Report Number: R114-24

MISO Affected System Study on SPP DISIS 2021-001 Phase 2 Projects

Prepared for

MISO

Submitted by:
Yaming Zhu, Technical Manager, Principal Consultant
Cesar Marzoa-Montalvo, Senior Consultant
Radwa Abdalaal, Senior Consultant
Qiyan Li, Consultant
Juhee Yeo, Consultant
William Wang, Staff Consultant

08/06/2024

Siemens PTI Project Number: 62OT-002522-B-1

Siemens Industry, Inc.
Siemens Power Technologies International
10900 Wayzata Boulevard
Minnetonka, Minnesota 55305 USA
Tel: +1 (952) 607-2270 • Fax: +1 (518) 346-2777
www.siemens.com/power-technologies

SIEMENS

Revision History

Date	Rev.	Description
07/15/2024	A	Initial draft
08/06/2024	B	Final report

Contents

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Executive Summary

This report presents the results of an Affected System Impact Study (AFSIS) on MISO transmission system performed for Phase 2 generator interconnection requests in the Southwest Power Pool (SPP) queue 2021-001 cycle (Study Projects). The AFSIS results are summarized below.

1.1 Project List

Because of a wide geographical region of the DISIS 2021-001 Phase 2 Study Projects, the MISO AFSIS was divided into two groups to identify the impacts on the MISO West and MISO South regions.

1.1.1 Phase 2 Study Projects in MISO South

The DISIS 2021-001 Phase 2 Study Projects in MISO South region (Study Projects in MISO South) have 16 generation projects with combined energy of 3134.2 MW, which are listed in Table ES-1.

Table ES-1: DISIS 2021-001 Phase 2 Study Projects in MISO South

Project #	Town / County	State	Point of Interconnection	Fuel Type	Pmax	SH (MW)	SPK (MW)
GEN-2021-001	Bryan	OK	Brown 138 kV	Battery	100	100	100
GEN-2021-016	Johnston, Murray	OK	Sunnyside-Johnston 345 kV	Wind	250	250	39
GEN-2021-018	Noble	OK	Sooner 345 kV	Solar	231	0	231
GEN-2021-033	Franklin	AR	Grand Prairie 161 kV	Solar	204.12	0	204.12
GEN-2021-036	Little River	AR	Craig-Patterson 138 kV	Solar	204.12	0	204.12
GEN-2021-038	Titus	TX	Welsh 345 kV	Battery	200	200	200
GEN-2021-041	Canadian	OK	Mustang 138 kV	Battery	100.6	100.6	100.6
GEN-2021-047	Mayes	OK	Tulsa-Igloo 345 kV	Solar	250	0	250
GEN-2021-052	Muskogee	OK	Pecan Creek 345 kV	Battery	75	75	75
GEN-2021-053	Muskogee	OK	Pecan Creek 345 kV	Solar	300	0	300
GEN-2021-063	McCurtain	OK	Craig Jct 138 kV	Solar / Storage	155	77.5	155
GEN-2021-064	Caddo	OK	Carnegie South 138 kV	Solar / Storage	100	50	100
GEN-2021-075	Camp	TX	CAMPCOR4 138 kV	Solar / Storage	302.4	300	300
GEN-2021-086	Howard	AR	Okay-Turk 138 kV	Solar / Storage	165	165	165

Project #	Town / County	State	Point of Interconnection	Fuel Type	Pmax	SH (MW)	SPK (MW)
GEN-2021-088	Cleveland	OK	Cedar Lane-Canadian 138 kV	Battery	100	100	100
GEN-2021-090	Yoakum	TX	Yoakum 345 kV	Solar / Storage	400	100	400

1.1.2 Phase 2 Study Projects in MISO West

The DISIS 2021-001 Phase 2 Study Projects in MISO West region (Study Projects in MISO West) have 35 generation projects with combined energy of 8366.2 MW, which are listed in Table ES-2.

Table ES-2: DISIS 2021-001 Phase 2 Study Projects in MISO West

Project #	Town / County	State	Point of Interconnection	Fuel Type	Pmax	SH (MW)	SPK (MW)
GEN-2021-005	Saline	KS	Summit 345 kV	Battery	350	350.00	350.00
GEN-2021-006	Labette	KS	Neosho 345 kV	Battery	300	300.00	300.00
GEN-2021-007	Knox, Cedar	NE	Turtle Creek 345 kV	Wind	600	600.00	93.60
GEN-2021-008	McKenzie	ND	Patent Gate 345 kV	Solar	200	0.00	200.00
GEN-2021-017	Cloud, Mitchell	KS	Elm Creek 345 kV	Wind	37.5	37.50	5.85
GEN-2021-023	Grant	KS	Wild Plains 345 kV	Solar	306.18	0.00	306.18
GEN-2021-024	LaMoure	ND	Jamestown 230 kV	Wind	203.04	203.04	31.67
GEN-2021-027	Lancaster	NE	Olive Creek 115 kV	Solar	102.06	0.00	102.06
GEN-2021-029	Linn KS, Bates	KS	La Cygne-Stillwel 345 kV	Battery	253.8	253.80	253.80
GEN-2021-030	Linn KS, Bates	KS	La Cygne-Stillwel 345 kV	Solar	510.3	0.00	510.30
GEN-2021-034	Lancaster	NE	Rokeby 115 kV	Solar	113	0.00	113.00
GEN-2021-037	Perkins, Keith	NE	Sidney-Keystone 345 kV	Wind	244.22	244.22	38.10
GEN-2021-039	Douglas	NE	looping in OPPD 161 kV lines S1211-S1220 and S1211-S1299	Battery	100	100.00	100.00
GEN-2021-040	Cass	NE	Cass County Power Plant 345 kV	Battery	200	200.00	200.00
GEN-2021-042	Jackson	MO	Blue Valley 161 kV	Battery	50	50.00	50.00
GEN-2021-043	Lancaster	NE	SW 12th (Rokeby) 115 kV	Battery	250	250.00	250.00
GEN-2021-048	Lancaster	NE	Wagener 115 kV	Battery	75	75.00	75.00
GEN-2021-049	Lancaster	NE	Wagener 115 kV	Solar	250	0.00	250.00

Project #	Town / County	State	Point of Interconnection	Fuel Type	Pmax	SH (MW)	SPK (MW)
GEN-2021-050	Henry	MO	Stilwell-Clinton 161 kV	Solar	200	0.00	200.00
GEN-2021-051	Henry	MO	Stilwell-Clinton 161 kV	Battery	75	75.00	75.00
GEN-2021-056	Harper, Kingman	KS	Viola 345 kV	Wind	300	300.00	46.80
GEN-2021-057	Antelope	NE	Antelope 345 kV	Wind	300	300.00	46.80
GEN-2021-068	Hodgeman, Ford	KS	Spearville-Holcomb 345 kV	Wind	249.6	249.60	38.94
GEN-2021-069	Hodgeman, Ford	KS	Spearville-Holcomb 345 kV	Wind	249.6	249.60	38.94
GEN-2021-070	Hodgeman, Ford	KS	Spearville-Holcomb 345 kV	Wind	504	504.00	78.62
GEN-2021-072	Mercer	ND	Antelope Valley-Leland Olds 345 kV	Solar	600	0.00	600.00
GEN-2021-073	Lincoln	NE	Sweetwater-Gerald Gentleman 345 kV	Solar	240	0.00	240.00
GEN-2021-076	Ellis	KS	ITC Post Rock 345 kV Substation	Solar	113	0.00	113.00
GEN-2021-077	Pettis	MO	Windsor to AEC Sedalia 161 kV	Solar / Battery	95	95	95
GEN-2021-096	Coffey	KS	Wolf Creek - Benton 345 kV	Solar	500	0.00	500.00
GEN-2021-101	Douglas	KS	Midland 115 kV	Solar	159	0.00	159.00
GEN-2021-103	Johnson	KS	Atlantic 115 kV	Battery	150	150.00	150.00
GEN-2021-106	Thayer	NE	Hebron North 115 kV	Solar	102.06	0.00	102.06
GEN-2021-107	Pottawatomie	KS	Jeffrey Energy Center 345 kV	Solar	201.6	0.00	201.60
GEN-2021-108	Cass	NE	Cass County 345kV	Solar	182.25	0.00	182.25

1.2 MISO AFSIS Study Summary

1.2.1 Study Summary for Study Projects in MISO South

Summer peak steady state models and stability packages used for MISO AFSIS on SPP DISIS 2021-001 Study Projects in MISO South were developed from the Phase 2 models used in MISO South AFSIS on SPP DISIS-2020-001 Cycle, which were originally developed from MISO DPP 2020 South Phase 3 System Impact Study (SIS) models and stability packages.

Summer shoulder steady state models and stability packages used for MISO AFSIS on SPP DISIS 2021-001 Study Projects in MISO South were developed from the Phase 2 models used in MISO South AFSIS on SPP DISIS-2020-001 Cycle, which were originally developed from MISO DPP 2020 South Phase 3 System Impact Study (SIS) models and stability packages.

Steady state thermal and voltage analysis was performed to identify any thermal and voltage violations in the MISO South region. MISO AFSIS Thermal Network Upgrades identified in the summer peak scenario for steady state analysis are listed in Table ES-3. No MISO AFSIS voltage Network Upgrades were identified in the summer peak scenario.

No MISO AFSIS thermal or voltage Network Upgrades (NUs) were identified in the summer shoulder scenario.

Table ES-3: AFSIS Thermal Network Upgrades Identified in the Summer Peak Scenario for SPP Study Projects in MISO South

Constraint	Owner	Mitigation	Cost ($)
Couch-Lewisville 115 kV	EES-EAI	~9.07 miles of Single ACSR 666.6 FLAMINGO at 115 kV and 175.92 MVA	$10,983,745
Lewisville-Patmos 115 kV	EES-EAI	~10.38 miles of Single ACSR 954 CARDINAL at 115 kV and 220.64 MVA+Bus at Lweisville	$12,802,852
Patmos-Fulton 115 kV	EES-EAI AEPW	Entergy: reconductor for the 4.22 miles of the line that belongs to Entergy. $5,093,561 AEPW: Rebuild the 7.1 mile AEP owned section of the 115 kV line from Patmos to Fulton. $10.4M	$15,493,561

Transient stability analysis was performed to identify any transient stability violations caused by the SPP Study Projects in MISO South. No transient stability constraints were identified in the 2025 summer peak and summer shoulder scenarios. No MISO AFSIS stability NUs were identified in the transient stability analysis.

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 South. Based on the screening results, MISO Transmission Owners do not plan to conduct additional studies.

No contingent MTEP facilities were identified for the SPP Study Projects in MISO South.

It should be noted that a restudy may be required if 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 the study projects that are required to mitigate thermal violations, the projects should not be allowed to come into service before the required Network Upgrades are in service, unless a MISO restudy removes the mitigation requirement from the project, or an interim limit is provided to the project through MISO Annual ERIS process. For projects that are required to mitigate voltage violations, no injection is allowed until the allocated upgrades and contingent facilities are in service.

1.2.2 Study Summary for Study Projects in MISO West

Summer peak steady state models and stability packages used for MISO AFSIS on SPP DISIS 2021-001 Study Projects in MISO West were developed from the Phase 2 models used in MISO West AFSIS on SPP DISIS-2020-001 Cycle, which were originally developed from MISO DPP 2020 West Phase 3 System Impact Study (SIS) models and stability packages.

Summer shoulder steady state models and stability packages used for MISO AFSIS on SPP DISIS 2021-001 Study Projects in MISO West were developed from the Phase 2 models used in MISO West AFSIS on SPP DISIS-2020-001 Cycle, which were originally developed from MISO DPP 2020 West Phase 3 System Impact Study (SIS) models and stability packages.

Steady state thermal and voltage analysis was performed to identify any thermal and voltage violations in MISO West region. MISO AFSIS Thermal and voltage Network Upgrades identified in the summer shoulder scenario for steady state analysis are listed in Table ES-4 and Table ES-5.

No MISO AFSIS thermal or voltage Network Upgrades (NUs) were identified in the summer peak scenario.

