contingencies in MEC
MEC-DPP2017AUG West Ph3 2023 Cat P7 2021.02.04.con	Specified category P7 contingencies in MEC
AECI-AMMO.CON	Specified contingencies in AECI/Ameren
AECI-EES.CON	Specified contingencies in AECI/Entergy
160303-KACY_P1.con	Specified category P1 contingencies in KACY
160303-KACY_P2.con	Specified category P2 contingencies in KACY
KCPL_P1.con	Specified category P1 contingencies in KCPL
KCPL_P2.con	Specified category P2 contingencies in KCPL
KCPL_P4.con	Specified category P4 contingencies in KCPL
KCPL_P5.con	Specified category P5 contingencies in KCPL
KCPL_P7.con	Specified category P7 contingencies in KCPL
MISO18_2023_SUM_TA_P1_P2_P4_P5_NoLoadLoss.con	Specified category P1, P2, P4, P5 no load loss contingencies in MISO North
MISO18_2023_SUM_TA_P2_P4_P5_P7_LoadLoss.con	Specified category P2, P4, P5, P7 load loss contingencies in MISO North

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Appendix

B

MISO Steady State Thermal and Voltage Analysis Results

B.1 Summer Peak (SPK) MISO AFSIS Constraints

Table B-1. SPK System Intact Thermal Constraints

Table B-2. SPK System Intact Voltage Constraints

Table B-3. SPK Category P1 Thermal Constraints

Table B-4. SPK Category P1 Voltage Constraints

Table B-5. SPK Category P2-P7 Thermal Constraints

Table B-6. SPK Category P2-P7 Voltage Constraints

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B.2 Summer Shoulder (SH) MISO AFSIS Constraints – Invalid

The summer shoulder case result has been updated in the sensitivity analysis. Please refer to Section 4 for the details.

Table B-7. ~~SH System Intact Thermal Constraints~~

Table B-8. ~~SH System Intact Voltage Constraints~~

Table B-9. ~~SH Category P1 Thermal Constraints~~

Table B-10. ~~SH Category P1 Voltage Constraints~~

Table B-11. ~~SH Category P2-P7 Thermal Constraints~~

Table B-12. ~~SH Category P2-P7 Voltage Constraints~~

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Appendix

C

Stability Analysis Results

C.1 Summer Peak Stability Results

Stability simulation was performed in the summer peak (SPK) stability model.

C.1.1 SPK Stability Summary

DISIS-2017-002 summer peak stability study results are summarized in Table C-2.

Table C-1: DISIS-2017-002 Summer Peak Stability Analysis Results Summary

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C.1.2 SPK Stability Plots

Plots of stability simulations for summer peak study case are in separate files which are listed below:

AppendixC1-2_SPK_DISIS-2017-002_Study_Plots.zip

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C.2 Summer Shoulder Stability Results

Stability simulation was performed in the summer shoulder (SH) stability model.

C.2.1 SH Stability Summary

DISIS-2017-002 summer shoulder stability study results are summarized in Table C-2.

Table C-2: DISIS-2017-002 Summer Shoulder Stability Analysis Results Summary

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C.2.2 SH Stability Plots

Plots of stability simulations for summer shoulder study case are in separate files which are listed below:

AppendixC2-2_SH_DISIS-2017-002_Study_Plots.zip

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Appendix

D

Summer Shoulder (SH) Steady State Sensitivity Results

Table D-1: SH Sensitivity System Intact Thermal Constraints

Table D-2: SH Sensitivity System Intact Voltage Constraints

Table D-3: SH Sensitivity Category P1 Thermal Constraints

Table D-4: Table D-4. SH Sensitivity Category P1 Voltage Constraints

Table D-5: SH Sensitivity Category P2-P7 Thermal Constraints

Table D-6: SH Sensitivity Category P2-P7 Voltage Constraints

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Appendix
E

Cost Allocation Results

E.1 Distribution Factor (DF), Voltage Impact, and MW Contribution Results for Cost Allocation

Table E-1: Distribution Factor and MW Contribution on Constraints for MISO Affected System Thermal NU Cost Allocation

Table E-2: Voltage Impact on MISO Voltage NUs Cost Allocation

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E.2 Cost Allocation Details

Table E-3: MISO Affected System Network Upgrades Cost Allocation

Table E-3: MISO Affected System Network Upgrades Cost Allocation

Monitored Element	English Name	Owner	Cost	GEN-2017-105	GEN-2017-108	GEN-2017-115	GEN-2017-119	GEN-2017-120	GEN-2017-144	GEN-2017-175	GEN-2017-181	GEN-2017-182	GEN-2017-183	GEN-2017-184	GEN-2017-188	GEN-2017-195	GEN-2017-196	GEN-2017-201	GEN-2017-202	GEN-2017-210	GEN-2017-214	GEN-2017-215	GEN-2017-222	GEN-2017-234
86111 J611 POI 161 541251 MARYVLE5 161 1	J611 POI-Maryville 161 kV	MEC GMO	$22,335,001	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$22,335,001	$0
603022 SOURIS 7 115 603023 MALLARD7 115 1	Souris-Mallard 115 kV	XEL	$100,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$50,000	$50,000	$0	$0
Add 1×15 Mvar switched cap at J611 POI 161 kV (86111)	Add 1×15 Mvar switched cap at J611 POI	MEC	$2,000,000	$84,302	$0	$284,884	$0	$0	$178,779	$247,093	$286,337	$132,267	$0	$0	$0	$0	$0	$238,372	$0	$95,930	$63,953	$63,953	$210,756	$113,372
Total Cost Per Project for each Project	**Total Cost Per Project**		**$24,435,001**	**$84,302**	**$0**	**$284,884**	**$0**	**$0**	**$178,779**	**$247,093**	**$286,337**	**$132,267**	**$0**	**$0**	**$0**	**$0**	**$0**	**$238,372**	**$0**	**$95,930**	**$113,953**	**$113,953**	**$22,545,757**	**$113,372**

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