Table ES-4: AFSIS Thermal Network Upgrades Identified in the Summer Shoulder Scenario for SPP Study Projects in MISO West

Constraint	Owner	Mitigation	Cost ($)
New Sub - Buffalo 345 kV	OTP MPC	OTP: OTP equipment is sufficient, MPC conductor is limiter. $0 MPC: NU will be determined in MPC study	$0
Sheyenne-Lake Park 230 kV	XEL MPC OTP	OTP: Additional structure replacements beyond DISIS-2020-001 and MPC-04300. $100,000 XEL: the OTP section is limiting this line. $0	$100,000
Sheyenne-Fargo 230 kV	XEL WAPA	XEL: Rebuild line and substations to 3000A. $43M WAPA: Rebuild terminal to 3000A. $3.7M	$46,700,000
Hubbard-Badoura 230 kV	GRE MP	GRE: limiter is an MP conductor. $0 MP: Increase operating temp from 50C to 55C. $1,348,200	$1,348,200
Hubbard-Erie Jct 230 kV	GRE OTP	GRE: limiter is an MP conductor. $0 MP: Increase operating temp from 70C to 75C. $407,700	$407,700
Erie Jct-Audubon 230 kV	OTP	With Erie substation addition, expected rating of Audubon-Erie 230 kV is 360.9 MVA	$0
Wahpeton-Fergus Falls 230 kV	OTP MRES	OTP: Prior queued upgrade will increase rating to 425.4 MVA (MPC-04300). $0 MRES: No mitigation for MRES. $0	$0
Audubon-Lake Park 230 kV	OTP	Prior queued upgrade will increase rating to 527.1 MVA (MPC-04300).	$0
Raun - G18-043 Tap 345 kV	MEC OPPD	NU was assigned to SPP DISIS-18-1 / 19-1 MEC: No mitigation required. Existing MEC Only rating is 1195/1333 MVA. $0 OPPD: Structure replacements on the line. $3,720,909	$0

Table ES-5: AFSIS Voltage Network Upgrades Identified in Summer Shoulder Scenario for SPP Study Projects in MISO West

Network Upgrades	Owner	Cost ($)[1]
LRTP-02: Big Stone South – Alexandria – Big Oaks (Cassie's Crossing)	MRES OTP XEL	$573,500,000
LRTP-04: Wilmarth – North Rochester – Tremval	DPC GRE XEL	$689,140,000

Note 1: LRTP projects' costs are not assigned to DISIS-2021-001 projects

Transient stability analysis was performed to identify any transient stability violations caused by the SPP Study Projects in MISO West. No transient stability constraints were identified in MISO Affected System in the 2025 summer peak and summer shoulder scenarios. No MISO AFSIS stability NUs were identified in the transient stability analysis.

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.

Contingent facilities were identified. Details are in Section 4.2.

It should be noted that a restudy may be required if 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 the study projects that are required to mitigate thermal violations, the projects should not be allowed to come into service before the required Network Upgrades are in service, unless a MISO restudy removes the mitigation requirement from the project, or an interim limit is provided to the project through MISO Annual ERIS process. For projects that are required to mitigate voltage violations, no injection is allowed until the allocated upgrades and contingent facilities are in service.

1.3 Total MISO AFSIS Network Upgrades

1.3.1 Total MISO AFSIS Network Upgrades for Study Projects in MISO South

The total cost of MISO AFSIS Network Upgrades required for the Study Projects in MISO South is listed in Table ES-6. The costs for Network Upgrades are planning level estimates and subject to be revised in the facility studies.

Table ES-6: Total Cost of MISO AFSIS Network Upgrades for SPP DISIS 2021-001 Study Projects in MISO South

Project Num	Network Upgrades ($)			Total Network Upgrade Cost ($)
	MISO Thermal & Voltage	Transient Stability	Short Circuit	
GEN-2021-001	$0	$0	$0	$0
GEN-2021-016	$0	$0	$0	$0
GEN-2021-018	$0	$0	$0	$0
GEN-2021-033	$0	$0	$0	$0
GEN-2021-036	$14,541,615	$0	$0	$14,541,615
GEN-2021-038	$0	$0	$0	$0
GEN-2021-041	$0	$0	$0	$0
GEN-2021-047	$0	$0	$0	$0
GEN-2021-052	$0	$0	$0	$0
GEN-2021-053	$0	$0	$0	$0
GEN-2021-063	$0	$0	$0	$0
GEN-2021-064	$0	$0	$0	$0
GEN-2021-075	$0	$0	$0	$0
GEN-2021-086	$24,738,543	$0	$0	$24,738,543
GEN-2021-088	$0	$0	$0	$0
GEN-2021-090	$0	$0	$0	$0
Total ($)	**$39,280,158**	**$0**	**$0**	**$39,280,158**

1.3.2 Total MISO AFSIS Network Upgrades for Study Projects in MISO West

The total cost of MISO AFSIS Network Upgrades required for the Study Projects in MISO West is listed in Table ES-7. The costs for Network Upgrades are planning level estimates and subject to be revised in the facility studies.

Table ES-7: Total Cost of MISO AFSIS Network Upgrades for SPP Study Projects in MISO West

Project Num	Network Upgrades ($)			Total Network Upgrade Cost ($)
	MISO Thermal & Voltage	Transient Stability	Short Circuit	
GEN-2021-005	$0	$0	$0	$0
GEN-2021-006	$0	$0	$0	$0
GEN-2021-007	$0	$0	$0	$0
GEN-2021-008	$0	$0	$0	$0
GEN-2021-017	$0	$0	$0	$0
GEN-2021-023	$0	$0	$0	$0
GEN-2021-024	$48,555,900	$0	$0	$48,555,900
GEN-2021-027	$0	$0	$0	$0
GEN-2021-029	$0	$0	$0	$0
GEN-2021-030	$0	$0	$0	$0
GEN-2021-034	$0	$0	$0	$0
GEN-2021-037	$0	$0	$0	$0
GEN-2021-039	$0	$0	$0	$0
GEN-2021-040	$0	$0	$0	$0
GEN-2021-042	$0	$0	$0	$0
GEN-2021-043	$0	$0	$0	$0
GEN-2021-048	$0	$0	$0	$0
GEN-2021-049	$0	$0	$0	$0
GEN-2021-050	$0	$0	$0	$0
GEN-2021-051	$0	$0	$0	$0
GEN-2021-056	$0	$0	$0	$0
GEN-2021-057	$0	$0	$0	$0
GEN-2021-068	$0	$0	$0	$0
GEN-2021-069	$0	$0	$0	$0
GEN-2021-070	$0	$0	$0	$0
GEN-2021-072	$0	$0	$0	$0
GEN-2021-073	$0	$0	$0	$0
GEN-2021-076	$0	$0	$0	$0
GEN-2021-077	$0	$0	$0	$0

Project Num	Network Upgrades ($)			Total Network Upgrade Cost ($)
	MISO Thermal & Voltage	Transient Stability	Short Circuit	
GEN-2021-096	$0	$0	$0	$0
GEN-2021-101	$0	$0	$0	$0
GEN-2021-103	$0	$0	$0	$0
GEN-2021-106	$0	$0	$0	$0
GEN-2021-107	$0	$0	$0	$0
GEN-2021-108	$0	$0	$0	$0
Total ($)	**$48,555,900**	**$0**	**$0**	**$48,555,900**

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 2021-001 cycle.

1.4.1 Per Project Summary for Study Projects in MISO South

The following projects in MISO South do not have MISO AFSIS Network Upgrade cost allocated to the projects:

- GEN-2021-001, GEN-2021-016, GEN-2021-018, GEN-2021-033, GEN-2021-038, GEN-2021-041, GEN-2021-047, GEN-2021-052, GEN-2021-053, GEN-2021-063, GEN-2021-064, GEN-2021-075, GEN-2021-088, GEN-2021-090.

MISO AFSIS Network Upgrade costs are allocated to the below projects in MISO South:

1.4.1.1 GEN-2021-036 Summary

Network Upgrade	Owner	Cost	GEN-2021-036	NUs Type
Couch-Lewisville 115 kV	EES-EAI	$10,983,745	$4,066,211	SUM
Lewisville-Patmos 115 kV	EES-EAI	$12,802,852	$4,739,649	SUM
Patmos-Fulton 115 kV	EES-EAI AEPW	$15,493,561	$5,735,756	SUM
Total Cost Per Project			**$14,541,615**	

1.4.1.2 GEN-2021-086 Summary

Network Upgrade	Owner	Cost	GEN-2021-086	NUs Type
Couch-Lewisville 115 kV	EES-EAI	$10,983,745	$6,917,534	SUM
Lewisville-Patmos 115 kV	EES-EAI	$12,802,852	$8,063,203	SUM
Patmos-Fulton 115 kV	EES-EAI AEPW	$15,493,561	$9,757,805	SUM
Total Cost Per Project			**$24,738,543**	

1.4.2 Per Project Summary for Study Projects in MISO West

The following projects in MISO West do not have MISO AFSIS Network Upgrade cost allocated to the projects:

- GEN-2021-005, GEN-2021-006, GEN-2021-007, GEN-2021-008, GEN-2021-017, GEN-2021-023, GEN-2021-027, GEN-2021-029, GEN-2021-030, GEN-2021-034, GEN-2021-037, GEN-2021-039, GEN-2021-040, GEN-2021-042, GEN-2021-043, GEN-2021-048, GEN-2021-049, GEN-2021-050, GEN-2021-051, GEN-2021-056, GEN-2021-057, GEN-2021-068, GEN-2021-069, GEN-2021-070, GEN-2021-072, GEN-2021-073, GEN-2021-076, GEN-2021-077, GEN-2021-096, GEN-2021-101, GEN-2021-103, GEN-2021-106, GEN-2021-107, GEN-2021-108.

MISO AFSIS Network Upgrade costs are allocated to the below projects in MISO West:

1.4.3 GEN-2021-024 Summary

Network Upgrade	Owner	Cost	GEN-2021-024	NUs Type
Sheyenne-Lake Park 230 kV	XEL MPC OTP	$100,000	$100,000	SH Thermal
Sheyenne-Fargo 230 kV	XEL WAPA	$46,700,000	$46,700,000	SH Thermal
Hubbard-Badoura 230 kV	GRE MP	$1,348,200	$1,348,200	SH Thermal
Hubbard-Erie Jct 230 kV	GRE MP	$407,700	$407,700	SH Thermal
Total Cost Per Project			**$48,555,900**	

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.

Section

1

Model Development and Study Criteria

1.1 MISO South Model Development and Study Criteria

1.1.1 MISO South Region AFSIS Model Development

Summer peak steady state models and stability packages used for MISO AFSIS on SPP DISIS 2021-001 Study Projects in MISO South were developed from the Phase 2 models used in MISO South AFSIS on SPP DISIS-2020-001 Cycle, which were originally developed from MISO DPP 2020 South Phase 3 System Impact Study (SIS) models and stability packages.

Summer shoulder steady state models and stability packages used for MISO AFSIS on SPP DISIS 2021-001 Study Projects in MISO South were developed from the Phase 2 models used in MISO South AFSIS on SPP DISIS-2020-001 Cycle, which were originally developed from MISO DPP 2020 South Phase 3 System Impact Study (SIS) models and stability packages.

The starting models used for developing MISO South AFSIS models on DISIS 2021-001 Study are listed below:

- 2025 summer peak model: DISIS-2020-001_AFSIS-South-2025SUM-Ph2-Study_231102.sav
- 2025 summer shoulder model: DISIS-2020-001_AFSIS-South-2025SH90-Ph2-Study_231102.sav

1.1.1.1 MISO South AFSIS Benchmark Cases

The benchmark cases for the MISO South AFSIS study were created as follows:

- Removed recently withdrawn MISO South prior queued generation projects (Table A-1). Power mismatch was balanced by scaling generation in the MISO South (Table A-13).
- Removed recently withdrawn MISO Central prior queued generation projects (Table A-2). Power mismatch was balanced by scaling generation in the MISO North (Table A-12).
- Removed recently withdrawn SPP prior queued generation projects (Table A-3). Power mismatch was balanced by scaling generation in SPP market (Table A-14) based on the load-ratio share of the Transmission Owner (TO) power flow modeling areas.
- Removed several withdrawn generation projects in DISIS 18-002 / 19-001 cycle, (Table A-4). Removed withdrawn generation projects in DISIS 2020-001 cycle (Table A-5). Power mismatch was balanced by scaling generation in SPP market (Table A-14) based on the load-ratio share of the TO power flow modeling areas.

- SPP prior queued generation projects (Table A-6) close to MISO South were modeled. SPP DISIS 18-002 / 19-001 generation projects in MISO South (Table A-7) were updated and dispatched. SPP DISIS 2020-001 generation projects in MISO South (Table A-8) were updated and dispatched.
- Removed several SPP Network Upgrades associated with SPP prior queued withdrawn projects. Added SPP NU of "Holt to Atchinson 345 kV New Line Build". Added SPP R PLAN "BUILD GENTLEMAN - CHERRY COUNTY - HOLT 345kV". Power mismatch was balanced by scaling generation in SPP market (Table A-14) based on the load-ratio share of the TO power flow modeling areas.
- AECI prior queued generation projects (Table A-9) were modeled. Power mismatch was balanced by scaling generation in AECI (Table A-15).
- Removed recently retired MISO generation in MISO South area. These recently retired MISO South generation are listed in Table A-10. Power mismatch was balanced by scaling generation in the MISO South (Table A-13).
- Removed recently retired MISO generation in MISO Central area. These recently retired generation projects in MISO Central are listed in Table A-10. Power mismatch was balanced by scaling generation in the MISO North (Table A-12).
- Turned on and dispatched MISO generation projects in DPP 2020 Central area due to their higher queue position. Power mismatch was balanced by scaling generation in the MISO North (Table A-12).
- Added the SPP Study Projects with offline status in DISIS 2021-001 cycles close to MISO South. The SPP Study Projects in MISO South are listed in Table ES-1.

1.1.1.2 MISO South AFSIS Study Cases

Summer peak (SPK) study case was created by dispatching the Study Projects in MISO South at the specified summer peak level from the benchmark case.

Summer shoulder (SH) study case was created by dispatching the Study Projects in MISO South at the specified summer shoulder level from the benchmark case.

Generation in the SPP market was used for power balance, where SPP generation was scaled 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.

1.1.2 MISO South Region AFSIS Contingency Criteria

The following contingencies were considered in the MISO South AFSIS analysis:

- NERC Category P0 (system intact - no contingencies)
- NERC Category P1 contingencies
    - Single element outages, at buses with a nominal voltage of 60 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.9

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.

1.1.3 MISO South Region AFSIS Monitored Elements

The MISO South AFSIS 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: MISO South AFSIS 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
CLECO	100% of Rate A	100% of Rate B	1.05/0.95	1.10/0.90
SMEPA	100% of Rate A	100% of Rate B	1.05/0.95	1.05/0.90
LAFA	100% of Rate A	100% of Rate B	1.05/0.95	1.05/0.90
LAGN	100% of Rate A	100% of Rate B	1.05/0.975/0.95	1.05/0.95/0.92
LEPA	100% of Rate A	100% of Rate B	1.05/0.975/0.95	1.05/0.95/0.92

Notes

1: PSS®E Rate A, Rate B or Rate C

2: Limits dependent on nominal bus voltage

1.2 MISO West Model Development and Study Criteria

1.2.1 MISO West Region AFSIS Model Development

Summer peak steady state models and stability packages used for MISO AFSIS on SPP DISIS 2021-001 Study Projects in MISO West were developed from the Phase 2 models used in MISO West AFSIS on SPP DISIS-2020-001 Cycle, which were originally developed from MISO DPP 2020 West Phase 3 System Impact Study (SIS) models and stability packages.

Summer shoulder steady state models and stability packages used for MISO AFSIS on SPP DISIS 2021-001 Study Projects in MISO West were developed from the Phase 2 models used in MISO West AFSIS on SPP DISIS-2020-001 Cycle, which were originally developed from MISO DPP 2020 West Phase 3 System Impact Study (SIS) models and stability packages.

The starting models used for developing MISO West AFSIS models on DISIS 2021-001 Study are listed below:

- 2025 summer peak model: DISIS-2020-001_AFSIS-West-2025SUM-Ph2-Study_231102.sav
- 2025 summer shoulder model: DISIS-2020-001_AFSIS-West-2025SH90-Ph2-Study_231102.sav

1.2.1.1 MISO West AFSIS Benchmark Cases

The benchmark cases for the MISO West AFSIS study were created as follows:

- Removed recently withdrawn MISO West and Central prior queued generation projects (Table B-1). Power mismatch was balanced by scaling generation in the MISO North (Table A-12).
- Removed recently withdrawn SPP prior queued generation projects (Table B-2). Power mismatch was balanced by scaling generation in SPP market (Table A-14) based on the load-ratio share of the TO power flow modeling areas.
- Removed several withdrawn generation projects in DISIS 18-002 / 19-001 cycle (Table B-3). Removed withdrawn generation projects in DISIS 2020-001 cycle (Table B-4). Power mismatch was balanced by scaling generation in SPP market (Table A-14) based on the load-ratio share of the TO power flow modeling areas.
- SPP prior queued generation projects (Table B-5) close to MISO West were modeled. SPP DISIS 18-002 / 19-001 generation projects in MISO West (Table B-6) were updated and dispatched. SPP DISIS 2020-001 generation projects in MISO West (Table B-7) were also updated and dispatched.
- MPC prior queued generation projects (Table B-8) were modeled. Power mismatch was balanced by scaling generation in the MISO North (Table A-12) except generation in Dakotas.
- AECI prior queued generation projects (Table B-9) were modeled. Power mismatch was balanced by scaling generation in AECI (Table A-15).
- Removed Scott County – Hazel Creek 345 kV Network Upgrade which was originally required for DPP 2020 West projects. Removed fictitious shunt capacitors at Jamestown 345 kV bus (bus #: 620369) and Wahpeton 230 kV bus (bus #: 620329) which were originally modeled in DPP 2020 West summer shoulder models.
- Removed Gentleman – Keystone – Red Willow – Post Rock 345 kV line which is no longer required by prior queued SPP projects. Removed Antelope Valley – Grand Prairie 345 kV line which is no longer required by prior queued SPP projects. Added SPP NU of "Holt to Atchinson 345 kV New Line Build". Added SPP R PLAN "BUILD GENTLEMAN - CHERRY COUNTY - HOLT 345kV". Power mismatch was balanced by scaling generation in SPP market (Table A-14) based on the load-ratio share of the TO power flow modeling areas
- Removed recently retired MISO generation in MISO West and Central areas. These recently retired MISO Central generation are listed in Table B-10. Power mismatch was balanced by scaling generation in the MISO North (Table A-12).
- Turned on MISO generation projects in DPP 2020 Central area due to their higher queue position. Power mismatch was balanced by scaling generation in the MISO North (Table A-12).
- Added NUs required for SPP West projects prior to DISIS 18-002 / 19-001 cycle (Table B-11); Added NUs required for SPP West projects in DISIS 18-002 / 19-001 cycle (Table B-12).
- Added NUs required for MPC Group 2021 projects (Table B-13); Added several NUs required for MPC 04300 project (Table B-14).

- Added the SPP Study Projects with offline status in DISIS 2021-001 cycles close to MISO West. The SPP Study Projects in MISO West are listed in Table ES-2.

1.2.1.2 MISO West AFSIS Study Cases

Summer peak (SPK) study case was created by dispatching the Study Projects in MISO West at the specified summer peak level from the benchmark case.

Summer shoulder (SH) study case was created by dispatching the Study Projects in MISO West at the specified summer shoulder level from the benchmark case.

Generation in the SPP market was used for power balance, where SPP generation was scaled 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.

1.2.1.3 Fictitious Shunt Capacitors in Summer Shoulder Case

In the starting model of MISO DPP 2020 West Phase 3 summer shoulder model, four (4) fictitious shunt capacitors were modeled due to low voltages in SPP system. Due to further voltage degradations in SPP system, sizes of some fictitious shunt capacitors were increased and additional shunt capacitors were added. All these fictitious shunt capacitors were only modeled in summer shoulder cases, which are listed in Table 1-2.

Table 1-2: Fictitious Shunt Capacitors in SPP System Modeled in Summer Shoulder

Model	Cap MVar at Mingo 345 kV (531451)	Cap MVar at Red Willow 345 kV (640325)	Cap MVar at Post Rock 345 kV (530583)	Cap MVar at Cooper 345 kV (640139)	Cap MVar at Spearville 345 kV (531469)
DPP 2020 West Ph3 Shoulder Model	100	300	300	4×50	0
MISO AFS on DISIS 2020-001 Shoulder Model	300	300	600	4×50	0
MISO AFS on DISIS 2020-001 Shoulder Model	300	300	600	4×50	250

1.2.2 MISO West Region AFSIS Contingency Criteria

The following contingencies were considered in the MISO West AFSIS analysis:

- NERC Category P0 (system intact - no contingencies)
- NERC Category P1 contingencies
  - Single element outages, at buses with a nominal voltage of 60 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 B.7.

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.

1.2.3 MISO West Region AFSIS Monitored Elements

The MISO West AFSIS study area is defined in Table 1-3. 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 1-3: MISO West AFSIS Monitored Elements

Owner / Area	Thermal Limits [1]		Voltage Limits [2]	
	Pre-Disturbance	Post-Disturbance	Pre-Disturbance	Post-Disturbance
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
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
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
DPC	100% of Rate A	100% of Rate B	1.05/0.95	1.10/0.90
EES	100% of Rate A	100% of Rate B	1.05/0.975/0.95	1.05/0.95/0.92/0.90
GLH	100% of Rate A	100% of Rate B	1.05/0.95	1.05/0.90
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
MPW	100% of Rate A	100% of Rate B	1.05/0.95	1.05/0.95
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
PPI	100% of Rate A	100% of Rate B	1.05/0.95	1.05/0.95
RPU	100% of Rate A	100% of Rate B	1.05/0.95	1.10/0.92
SIPC	100% of Rate A	100% of Rate B	1.07/0.95	1.09/0.91
SMMPA	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
WPPI	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.

1.3 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 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.

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Section 2

MISO South Affected System Study

Steady state thermal and voltage analysis and transient stability analysis were performed in the MISO South AFSIS study.

2.1 MISO South AFSIS Thermal and Voltage Analysis

Nonlinear (AC) contingency analysis was performed on the benchmark and study cases, and the incremental impact of the SPP DISIS 2021-001 Study Projects in MISO South were 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 discharging scenarios. PSS®E version 34.9.3 and PSS®MUST version 12.4.1 were used in the study.

2.1.1 MISO Contingency Analysis for 2025 Summer Peak Condition

Steady state AC contingency analysis was performed on the MISO South AFSIS summer peak (SPK) study and benchmark cases developed in Section 1.1.1. The 2025 summer peak MISO thermal and voltage results are in Appendix C.1.

2.1.1.1 Summer Peak System Intact Conditions

For NERC category P0 (system intact) conditions, thermal constraints are listed in Table C-1. No voltage constraints were identified (Table C-2).

2.1.1.2 Summer Peak Post Contingency Conditions

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

For P1 contingencies, thermal constraints are listed in Table C-3. No voltage constraints were identified (Table C-4).

For P2-P7 contingencies, thermal constraints are listed in Table C-5. No voltage constraints were identified (Table C-6).

2.1.1.3 Summary of Summer Peak Results

In summer peak scenario, MISO South AFSIS worst thermal constraints are listed in Table 2-1. No voltage constraints were identified.

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

Generator	Constraint	Rating	Owner	Worst Loading		Contingency	Cont Type
				(MVA)	(%)		
GEN-2021-036, GEN-2021-086	Couch-Lewisville 115 kV	159.0	EES-EAI	166.2	104.5	CEII Redacted	P1
GEN-2021-036, GEN-2021-086	Couch-Lewisville 115 kV	159.0	EES-EAI	171.3	107.7	CEII Redacted	P2-P7
GEN-2021-036, GEN-2021-086	Lewisville-Patmos 115 kV	159.0	EES-EAI	165.7	104.2	CEII Redacted	P0
GEN-2021-036, GEN-2021-086	Lewisville-Patmos 115 kV	159.0	EES-EAI	194.6	122.4	CEII Redacted	P1
GEN-2021-036, GEN-2021-086	Lewisville-Patmos 115 kV	159.0	EES-EAI	200.1	125.9	CEII Redacted	P2-P7
GEN-2021-036, GEN-2021-086	Patmos-Fulton 115 kV	159.0	EES-EAI AEPW	170.1	107.0	CEII Redacted	P0
GEN-2021-036, GEN-2021-086	Patmos-Fulton 115 kV	159.0	EES-EAI AEPW	199.0	125.2	CEII Redacted	P1
GEN-2021-036, GEN-2021-086	Patmos-Fulton 115 kV	159.0	EES-EAI AEPW	204.6	128.7	CEII Redacted	P2-P7

2.1.2 MISO Contingency Analysis for 2025 Summer Shoulder Condition

Steady state AC contingency analysis was performed on the MISO South AFSIS summer shoulder (SH) study and benchmark cases developed in Section 1.1.1. The 2025 summer shoulder MISO thermal and voltage results are in Appendix C.2.

2.1.2.1 Summer Shoulder System Intact Conditions

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

2.1.2.2 Summer Shoulder Post Contingency Conditions

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

For P1 contingencies, no thermal constraints (Table C-9) or voltage constraints (Table C-10) were identified.

For P2-P7 contingencies, no thermal constraints (Table C-11) or voltage constraints (Table C-12) were identified.

2.1.2.3 Summary of Summer Shoulder Results

In summer shoulder scenario, no thermal or voltage constraints were identified in the MISO South steady state analysis for the SPP Study Projects.

2.1.3 Summary of MISO South AFSIS Steady State Analysis

MISO South steady state analyses were performed on the MISO 2025 summer peak and summer shoulder scenarios. The steady state thermal constraints and required Network Upgrades are listed in Table 2-2. No voltage constraints were identified.

Table 2-2: MISO South AFSIS Combined Thermal Constraints and Network Upgrades

Generator	Constraint	Owner	Mitigation	Cost ($)
GEN-2021-036, GEN-2021-086	Couch-Lewisville 115 kV	EES-EAI	~9.07 miles of Single ACSR 666.6 FLAMINGO at 115 kV and 175.92 MVA	$10,983,745
GEN-2021-036, GEN-2021-086	Lewisville-Patmos 115 kV	EES-EAI	~10.38 miles of Single ACSR 954 CARDINAL at 115 kV and 220.64 MVA+Bus at Lweisville	$12,802,852
GEN-2021-036, GEN-2021-086	Patmos-Fulton 115 kV	EES-EAI AEPW	Entergy: reconductor for the 4.22 miles of the line that belongs to Entergy. $5,093,561 AEPW: Rebuild the 7.1 mile AEP owned section of the 115 kV line from Patmos to Fulton. $10.4M	$15,493,561

2.2 MISO South AFSIS Transient Stability Analysis

Stability analysis was performed to evaluate transient stability and impact on the MISO South region of the SPP Study Projects in MISO South.

2.2.1 Procedure

2.2.1.1 Computer Programs

Stability analysis was performed using TSAT revision 22.0.

2.2.1.2 Methodology

Stability package representing 2025 summer peak (SPK) scenario with SPP DISIS 2021-001 Study Projects in MISO South was created from stability package used in MISO South AFSIS on SPP DISIS-2020-001 Phase 2 Cycle. Power flow models are the same as steady state power flow models, which were developed in Section 1.1.1.

Stability package representing 2025 summer shoulder (SH) scenario with SPP DISIS 2021-001 Study Projects in MISO South was created from stability package used in MISO South AFSIS on SPP DISIS-2020-001 Phase 2 Cycle. Power flow models are the same as steady state power flow models, which were developed in Section 1.1.1.

Disturbances were simulated to evaluate the transient stability and impact on the region of the SPP Study Projects in MISO South. MISO transient stability criteria and local TOs' planning criteria specified in MTEP20 were adopted for checking stability violations.

2.2.2 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 1.1.1.

Transient stability study was performed for the following Study Projects listed in Table 2-3. Based on the generator / inverter / turbine types, corresponding dynamic models were used for representing the dynamic behaviors of these Study Projects. The dynamic models are listed in Table 2-3.

Table 2-3: Dynamic Models for SPP DISIS 2021-001 Study Projects in MISO South

SPP Project #	Fuel Type	Generator / Inverter / Turbine Type
GEN-2021-001	Battery	REGCAU
GEN-2021-016	Wind	REGCA1
GEN-2021-018	Solar	REGCAU
GEN-2021-033	Solar	REGCAU
GEN-2021-036	Solar	REGCAU
GEN-2021-038	Battery	REGCAU

SPP Project #	Fuel Type	Generator / Inverter / Turbine Type
GEN-2021-041	Battery	REGCAU
GEN-2021-047	Solar	REGCA1
GEN-2021-052	Battery	REGCA1
GEN-2021-053	Solar	REGCA1
GEN-2021-063	Solar / Storage	REGCA1 (solar) REGCA1 (battery)
GEN-2021-064	Solar / Storage	REGCA1 (solar) REGCA1 (battery)
GEN-2021-075	Solar / Storage	REGCA1 (solar) REGCA1 (battery)
GEN-2021-086	Solar / Storage	REGCA1 (solar) REGCA1 (battery)
GEN-2021-088	Battery	REGCA1
GEN-2021-090	Solar / Storage	REGCA1 (solar) REGCA1 (battery)

2.2.3 Disturbance Criteria

The stability simulations performed as part of this study considered all the regional and local contingencies listed in Table 2-4. Regional contingencies with pre-defined switching sequences were selected from the MISO MTEP20 study; switching sequences for local contingencies were developed based on the generic clearing times shown in Table 2-5. 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.

Table 2-4: MISO South AFSIS Regional and Local Disturbance Descriptions

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Table 2-5: 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

2.2.4 Performance Criteria

MISO transient stability criteria and local TOs' planning criteria specified in MTEP20 were adopted. The Study Projects must mitigate the stability constraints to obtain any type of Interconnection Service.

2.2.5 Summer Peak Stability Results

The contingencies listed in Table 2-4 were simulated using the summer peak stability model.

Appendix D.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.

MISO South AFSIS summer peak stability study results summary is in Appendix D.1.1, Table D-1.

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

2.2.5.1 Slow Transient Low Voltages Recovery

Under one contingency of "6354_S_EES_P5", voltages at 11 buses in Lewis Creek 230 kV area in EES are below 0.7 per unit for up to 0.613 second, and voltages at 38 buses in Lewis Creek 230 kV area in EES are below 0.8 per unit (>0.7 pu) for up to 0.333 second (Table 2-6). Per Entergy's Local Planning Criteria, mitigations are not required for these slow transient low voltage recovery violations since all these HV buses (≤230 kV) recover to above 80% voltage within 4 seconds of the initial P5 fault.

Table 2-6: Slow Transient Low Voltage Recovery

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2.2.5.2 Post-Fault Steady State Low Voltages

Under one contingency of "CAMPCOR4_SLG_POI_PITTSB_4_Fault", study project GEN-2021-075 has active power curtailment after the fault, and its post-fault terminal voltage and POI voltage settle below 0.9 pu (Table 2-7). The GEN-2021-075 project has electrical controller model in P priority which does not support voltage recovery. If the GEN-2021-075 electrical controller model is updated from P priority to Q priority, the issues of GEN-2021-075 active power curtailment and post-fault steady state low voltages will be resolved. Since the active power curtailment occurs at GEN-2021-075 project and post-fault steady state low voltages occur at SPP system, MISO AFSIS Network Upgrades are not required.

Table 2-7: Post-Fault Steady State Low Voltages

CEII Redacted

2.2.6 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.

2.2.7 Summer Shoulder Stability Results

The contingencies listed in Table 2-4 were simulated using the summer shoulder stability model.

Appendix D.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.

MISO South AFSIS summer shoulder stability study results summary is in Appendix D.2.1, Table D-2.

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

2.2.7.1 Generation Tripping Due to Low Voltages / Instability

Under two NERC Category P6 contingencies (Table 2-8), several local generators were tripped due to instability and/or low voltages. These local generators have more than 1200 MW power flowing through one or two transformers after the fault. The same local generators were also tripped due to instability and/or low voltages under the same contingencies in the benchmark model. Therefore, the SPP Study Projects in MISO South are not responsible for the local generation tripping.

Table 2-8: Local Generation Tripping Due to Instability / Low Voltages

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2.2.7.2 Post-Fault Steady State Low Voltages

Under one contingency of "CAMPCOR4_SLG_POI_PITTSB_4_Fault", study project GEN-2021-075 has active power curtailment after the fault, and its post-fault terminal voltage and POI voltage settle below 0.9 pu (Table 2-9). The GEN-2021-075 project has electrical controller model in P priority which does not support voltage recovery. If the GEN-2021-075 electrical controller model is updated from P priority to Q priority, the issues of GEN-2021-075 active power curtailment and post-fault steady state low voltages will be resolved. Since the active power curtailment occurs at GEN-2021-075 project and post-fault steady state low voltages occur at SPP system, MISO AFSIS Network Upgrades are not required.

Table 2-9: Post-Fault Steady State Low Voltages

CEII Redacted

2.2.8 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.

2.2.9 Summary of MISO South AFSIS Transient Stability Analysis

Based on the MISO South 2025 summer peak and summer shoulder transient stability analysis, no MISO South AFSIS stability NUs are required for the SPP Study Projects in MISO South.

Section

3

MISO West Affected System Study

Steady state thermal and voltage analysis and transient stability analysis were performed in the MISO West AFSIS study.

3.1 MISO West AFSIS Thermal and Voltage Analysis

Nonlinear (AC) contingency analysis was performed on the benchmark and study cases, and the incremental impact of the SPP DISIS 2021-001 Study Projects in MISO West were 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 discharging scenarios. PSS®E version 34.9.3 and PSS®MUST version 12.4.1 were used in the study.

3.1.1 MISO Contingency Analysis for 2025 Summer Peak Condition

Steady state AC contingency analysis was performed on the MISO West AFSIS summer peak (SPK) study and benchmark cases developed in Section 1.2.1. The 2025 summer peak MISO thermal and voltage results are in Appendix E.1.

3.1.1.1 Summer Peak System Intact Conditions

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

3.1.1.2 Summer Peak Post Contingency Conditions

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

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

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

3.1.1.3 Summary of Summer Peak Results

In summer peak scenario, no thermal or voltage constraints were identified in the MISO West steady state analysis for the SPP Study Projects.

3.1.2 MISO Contingency Analysis for 2025 Summer Shoulder Condition

Steady state AC contingency analysis was performed on the MISO West AFSIS summer shoulder (SH) study and benchmark cases developed in Section 1.2.1. The 2025 summer shoulder MISO thermal and voltage results are in Appendix E.2.

3.1.2.1 Summer Shoulder System Intact Conditions

For NERC category P0 (system intact) conditions, thermal constraints are listed in Table E-7. No voltage constraints were identified (Table E-8).

3.1.2.2 Summer Shoulder Post Contingency Conditions

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

For P1 contingencies, thermal constraints are listed in Table E-9. No voltage constraints were identified (Table E-10).

One category P2-P7 contingency (Table E-13) was not converged in both the benchmark and study cases. No mitigation plan is required for the SPP Study Projects for this non-converged contingency.

For the non-converged contingency in Table E-13, DC contingency analysis was performed to get the dc thermal results. The dc thermal results for non-converged contingencies are listed in Table E-14.

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

3.1.2.3 Summer Shoulder Worst Constraints

In the 2025 summer shoulder scenario, MISO West AFSIS worst thermal constraints are listed in Table 3-1, and MISO West AFSIS worst voltage constraints are listed in Table E-15.

Table 3-1: 2025 Summer Shoulder MISO West AFSIS Thermal Constraints, Maximum Screened Loading

Generator	Constraint	Rating	Owner	Worst Loading (MVA)	Worst Loading (%)	Contingency	Cont Type
GEN-2021-024	New Sub - Buffalo 345 kV	1041.6	OTP MPC	1102.8	105.9	CEII Redacted	P1
GEN-2021-024	Sheyenne-Lake Park 230 kV	300.8	XEL MPC OTP	387.2	128.7	CEII Redacted	P0
GEN-2021-024	Sheyenne-Lake Park 230 kV	300.8	XEL MPC OTP	396.6	131.8	CEII Redacted	P1
GEN-2021-024	Sheyenne-Fargo 230 kV	505.3	XEL WAPA	750.9	148.6	CEII Redacted	P1
GEN-2021-024	Sheyenne-Fargo 230 kV	505.3	XEL WAPA	750.9	148.6	CEII Redacted	P2-P7
GEN-2021-024	Hubbard-Badoura 230 kV	206.0	GRE MP	218.4	106.0	CEII Redacted	P1
GEN-2021-024	Hubbard-Erie Jct 230 kV	305.0	GRE OTP	315.0	103.3	CEII Redacted	P0
GEN-2021-024	Erie Jct-Audubon 230 kV	305.0	OTP	321.4	105.4	CEII Redacted	P0
GEN-2021-024	Wahpeton-Fergus Falls 230 kV	357.3	OTP MRES	418.7	117.2	CEII Redacted	P1
GEN-2021-024	Audubon-Lake Park 230 kV	293.6	OTP	379.4	129.2	CEII Redacted	P0
GEN-2021-024	Audubon-Lake Park 230 kV	293.6	OTP	388.5	132.3	CEII Redacted	P1

Generator	Constraint	Rating	Owner	Worst Loading		Contingency	Cont Type
				(MVA)	(%)		
GEN-2021-007	Raun - G18-043 Tap 345 kV	956.0	MEC OPPD	1089.3	113.9	CEII Redacted	P1

3.1.2.4 Summary of Summer Shoulder Results

In the summer shoulder scenario, Table 3-2 lists MISO West AFSIS thermal constraints and Network Upgrades, and Table 3-3 lists MISO West AFSIS voltage constraints and Network Upgrades.

Table 3-2: MISO West AFSIS Thermal Constraints and Network Upgrades in Summer Shoulder Scenario

Generator	Constraint	Owner	Mitigation	Cost ($)
GEN-2021-024	New Sub - Buffalo 345 kV	OTP MPC	OTP: OTP equipment is sufficient, MPC conductor is limiter. $0 MPC: NU will be determined in MPC study	$0
GEN-2021-024	Sheyenne-Lake Park 230 kV	XEL MPC OTP	OTP: Additional structure replacements beyond DISIS-2020-001 and MPC-04300. $100,000 XEL: the OTP section is limiting this line. $0	$100,000
GEN-2021-024	Sheyenne-Fargo 230 kV	XEL WAPA	XEL: Rebuild line and substations to 3000A. $43M WAPA: Rebuild terminal to 3000A. $3.7M	$46,700,000
GEN-2021-024	Hubbard-Badoura 230 kV	GRE MP	GRE: limiter is an MP conductor. $0 MP: Increase operating temp from 50C to 55C. $1,348,200	$1,348,200
GEN-2021-024	Hubbard-Erie Jct 230 kV	GRE OTP	GRE: limiter is an MP conductor. $0 MP: Increase operating temp from 70C to 75C. $407,700	$407,700
GEN-2021-024	Erie Jct-Audubon 230 kV	OTP	With Erie substation addition, expected rating of Audubon-Erie 230 kV is 360.9 MVA	$0
GEN-2021-024	Wahpeton-Fergus Falls 230 kV	OTP MRES	OTP: Prior queued upgrade will increase rating to 425.4 MVA (MPC-04300). $0 MRES: No mitigation for MRES. $0	$0
GEN-2021-024	Audubon-Lake Park 230 kV	OTP	Prior queued upgrade will increase rating to 527.1 MVA (MPC-04300).	$0
GEN-2021-007	Raun - G18-043 Tap 345 kV	MEC OPPD	NU was assigned to SPP DISIS-18-1 / 19-1 MEC: No mitigation required. Existing MEC Only rating is 1195/1333 MVA. $0 OPPD: Structure replacements on the line. $3,720,909	$0

Table 3-3: MISO West AFSIS Voltage Constraints and Network Upgrades in Summer Shoulder Scenario

Constraint	Network Upgrades	Owner	Cost ($)[1]
Low voltages in Alexandria area	LRTP-02: Big Stone South – Alexandria – Big Oaks (Cassie's Crossing)	MRES OTP XEL	$573,500,000
Low voltages in Wilmarth area	LRTP-04: Wilmarth – North Rochester – Tremval	DPC GRE XEL	$689,140,000

Note 1: LRTP projects' costs are not assigned to DISIS-2021-001 projects

3.1.3 Summary of MISO West AFSIS Steady State Analysis

MISO West steady state analyses were performed on the MISO 2025 summer peak and summer shoulder scenarios. The steady state thermal constraints and required Network Upgrades are listed in Table 3-4, and voltage constraints and required Network Upgrades are listed in Table 3-5.

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

Generator	Constraint	Owner	Mitigation	Cost ($)
GEN-2021-024	New Sub - Buffalo 345 kV	OTP MPC	OTP: OTP equipment is sufficient, MPC conductor is limiter. $0 MPC: NU will be determined in MPC study	$0
GEN-2021-024	Sheyenne-Lake Park 230 kV	XEL MPC OTP	OTP: Additional structure replacements beyond DISIS-2020-001 and MPC-04300. $100,000 XEL: the OTP section is limiting this line. $0	$100,000
GEN-2021-024	Sheyenne-Fargo 230 kV	XEL WAPA	XEL: Rebuild line and substations to 3000A. $43M WAPA: Rebuild terminal to 3000A. $3.7M	$46,700,000
GEN-2021-024	Hubbard-Badoura 230 kV	GRE MP	GRE: limiter is an MP conductor. $0 MP: Increase operating temp from 50C to 55C. $1,348,200	$1,348,200
GEN-2021-024	Hubbard-Erie Jct 230 kV	GRE OTP	GRE: limiter is an MP conductor. $0 MP: Increase operating temp from 70C to 75C. $407,700	$407,700
GEN-2021-024	Erie Jct-Audubon 230 kV	OTP	With Erie substation addition, expected rating of Audubon-Erie 230 kV is 360.9 MVA	$0
GEN-2021-024	Wahpeton-Fergus Falls 230 kV	OTP MRES	OTP: Prior queued upgrade will increase rating to 425.4 MVA (MPC-04300). $0 MRES: No mitigation for MRES. $0	$0
GEN-2021-024	Audubon-Lake Park 230 kV	OTP	Prior queued upgrade will increase rating to 527.1 MVA (MPC-04300).	$0
GEN-2021-007	Raun - G18-043 Tap 345 kV	MEC OPPD	NU was assigned to SPP DISIS-18-1 / 19-1 MEC: No mitigation required. Existing MEC Only rating is 1195/1333 MVA. $0	$0

Generator	Constraint	Owner	Mitigation	Cost ($)
			OPPD: Structure replacements on the line. $3,720,909	

Table 3-5: MISO West AFSIS Combined Voltage Constraints and Network Upgrades

Constraint	Network Upgrades	Owner	Cost ($)[1]
Low voltages in Alexandria area	LRTP-02: Big Stone South – Alexandria – Big Oaks (Cassie's Crossing)	MRES OTP XEL	$573,500,000
Low voltages in Wilmarth area	LRTP-04: Wilmarth – North Rochester – Tremval	DPC GRE XEL	$689,140,000

Note 1: LRTP projects' costs are not assigned to DISIS-2021-001 projects

3.2 MISO West AFSIS Transient Stability Analysis

Stability analysis was performed to evaluate transient stability and impact on the MISO West region of the SPP Study Projects in MISO West.

3.2.1 Procedure

3.2.1.1 Computer Programs

Stability analysis was performed using TSAT revision 22.0.

3.2.1.2 Methodology

Stability package representing 2025 summer peak (SPK) scenario with SPP DISIS 2021-001 Study Projects in MISO West was created from stability package used in MISO West AFSIS on SPP DISIS 2020-001 Phase 2 Cycle. Power flow models are the same as steady state power flow models, which were developed in Section 1.2.1.

Stability package representing 2025 summer shoulder (SH) scenario with SPP DISIS 2021-001 Study Projects in MISO West was created from stability package used in MISO West AFSIS on SPP DISIS 2020-001 Phase 2 Cycle. Power flow models are the same as steady state power flow models, which were developed in Section 1.2.1.

Disturbances were simulated to evaluate the transient stability and impact on the region of the SPP Study Projects in MISO West. MISO transient stability criteria and local TOs' planning criteria specified in MTEP20 were adopted for checking stability violations.

3.2.2 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 1.2.1.

Transient stability study was performed for the following Study Projects listed in Table 3-6. Based on the generator / inverter / turbine types, corresponding dynamic models were used for representing the dynamic behaviors of these Study Projects. The dynamic models are listed in Table 3-6.

Table 3-6: Dynamic Models for SPP Study Projects in MISO West

SPP Project #	Fuel Type	Generator / Inverter / Turbine Type
GEN-2021-005	Battery	REGCA1
GEN-2021-006	Battery	REGCA1
GEN-2021-007	Wind	REGCAU
GEN-2021-008	Solar	REGCA1
GEN-2021-017	Wind	REGCA1
GEN-2021-023	Solar	REGCAU
GEN-2021-024	Wind	GEWTGCU1
GEN-2021-027	Solar	REGCAU
GEN-2021-029	Battery	REGCAU
GEN-2021-030	Solar	REGCAU
GEN-2021-034	Solar	REGCAU
GEN-2021-037	Wind	GEWTGCU1
GEN-2021-039	Battery	REGCA1
GEN-2021-040	Battery	REGCA1
GEN-2021-042	Battery	REGCA1
GEN-2021-043	Battery	REGCA1
GEN-2021-048	Battery	REGCAU
GEN-2021-049	Solar	REGCAU
GEN-2021-050	Solar	REGCAU
GEN-2021-051	Battery	REGCAU
GEN-2021-056	Wind	REGCAU
GEN-2021-057	Wind	REGCA1
GEN-2021-068	Wind	REGCA1
GEN-2021-069	Wind	REGCA1
GEN-2021-070	Wind	REGCA1

SPP Project #	Fuel Type	Generator / Inverter / Turbine Type
GEN-2021-072	Solar	REGCAU
GEN-2021-073	Solar	REGCA1
GEN-2021-076	Solar	REGCAU
GEN-2021-077	Solar / Battery	REGCA1 (solar) REGCA1 (battery)
GEN-2021-096	Solar	REGCAU
GEN-2021-101	Solar	REGCAU
GEN-2021-103	Battery	REGCAU
GEN-2021-106	Solar	REGCAU
GEN-2021-107	Solar	REGCAU
GEN-2021-108	Solar	REGCAU

3.2.3 Disturbance Criteria

The stability simulations performed as part of this study considered all the regional and local contingencies listed in Table 3-7. Regional contingencies with pre-defined switching sequences were selected from the MISO MTEP20 study; switching sequences for local contingencies were developed based on the generic clearing times shown in Table 2-5. 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.

Table 3-7: MISO West AFSIS Regional and Local Disturbance Descriptions

CEII Redacted

3.2.4 Performance Criteria

MISO transient stability criteria and local TOs' planning criteria specified in MTEP20 were adopted. The Study Projects must mitigate the stability constraints to obtain any type of Interconnection Service.

3.2.5 Summer Peak Stability Results

The contingencies listed in Table 3-7 were simulated using the summer peak stability model.

Appendix F.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.

MISO West AFSIS summer peak stability study results summary is in Appendix F.1.1, Table F-1.

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

3.2.5.1 Simulation Crash

Under two contingencies listed in Table 3-8, stability simulation was crashed due to AC iteration issue. After the fault was cleared, there was only one remaining 161 kV outlet for projects GEN-2017-108, GEN-2021-050, and GEN-2021-051 with loading around 670 MW. Short Circuit Ratio (SCR) at the POI was around 1.90. The simulation crash issue was related to insufficient outlet of GEN-2017-108, GEN-2021-050, and GEN-2021-051. No MISO AFSIS NU is required.

Table 3-8: Simulation Crash

CEII Redacted

3.2.5.2 Post-Fault Small Oscillation of Generation Output

Under two contingencies listed in Table 3-9, small oscillations were observed on active and reactive power output of several conventional generators (Coal Creek unit 2, Young 1, Young 2) after faults were cleared. The same power output oscillations were also observed in the benchmark case. The oscillation issues were not caused by the SPP Study Projects in MISO West.

Table 3-9: Post-Fault Small Oscillation of Generation Output

CEII Redacted

3.2.5.3 Transient Low Voltage Recovery

Under two contingencies of "G17-108-TAP_3PH_POI_G17-111-TAP_Fault" and "G17-108-TAP_SLG_POI_G17-111-TAP_Fault" (Table 3-10), voltage at POI of G21-050 and G21-051 was around 0.89 p.u. after the faults were cleared. After the fault was cleared, there was only one remaining 161 kV outlet for projects GEN-2017-108, GEN-2021-050, and GEN-2021-051 with loading around 670 MW. The post-fault low voltage issue is related to insufficient outlet of GEN-2017-108, GEN-2021-050, and GEN-2021-051. No MISO AFSIS NU is required.

Under two contingencies of "MONOLITH 7_3PH_POI_FIRTH 7_Fault" and "MONOLITH 7_SLG_POI_FIRTH 7_Fault" (Table 3-10), voltages at Firth 115 kV (640171) and Sterling 115 kV (640362) were around 0.82 p.u. after the faults were cleared. The two 115 kV buses were back fed by 69 kV system via a 3-winding transformer. Same low voltage recovery issues were also observed in the benchmark case. The low voltage recovery issues were not caused by the SPP Study Projects in MISO West.

Table 3-10: Transient Low Voltage Recovery

CEII Redacted

3.2.6 Stability Network Upgrades Identified in Summer Peak

In summary, no MISO Affected System stability constraints were identified in the summer peak scenario. The simulation crash and transient low voltage recovery at POI of G2021-050 and G2021-051 projects was caused by insufficient outlet of GEN-2017-108, GEN-2021-050, and GEN-2021-051. The GEN-2021-050 and GEN-2021-051 generation projects are responsible for fixing this issue. No MISO AFSIS stability NUs are required in summer peak stability study.

3.2.7 Summer Shoulder Stability Analysis

The contingencies listed in Table 3-7 were simulated using the summer shoulder stability model. The summer shoulder stability model was developed from the summer shoulder steady state model. As mentioned in Section 1.2.1.3, five (5) fictitious shunt capacitors were modeled in summer shoulder cases (Table 1-2) due to low voltages in SPP system.

3.2.8 Summer Shoulder Stability Results

Appendix F.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.

MISO West AFSIS summer shoulder stability study results summary is in Appendix F.2.1, Table F-2.

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

3.2.8.1 Post-Fault Small Oscillation of Generation Output

Under two contingencies listed in Table 3-11, small oscillations were observed on active and reactive power output of Coal Creek unit 2 after faults were cleared. The same power output oscillations were also observed in the benchmark case. The oscillation issues were not caused by the SPP Study Projects in MISO West.

Table 3-11: Post-Fault Small Oscillation of Generation Output

CEII Redacted

3.2.8.2 Transient Low Voltage Recovery

Under two contingencies of “MONOLITH 7_3PH_POI_FIRTH 7_Fault” and “MONOLITH 7_SLG_POI_FIRTH 7_Fault” (Table 3-12), voltages at Firth 115 kV (640171) and Sterling 115 kV (640362) were around 0.82 p.u. after the faults were cleared. The two 115 kV buses were back fed by 69 kV system via a 3-winding transformer. Same low voltage recovery issues were also observed in the benchmark case. The low voltage recovery issues were not caused by the SPP Study Projects in MISO West.

Table 3-12: Transient Low Voltage Recovery

CEII Redacted

3.2.8.3 Transient High Voltage Violations in OTP, GRE, MRES

Under twelve contingencies listed in Table 3-13, transient high voltage violations were observed in OTP, GRE, and MRES buses. These transient high voltage violations should be mitigated once the added STATCOMs at Winger (50 MVar STATCOM, MPC Group 2021 NU), Wahpeton (150 MVar STATCOM, MPC04300 NU), and Audubon (150 MVar STATCOM, MPC04300 NU) are designed in detail. Network Upgrade is not required for the SPP Study Projects in MISO West.

Table 3-13: Transient High Voltage Violations in OTP, GRE, MRES

CEII Redacted

3.2.9 Stability Constraints 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.

3.2.10 Summary of MISO West AFSIS Transient Stability Analysis

Based on the MISO West 2025 summer peak and summer shoulder transient stability analysis, no MISO West AFSIS stability Network Upgrades are required for the SPP West projects in DISIS 2021-001 cycle.

Section

4

Contingent Facilities

4.1 Contingent Facilities in MISO South

No contingent MTEP facilities were identified for the SPP Study Projects in MISO South.

4.2 Contingent Facilities in MISO West

Table 4-1 describes transmission assumptions modeled in the studies that were deemed necessary to mitigate the thermal and voltage violations identified in the study.

For the study projects that are required to mitigate thermal violations, the projects should not be allowed to come into service before the required Network Upgrades are in service, unless a MISO restudy removes the mitigation requirement from the project, or an interim limit was provided to the project through MISO Annual ERIS process.

Table 4-1: Contingent Facility and Conditional Projects in MISO West

MTEP ID	MTEP Cycle	Facility Name	Description	Expected ISD	Conditional Projects
TBD	TBD	MPC04300 Upgrade: Sheyenne-Lake Park 230 kV Rating Increase	OTP: Prior queued upgrade will increase rating to 353.7 MVA (MPC-04300).	TBD	GEN-2021-024
TBD	TBD	MPC04300 Upgrade: Wahpeton-Fergus Falls 230 kV Rating Increase	OTP: Prior queued upgrade will increase rating to 425.4 MVA (MPC-04300).	TBD	GEN-2021-024
TBD	TBD	MPC04300 Upgrade: Audubon-Lake Park 230 kV Rating Increase	OTP: Prior queued upgrade will increase rating to 479.2 / 527.1 MVA (MPC-04300).	TBD	GEN-2021-024
TBD	TBD	DISIS-18-1 / 19-1 Upgrade: Raun - G18-043 Tap 345 kV Structure Replacement	OPPD: Structure replacements on the line	TBD	GEN-2021-007
16490	MTEP21	24316-Granville	Granville SS Asset Renewal	6/30/2026	GEN-2021-024
23369	MTEP21	LRTP-02: Big Stone South – Alexandria – Big Oaks (Cassie's Crossing) 27044-Big Stone South 345 kV- 27045-Big Stone South 345 kV-Alexandria 345kV	Install single circuit 345kV transmission line from existing Big Stone South Substation, to the existing Alexandria Substation (constructed with double circuit	6/1/2030	GEN-2021-005, GEN-2021-006, GEN-2021-007, GEN-2021-017, GEN-2021-024, GEN-2021-029, GEN-2021-037, GEN-2021-039, GEN-2021-040, GEN-2021-042,

Contingent Facilities

MTEP ID	MTEP Cycle	Facility Name	Description	Expected ISD	Conditional Projects
		27046-Alexandria 345kV- 27047-Alexandria 345kV-Outside Monticello Substation 27048-Outside Monticello Substation-Big Oaks (Cassie's Crossing) 27049-Big Oaks (Cassie's Crossing)- 27050-Big Oaks (Cassie's Crossing)-	capable 345kV structures), to the new Big Oaks Substation (Cassie's Crossing).		GEN-2021-043, GEN-2021-048, GEN-2021-051, GEN-2021-056, GEN-2021-057, GEN-2021-068, GEN-2021-069, GEN-2021-077, GEN-2021-103
23371	MTEP21	LRTP #4: Wilmarth – North Rochester – Tremval 27062-Crandall-Last double circuit structure from Wilmarth 27066-Wilmarth- 27067-Wilmarth-North Rochester 27068-North Rochester- 27086-North Rochester-161kV structure along line to Chester 27087-161kV structure along line to Chester -161kV structure along line Wabaco 27096-161kV structure along line Wabaco-345kV deadend structure 27097-345kV deadend structure -161kV structure outside Alma Substation 27098-161kV structure outside Alma Substation-Tremval 27099-Tremval- 27100-Tremval- 28033-345kV deadend structure-161kV structure outside Alma Substation 28035-161kV structure outside Alma Substation-Tremval 28036-161kV structure outside Alma Substation-Tremval	Install single circuit 345kV transmission line from the existing Wilmarth Substation, to the existing North Rochester Substation, to the existing Tremval Substation.	6/1/2028	GEN-2021-005, GEN-2021-006, GEN-2021-007, GEN-2021-017, GEN-2021-024, GEN-2021-029, GEN-2021-037, GEN-2021-039, GEN-2021-040, GEN-2021-042, GEN-2021-043, GEN-2021-048, GEN-2021-051, GEN-2021-056, GEN-2021-057, GEN-2021-068, GEN-2021-069, GEN-2021-070, GEN-2021-077, GEN-2021-103

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 MISO South AFSIS Network Upgrades Required for the SPP Study Projects in MISO South

5.3.1 MISO South AFSIS Network Upgrades

Based on the MISO South 2025 summer peak and summer shoulder steady state analysis, thermal constraints were identified in MISO system for the SPP Study Projects in MISO South; No voltage constraints were identified in MISO South. MISO South AFSIS thermal NUs are required for the SPP Study Projects in MISO South.

Based on the MISO South 2025 summer peak and summer shoulder transient stability analysis, no transient stability constraints were identified for the SPP Study Projects in MISO South; No MISO South AFSIS stability NUs are required for the SPP Study Projects in MISO South.

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 South. Based on the screening results, MISO Transmission Owners do not plan to conduct additional studies.

No contingent MTEP facilities were identified for the SPP Study Projects in MISO South.

The total costs of MISO South AFSIS Network Upgrades for SPP Study Projects in MISO South are summarized in Table 5-1.

It should be noted that a restudy may be required if 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 the study projects that are required to mitigate thermal violations, the projects should not be allowed to come into service before the required Network Upgrades are in service, unless a MISO restudy removes the mitigation requirement from the project, or an interim limit is provided to the project through MISO Annual ERIS process. For projects that are required to mitigate voltage violations, no injection is allowed until the allocated upgrades and contingent facilities are in service.

Table 5-1: Summary of MISO South AFSIS Network Upgrades

Category of Network Upgrades	Cost ($)
Thermal Network Upgrades Identified in MISO Steady-State Analysis	$39,280,158
Voltage Network Upgrades Identified in MISO Steady-State Analysis	$0
Network Upgrades Identified in Stability Analysis	$0
Network Upgrades Identified in Short Circuit Analysis	$0
Total	**$39,280,158**

MISO South AFSIS Network Upgrades for SPP Study Projects in MISO South are listed below.

Table 5-2: MISO South Thermal NUs and Cost

Constraint	Owner	Mitigation	Cost ($)
Couch-Lewisville 115 kV	EES-EAI	~9.07 miles of Single ACSR 666.6 FLAMINGO at 115 kV and 175.92 MVA	$10,983,745
Lewisville-Patmos 115 kV	EES-EAI	~10.38 miles of Single ACSR 954 CARDINAL at 115 kV and 220.64 MVA+Bus at Lweisville	$12,802,852
Patmos-Fulton 115 kV	EES-EAI AEPW	Entergy: reconductor for the 4.22 miles of the line that belongs to Entergy. $5,093,561 AEPW: Rebuild the 7.1 mile AEP owned section of the 115 kV line from Patmos to Fulton. $10.4M	$15,493,561

Table 5-3: MISO South Steady-State Voltage NUs and Cost

Network Upgrades	Owner	Study Cycle	Cost ($)
No voltage NUs			$0

Table 5-4: MISO South Transient Stability NUs and Cost

Network Upgrades	Owner	Cost ($)
No MISO AFS stability NUs		$0

Table 5-5: MISO South Short Circuit Network Upgrades

NUs	Cost ($)
No short circuit NUs	$0

Table 5-6: MISO South Contingent Facility and Conditional Projects

MTEP ID	MTEP Cycle	Project Name	Expected ISD	Conditional Projects
		No contingent facilities		

5.3.2 MISO South AFSIS NU Cost Allocation

The calculated Distribution Factor (DF) results and MW contribution on each MISO South Affected System constraint are in Appendix G.1.1. The cost allocation for each NU is calculated based on the contribution of each generating facility, as detailed in Appendix G.1.2.

Assuming all generation projects in the SPP Study Projects in MISO South advance, a summary of the costs for total MISO South AFSIS NUs allocated to each generation project is listed in Table 5-7.

Table 5-7: Summary of MISO South AFSIS NU Costs Allocated to the SPP South Study Projects

Project Num	Network Upgrades ($)			Total Network Upgrade Cost ($)
	MISO Thermal & Voltage	Transient Stability	Short Circuit	
GEN-2021-001	$0	$0	$0	$0
GEN-2021-016	$0	$0	$0	$0
GEN-2021-018	$0	$0	$0	$0
GEN-2021-033	$0	$0	$0	$0
GEN-2021-036	$14,541,615	$0	$0	$14,541,615
GEN-2021-038	$0	$0	$0	$0
GEN-2021-041	$0	$0	$0	$0
GEN-2021-047	$0	$0	$0	$0
GEN-2021-052	$0	$0	$0	$0
GEN-2021-053	$0	$0	$0	$0
GEN-2021-063	$0	$0	$0	$0
GEN-2021-064	$0	$0	$0	$0
GEN-2021-075	$0	$0	$0	$0
GEN-2021-086	$24,738,543	$0	$0	$24,738,543
GEN-2021-088	$0	$0	$0	$0

Project Num	Network Upgrades ($)			Total Network Upgrade Cost ($)
	MISO Thermal & Voltage	Transient Stability	Short Circuit	
GEN-2021-090	$0	$0	$0	$0
Total ($)	**$39,280,158**	**$0**	**$0**	**$39,280,158**

5.4 MISO West AFSIS Network Upgrades Required for the SPP Study Projects in MISO West

5.4.1 MISO West AFSIS Network Upgrades

Based on the MISO West 2025 summer peak and summer shoulder steady state analysis, thermal and voltage constraints were identified in MISO system for the SPP Study Projects in MISO West; MISO West AFSIS thermal and voltage NUs are required for the SPP Study Projects in MISO West.

Based on the MISO West 2025 summer peak and summer shoulder transient stability analysis, no MISO West AFSIS stability Network Upgrades are required for the SPP Study Projects in MISO West.

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.

Contingent MTEP facilities and Network Upgrades were identified for the SPP Study Projects in MISO West, as listed in Table 4-1.

The total costs of MISO West AFSIS Network Upgrades for SPP Study Projects in MISO West are summarized in Table 5-8.

Table 5-8: Summary of MISO West AFSIS Network Upgrades

Category of Network Upgrades	Cost ($)
Thermal Network Upgrades Identified in MISO Steady-State Analysis	$48,555,900
Voltage Network Upgrades Identified in MISO Steady-State Analysis	$0
Network Upgrades Identified in Stability Analysis	$0
Network Upgrades Identified in Short Circuit Analysis	$0
Total	**$48,555,900**

MISO West AFSIS Network Upgrades for SPP Study Projects in MISO West are listed below.

It should be noted that a restudy may be required if 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 the study projects that are required to mitigate thermal violations, the projects should not be allowed to come into service before the required Network Upgrades are in service, unless a MISO restudy removes the mitigation requirement from the project, or an interim limit is provided to the project through MISO Annual ERIS process. For projects that are required to mitigate voltage violations, no injection is allowed until the allocated upgrades and contingent facilities are in service.

Table 5-9: MISO West Thermal NUs and Cost

Constraint	Owner	Mitigation	Cost ($)
New Sub - Buffalo 345 kV	OTP MPC	OTP: OTP equipment is sufficient, MPC conductor is limiter. $0 MPC: NU will be determined in MPC study	$0
Sheyenne-Lake Park 230 kV	XEL MPC OTP	OTP: Additional structure replacements beyond DISIS-2020-001 and MPC-04300. $100,000 XEL: the OTP section is limiting this line. $0	$100,000
Sheyenne-Fargo 230 kV	XEL WAPA	XEL: Rebuild line and substations to 3000A. $43M WAPA: Rebuild terminal to 3000A. $3.7M	$46,700,000
Hubbard-Badoura 230 kV	GRE MP	GRE: limiter is an MP conductor. $0 MP: Increase operating temp from 50C to 55C. $1,348,200	$1,348,200
Hubbard-Erie Jct 230 kV	GRE OTP	GRE: limiter is an MP conductor. $0 MP: Increase operating temp from 70C to 75C. $407,700	$407,700
Erie Jct-Audubon 230 kV	OTP	With Erie substation addition, expected rating of Audubon-Erie 230 kV is 360.9 MVA	$0
Wahpeton-Fergus Falls 230 kV	OTP MRES	OTP: Prior queued upgrade will increase rating to 425.4 MVA (MPC-04300). $0 MRES: No mitigation for MRES. $0	$0
Audubon-Lake Park 230 kV	OTP	Prior queued upgrade will increase rating to 527.1 MVA (MPC-04300).	$0
Raun - G18-043 Tap 345 kV	MEC OPPD	NU was assigned to SPP DISIS-18-1 / 19-1 MEC: No mitigation required. Existing MEC Only rating is 1195/1333 MVA. $0 OPPD: Structure replacements on the line. $3,720,909	$0

Table 5-10: MISO West Steady-State Voltage NUs and Cost

Network Upgrades	Owner	Cost ($)[1]
LRTP-02: Big Stone South – Alexandria – Big Oaks (Cassie's Crossing)	MRES OTP XEL	$573,500,000
LRTP-04: Wilmarth – North Rochester – Tremval	DPC GRE XEL	$689,140,000

Note 1: LRTP projects' costs are not assigned to DISIS-2021-001 projects

Table 5-11: MISO West Transient Stability NUs and Cost

Network Upgrades	Owner	Cost ($)
No MISO AFS stability NUs		$0

Table 5-12: MISO West Short Circuit Network Upgrades

NUs	Cost ($)
No short circuit NUs	$0

5.4.2 MISO West AFSIS NU Cost Allocation

The calculated Distribution Factor (DF) results, voltage impact, and MW contribution on each MISO West Affected System constraint are in Appendix G.2.1. The cost allocation for each NU is calculated based on the contribution of each generating facility, as detailed in Appendix G.2.2.

Assuming all generation projects in the SPP Study Projects in MISO West advance, a summary of the costs for total MISO West AFSIS NUs allocated to each generation project is listed in Table 5-13.

Table 5-13: Summary of MISO West AFSIS NU Costs Allocated to the SPP West Study Projects

Project Num	Network Upgrades ($)			Total Network Upgrade Cost ($)
	MISO Thermal & Voltage	Transient Stability	Short Circuit	
GEN-2021-005	$0	$0	$0	$0
GEN-2021-006	$0	$0	$0	$0
GEN-2021-007	$0	$0	$0	$0
GEN-2021-008	$0	$0	$0	$0
GEN-2021-017	$0	$0	$0	$0
GEN-2021-023	$0	$0	$0	$0

Project Num	Network Upgrades ($)			Total Network Upgrade Cost ($)
	MISO Thermal & Voltage	Transient Stability	Short Circuit	
GEN-2021-024	$48,555,900	$0	$0	$48,555,900
GEN-2021-027	$0	$0	$0	$0
GEN-2021-029	$0	$0	$0	$0
GEN-2021-030	$0	$0	$0	$0
GEN-2021-034	$0	$0	$0	$0
GEN-2021-037	$0	$0	$0	$0
GEN-2021-039	$0	$0	$0	$0
GEN-2021-040	$0	$0	$0	$0
GEN-2021-042	$0	$0	$0	$0
GEN-2021-043	$0	$0	$0	$0
GEN-2021-048	$0	$0	$0	$0
GEN-2021-049	$0	$0	$0	$0
GEN-2021-050	$0	$0	$0	$0
GEN-2021-051	$0	$0	$0	$0
GEN-2021-056	$0	$0	$0	$0
GEN-2021-057	$0	$0	$0	$0
GEN-2021-068	$0	$0	$0	$0
GEN-2021-069	$0	$0	$0	$0
GEN-2021-070	$0	$0	$0	$0
GEN-2021-072	$0	$0	$0	$0
GEN-2021-073	$0	$0	$0	$0
GEN-2021-076	$0	$0	$0	$0
GEN-2021-077	$0	$0	$0	$0
GEN-2021-096	$0	$0	$0	$0
GEN-2021-101	$0	$0	$0	$0
GEN-2021-103	$0	$0	$0	$0
GEN-2021-106	$0	$0	$0	$0
GEN-2021-107	$0	$0	$0	$0
GEN-2021-108	$0	$0	$0	$0
Total ($)	**$48,555,900**	**$0**	**$0**	**$48,555,900**

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Appendix

A

MISO South AFSIS Model Development for Steady-State Analysis

A.1 Recently Withdrawn Prior Queued Projects

Table A-1: Recently Withdrawn MISO South Prior Queued Project

Prj #	Bus Number	Bus Name	Id	Status
J1509	45090	J1509 GEN 0.6300	1	Withdrawn

Table A-2: Recently Withdrawn MISO Central Prior Queued Project

Prj #	Bus Number	Bus Name	Id	Status
J1074	40740	J1074 GEN 0.6000	1	Withdrawn
J1225	42250	J1225 GEN 0.6300	1	Withdrawn
J1332	43320	J1332 GEN 0.6000	1	Withdrawn
J1353	43530	J1353 GEN 0.3850	1	Withdrawn
J1447	44470	J1447 GEN 0.6300	1	Withdrawn
J1501	45010	J1501 GEN 0.6300	1	Withdrawn
J1517	45170	J1517 GEN 0.5200	1	Withdrawn
J1535	45350	J1535 GEN 0.6300	1	Withdrawn
J1565	45650	J1565 GEN 0.6300	1	Withdrawn
J1585	45850	J1585 GEN 0.6300	1	Withdrawn
J1600	46000	J1600 GEN 0.6300	1	Withdrawn
J1601	46010	J1601 GEN 0.6300	1	Withdrawn
J1632	46320	J1632 GEN 0.6900	1	Withdrawn
J1632	46321	J1632 GEN1 0.6900	1	Withdrawn
J1652	46520	J1652 GEN 0.6450	1	Withdrawn
J1656	46560	J1656 GEN 0.7200	1	Withdrawn
J1656	46561	J1656 GEN1 0.7200	1	Withdrawn

Prj #	Bus Number	Bus Name	Id	Status
J1656	46562	J1656 GEN2 0.6600	1	Withdrawn
J1656	46563	J1656 GEN3 0.6600	1	Withdrawn
J1675	46750	J1675 GEN 0.6900	1	Withdrawn
J1675	46751	J1675 GEN1 0.6900	1	Withdrawn
J1681	46810	J1681 GEN 0.6300	1	Withdrawn
J1681	46811	J1681 GEN1 0.6300	1	Withdrawn
J1690	46900	J1690 GEN 0.6450	1	Withdrawn
J1699	46990	J1699 GEN 0.6300	1	Withdrawn
J1703	47030	J1703 GEN 0.6900	1	Withdrawn
J1703	47031	J1703 GEN1 0.6900	1	Withdrawn
J1704	47040	J1704 GEN 0.6300	1	Withdrawn
J1707	47070	J1707 GEN 0.6300	1	Withdrawn
J1731	47310	J1731 GEN 0.3850	1	Withdrawn
J1737	47370	J1737 GEN 0.6300	1	Withdrawn
J1683	47420	J1683 GEN 0.6300	1	Withdrawn
J1756	47560	J1756 GEN 0.6000	1	Withdrawn
J1756	47561	J1756 GEN1 0.6000	1	Withdrawn
J1765	47650	J1765 GEN 0.6300	1	Withdrawn
J1771	47710	J1771 GEN 0.6300	1	Withdrawn
J1784	47840	J1784 GEN 0.6300	1	Withdrawn
J1806	48060	J1806 GEN 0.6300	1	Withdrawn
J1810	48100	J1810 GEN 0.6300	1	Withdrawn
J1828	48280	J1828 VEST 0.7200	W	Withdrawn
J1828	48284	J1828 GE 0.7200	ES	Withdrawn
J1828	48285	J1828 PE 0.7200	PV	Withdrawn
J1829	48290	J1829 GEN 0.6300	1	Withdrawn
J1837	48370	J1837 GEN 0.7200	1	Withdrawn

Table A-3: Recently Withdrawn SPP Prior Queued Project

Prj #	Status	Bus Number	Bus Name	Id
GEN-2016-063	TERMINATED	587433	G16-063-GEN10.6900	1
GEN-2017-132	TERMINATED	760035	G17-132-GEN10.6900	1
GEN-2017-132	TERMINATED	760038	G17-132-GEN20.6900	1
GEN-2017-152	TERMINATED	761128	G17-152GEN1 0.6900	1
GEN-2017-155	WITHDRAWN	761337	G17-155GEN1 0.6900	1
GEN-2017-166	WITHDRAWN	761862	G17-166GEN1 0.6900	1
GEN-2017-213	WITHDRAWN	760371	G17-213-GEN10.6300	1
GEN-2017-213	WITHDRAWN	760371	G17-213-GEN10.6300	2
GEN-2017-213	WITHDRAWN	760374	G17-213-GEN20.6300	1
GEN-2017-213	WITHDRAWN	760374	G17-213-GEN20.6300	2
GEN-2017-240	WITHDRAWN	760161	G17-240-GEN10.5500	1
GEN-2018-051	WITHDRAWN	762859	G18-051-GEN10.6450	1

Table A-4: Removed Withdrawn Generation Projects in DISIS 18-002 / 19-001

Prj #	Status	Bus Number	Bus Name	Id
GEN-2018-073	WITHDRAWN	763090	G18-073-GEN10.6600	1
GEN-2018-087	WITHDRAWN	763167	G18-087-GEN10.6450	1
GEN-2018-092	WITHDRAWN	763222	G18-092-GEN10.6600	1
GEN-2018-092	WITHDRAWN	763225	G18-092-GEN20.6600	1
GEN-2018-117	WITHDRAWN	763343	G18-117-GEN10.6300	1
GEN-2018-117	WITHDRAWN	763346	G18-117-GEN20.6000	1
GEN-2019-052	WITHDRAWN	763838	G19-052-GEN10.6300	1
GEN-2019-052	WITHDRAWN	763841	G19-052-GEN20.6000	1
GEN-2019-066	WITHDRAWN	763948	G19-066GEN1 0.7200	1
GEN-2019-067	WITHDRAWN	763959	G19-067-GEN10.7200	1

Table A-5: Removed Withdrawn Generation Projects in DISIS 2020-001

Prj #	Pmax	Fuel Type	Town / County	State	Point of Interconnection
GEN-2020-015	104	Solar	Johnston	OK	Johnston County 345 kV
GEN-2020-016	202	Wind	Tillman	OK	Snyder SW-Cache 138 kV
GEN-2020-023	202	Storage	Carrier	OK	Woodring 345 kV
GEN-2020-052	251	Wind	Labette	KS	Neosho-Delaware 345 kV

A.2 SPP Prior Queued Generation Projects

Table A-6: SPP Prior Queued Generation Projects

Projects	Cluster	MW	Generation Type	Town or County	State	Substation or Line	TO at POI
GEN-2016-037	DISIS-2017-001	300	Wind	Washita	OK	Chisholm-Gracemont 345kV	AEP
GEN-2017-023	DISIS-2017-001	85	Solar	Choctaw	OK	Hugo Power Plant 138 kV	WFEC
GEN-2017-027	DISIS-2017-001	140	Wind	Carter	OK	Pooleville-Ratliff (Carter County) 138kV	OGE
GEN-2017-040	DISIS-2017-001	200.1	Solar	Ochiltree	TX	Canadian River-Muskogee and Muskogee-Seminole 345kV	OGE
GEN-2017-057	DISIS-2017-001	72.5	Solar	Caddo Parish	LA	Hosston 69kV	AEP
GEN-2017-061	DISIS-2017-001	101.5	Solar	Mayes	OK	GRDA1 to CLARMR 5 161kV	GRDA
GEN-2017-071	DISIS-2017-001	124.7	Solar	Payne	OK	Greenwood 138kV	OGE
GEN-2017-075	DISIS-2017-001	200	Solar	Johnston	OK	Hugo-Sunnyside 345 kV	OGE
GEN-2017-077	DISIS-2017-001	124.7	Solar	Mayes	OK	Explorer Claremore Tap EXCLART4	AEP
GEN-2017-092	DISIS-2017-001	200	Solar	Muskogee	OK	Canadian River-Muskogee and Muskogee-Seminole 345kV	OGE
GEN-2017-133	DISIS-2017-002	200	Wind	Oklahoma	OK	Arcadia 345kV	OGE
GEN-2017-134	DISIS-2017-002	250	Wind	Oklahoma	OK	Arcadia 345kV	OGE
GEN-2017-137	DISIS-2017-002	295	Wind	Oklahoma	OK	Arcadia 345kV	OGE
GEN-2017-140	DISIS-2017-002	160	Solar	Wagoner	OK	Clarksville 345kV	AEP
GEN-2017-141	DISIS-2017-002	241.7	Solar	Wagoner	OK	Clarksville 345kV	AEP
GEN-2017-149	DISIS-2017-002	258	Wind	Johnston	OK	Johnson County 345kV	OGE
GEN-2017-150	DISIS-2017-002	250	Solar	Grady	OK	Minco 345kV	OGE
GEN-2017-151	DISIS-2017-002	300	Wind	Crosby	TX	TUCO-Oklaunion 345kV	SPS
GEN-2017-154	DISIS-2017-002	255	Wind	Johnston	OK	Johnson County 345kV	OGE
GEN-2017-164	DISIS-2017-002	250	Solar	Garfield	OK	Woodring 345kV	OGE
GEN-2017-171	DISIS-2017-002	150	Solar	Stephen	OK	Lawton Eastside - Terry Road 345kV	AEP
GEN-2017-231	DISIS-2017-002	72.5	Solar	Franklin	AR	Branch 161kV	OGE
GEN-2017-233	DISIS-2017-002	215	Wind	Grady	OK	Minco 345kV	OGE
GEN-2018-003	DISIS-2018-001	150	Solar	Bowie	TX	North Boston-Bann 138kV	AEP
GEN-2018-011	DISIS-2018-001	74.1	Battery	Kingfisher	OK	Dover 138 kV	WFEC
GEN-2018-015	DISIS-2018-001	252	Solar	Paducah	TX	Tuco-Oklaunion 345kV	SPS
GEN-2018-021	DISIS-2018-001	74.1	Solar	Washita	OK	Chisholm-Gracemont 345kV	AEP

Projects	Cluster	MW	Generation Type	Town or County	State	Substation or Line	TO at POI
GEN-2018-024	DISIS-2018-001	100	Battery	Muskogee	OK	Canadian River-Muskogee and Muskogee-Seminole 345kV	OGE
GEN-2018-026	DISIS-2018-001	100	Battery	Canadian	OK	Mustang 138kV	OGE
GEN-2018-027	DISIS-2018-001	100	Battery	Tulsa	OK	Tulsa Power Station 138kV	AEP
GEN-2018-028	DISIS-2018-001	200	Battery	Tulsa	OK	Tulsa North 138kV	AEP
GEN-2018-029	DISIS-2018-001	100	Battery	Oklahoma	OK	Horseshoe Lake 138kV	OGE
GEN-2018-048	DISIS-2018-001	300	Solar	Caddo	OK	Pecan Creek 345kV	OGE
GEN-2018-050	DISIS-2018-001	200	Solar	Caddo	LA	Longwood 345kV	AEP
GEN-2018-055	DISIS-2018-001	252	Solar	Grady	OK	Terry Road 345kV	AEP

Table A-7: SPP DISIS 18-002 / 19-001 Generation Projects in MISO South

Project #	Town / County	State	Point of Interconnection	Generation Type	Pmax	SH (MW)	SPK (MW)
GEN-2018-064	Benton	AR	Tonnece 69 kV	Solar	80	0	80
GEN-2018-071	Kay	OK	Ranch Road 345 kV	Battery	151	151	151
GEN-2018-072	Kay	OK	Ranch Road 345 kV	Battery	151	151	151
GEN-2018-079	Craig / Novata	OK	Farmland-Delaware 138 kV	Solar	148	0	148
GEN-2018-082	Pittsburg	OK	Pittsburg 345 kV	Wind	215	215	33.54
GEN-2018-088	Bowie	TX	Lydia 345 kV	Solar	130	0	130
GEN-2018-106	Caddo	LA	Longwood 345 kV	Solar	165	0	165
GEN-2018-115	Lawton	OK	Lawton East 345/138 kV	Solar / Storage	250	50	250
GEN-2019-002	Mayes	OK	Maid 161 kV	Battery	100	100	100
GEN-2019-013	Roger Mills	OK	Dempsey / Sweetwater 230 kV	Battery	50	50	50
GEN-2019-035	Barry	MO	Reeds Spring-Aurora 161 kV	Solar	80	0	80
GEN-2019-065	Smith	TX	Overton-Northwest Henderson 138 kV	Battery	180	180	180

Table A-8: SPP DISIS 2020-001 Generation Projects in MISO South

Project #	Town / County	State	Point of Interconnection	Generation Type	Pmax	SH (MW)	SPK (MW)
GEN-2020-009	Cotton	OK	Lawton East Side-Oklaunion 345 kV	Solar / Storage	300	300	300
GEN-2020-010	Mutual	OK	Seiling-Taloga 138 kV	Solar / Storage	140	140	140
GEN-2020-012	Headrick	OK	Snyder–Altus Jct. 138 kV	Solar / Storage	113	113	113
GEN-2020-020	McCurtain	OK	Northwest Texarkana-Valliant 345 kV	Solar / Storage	201.6	100	201.6
GEN-2020-054	Bowie	TX	Lydia 345 kV	Solar	298	0	298
GEN-2020-059	Lovington	NM	Tuco-Yoakum-Hobbs 345 kV	Solar / Storage	250	259	259
GEN-2020-060	Lubbock	TX	Lubbock East 230 kV	Storage	200	200	200
GEN-2020-062	Curry	NM	Oasis 230 kV	Solar	256	0	256
GEN-2020-065	Gaines	NM	Hobbs-Andrews 345 kV	CC	1003	501.5	1003
GEN-2020-067	Terry, Hockley	TX	Tuco-Yoakum 345 kV	Wind	352.5	352.5	54.99
GEN-2020-068	Terry, Hockley	TX	Tuco-Yoakum 345 kV	Solar	400	0	400
GEN-2020-074	Carter	OK	Lawton-Sunnyside 345 kV	Storage	200	200	200
GEN-2020-075	Comanche	OK	Cimmarron-Lawton 345 kV	Storage	200	200	200
GEN-2020-081	Rusk	TX	Tenaska SS 345 kV	Storage	200	200	200
GEN-2020-085	Carter	OK	Lawton-Sunnyside 345 kV	Solar	500	0	500
GEN-2020-087	Comanche	OK	Cimmarron-Lawton 345 kV	Solar	500	0	500
GEN-2020-092	Mayes	OK	Pryor Junction-Midwest Carbide 138 kV	Solar	100	0	100

A.3 AECI Prior Queued Generation Projects

Table A-9: AECI Prior Queued Generation Projects

Projects	MW	Generation Type	Town or County	State	Substation or Line
GIA-61	230	Wind	Nodaway	MO	Maryville 161 kV
GIA-83	1018	Wind	Randolph	MO	McCredie 345 kV
GIA-86	100	Solar	Clifton Hill	MO	Thomas Hill 69 kV
GIA-90	100	Solar	Randolph	MO	Montgomery City 161 kV
GIA-91	96	Solar	Carroll	MO	Sedalia 69 kV
GIA-93	100	Solar	Macon		Palmyra 161 kV
GIA-95	247	Wind	Dade	MO	Jasper-Morgan 345 kV
GIA-96	97.5	Wind	Lincoln	OK	Stroud 138kV
GIA-099	470	CT Gas	Butler	MO	Gobbler Knob 345 kV
GIA-100	40	CT Gas	Butler	MO	Gobbler Knob 345 kV
GIA-101	460	CT Gas	Clinton	MO	Rockies Express 161 kV
GIA-102	75	CT Gas	Clinton	MO	Rockies Express 161 kV
GIA-103	460	CT Gas	Creek	OK	Bristow 138 kV
GIA-104	460	CT Gas	Payne	OK	Stillwater 138 kV
GIA-105	460	CT Gas	Osage	OK	Cleveland 138 kV

A.4 Removed Recently Retired MISO Generation

Table A-10: Removed Recently Retired MISO Generation in MISO South Area

Unit(s) Description	State	Power Flow Area	Bus Name	Bus Number	Unit ID	Derate To MW	Requested Change of Status
Teche Unit 3	LA	CLEC	G3TECHE	501823	1	0	Retirement
Baxter Wilson Unit 1	MS	EES	1B.WLSN U1	336801	18	0	Retirement
Waterford Unit 1	LA	EES	1WAT U1	336151	1	0	Retirement
Dolet Hills	LA	CLEC	G1DOLHIL	501801	1	330	Retirement
Sterlington 1-4 & 6-10	LA	LAGN	1KOCH U1	303010	1	0	Retirement
Sterlington 1-4 & 6-10	LA	LAGN	1KOCH U1	303010	2	0	Retirement
Sterlington 1-4 & 6-10	LA	LAGN	1KOCH U2	303011	1	0	Retirement
Sterlington 1-4 & 6-10	LA	LAGN	1KOCH U2	303011	2	0	Retirement
Sterlington 1-4 & 6-10	LA	LAGN	1KOCH U3	303012	1	0	Retirement
Sterlington 1-4 & 6-10	LA	LAGN	1KOCH U3	303012	2	0	Retirement
Sterlington 1-4 & 6-10	LA	LAGN	1KOCH U4	303013	1	0	Retirement
Sterlington 1-4 & 6-10	LA	LAGN	1KOCH U4	303013	2	0	Retirement
Sterlington 1-4 & 6-10	LA	LAGN	1KOCH U1	303010	1A	0	Retirement
Sabine Cogen	TX	EES	1BAYORU1	334740	1	0	Retirement
Sabine Cogen	TX	EES	1BAYORU2	334738	1	0	Retirement
Sabine Cogen	TX	EES	1BAYORU3	334739	1	0	Retirement
Nelson 4	LA	EES	1NELSON_G4!	335204	1	0	Retirement
Sterlington Unit 7C	LA	EES	1STERL_7C	337419	1	0	Retirement
Woodville Renewable Power Project	TX	EES	1WOODVILLE	334313	1	0	Retirement
Rex Brown 4 & 5	MS	EES-EMI	1REX BRWN U4	336944	1	0	Retirement
Rex Brown 4 & 5	MS	EES-EMI	1REX BRN U5	336941	1	0	Retirement
Dow GT300	LA	EES	1DOW_AEP_5!	335545	1	0	Retirement
Henderson Station	MS	EES-EMI	3GREENWOOD!	337054	1	0	Retirement
Henderson Station	MS	EES-EMI	3GREENWOOD!	337054	2	0	Retirement
Henderson Station	MS	EES-EMI	3GREENWOOD!	337054	3	0	Retirement
Henderson Station	MS	EES-EMI	3GREENWOOD!	337054	4	0	Retirement
Baxter Wilson 2	MS	EES-EMI	1B.WLSN U2	336831	1	0	Retirement
Rex Brown Plant Unit 3	MS	EES-EMI	1REX BRWN U3	336943	1	0	Retirement

Unit(s) Description	State	Power Flow Area	Bus Name	Bus Number	Unit ID	Derate To MW	Requested Change of Status
Morrow Units 1 and 2	MS	SMEPA	MOR GEN 1	318600	1	0	Retirement
Morrow Units 1 and 2	MS	SMEPA	MOR GEN 2	318601	1	0	Retirement

Table A-11: Removed Recently Retired MISO Generation in MISO Central Area

Unit(s) Description	State	Power Flow Area	Bus Name	Bus Number	Unit ID	Derate To MW	Requested Change of Status
Grand Tower Units 1-4	IL	AMIL	1GRTW 1	347170	1	0	Retirement
Grand Tower Units 1-4	IL	AMIL	1GRTW 2	347171	2	0	Retirement
Grand Tower Units 1-4	IL	AMIL	1GRTW 3	347168	3	0	Retirement
Grand Tower Units 1-4	IL	AMIL	1GRTW 4	347169	4	0	Retirement
Meramec CTG 2	MO	AMMO	1MER 6	345172	6	0	Retirement
Dallman Units 31 & 32	IL	CWLP	1DALMAN 31	343549	1	0	Retirement
Dallman Units 31 & 32	IL	CWLP	1DALMAN 32	343550	2	0	Retirement
Meramec CTG 1	MO	AMMO	1MER 5	345164	5	0	Retirement
Bailly Unit 10	IN	NIPS	17BAILLY-10	255246	10	0	Retirement
Coffeen Units 1 and 2	IL	AMIL	1COFFEN 1	346896	1	0	Retirement
Coffeen Units 1 and 2	IL	AMIL	1COFFEN 2	346897	2	0	Retirement
Hennepin Units 1 and 2	IL	AMIL	1HENNEPIN G1	349106	1	0	Retirement
Hennepin Units 1 and 2	IL	AMIL	1HENNEPIN G2	349107	H	0	Retirement
Hennepin Units 1 and 2	IL	AMIL	1HENNEPIN G2	349107	L	0	Retirement
Havana Unit 6	IL	AMIL	1HAVANA G6	349121	6	0	Retirement
Duck Creek Unit 1	IL	AMIL	1DCK GEN1	349633	1	0	Retirement
Baldwin 3	IL	AMIL	1BALDWIN G3	349128	3	0	Retirement
Reid Unit1	KY	BREC	1REID1	340574	5	0	Retirement
Plant D7	MO	CWLD	2PLANT2	343051	7	0	Retirement
Northeast - NET Units 1 & 2	IN	SIGE	10NE_GT	253512	1	0	Retirement
Henderson Municipal Power & Light Units 1&2	KY	BREC	HMP&L1	340577	3	0	Retirement
Henderson Municipal Power & Light Units 1&2	KY	BREC	HMP&L2	340578	4	0	Retirement
Bailly 7 & 8	IN	NIPS	17BAILLY-7	255234	7	0	Retirement
Bailly 7 & 8	IN	NIPS	17BAILLY-8	255235	8	0	Retirement

Unit(s) Description	State	Power Flow Area	Bus Name	Bus Number	Unit ID	Derate To MW	Requested Change of Status
Coleman 1,2,3	KY	BREC	COLEMAN1	340579	1	0	Retirement
Coleman 1,2,3	KY	BREC	COLEMAN2	340580	2	0	Retirement
Coleman 1,2,3	KY	BREC	COLEMAN3	340581	3	0	Retirement

A.5 MISO North for Power Balance

Table A-12. 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
315	HMPL
333	CWLD
356	AMMO
357	AMIL
360	CWLP
361	SIPC
362	GLH

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
740	MPC Prior

A.6 MISO South for Power Balance

Table A-13. MISO South for Power Balance

Area #	Area Name	Area #	Area Name
326	EES-EMI	502	CLEC
327	EES-EAI	503	LAFA
332	LAGN	504	LEPA
349	SMEPA	700	South Prior
351	EES		

A.7 SPP Market for Power Balance

Table A-14. 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
541	KCPL

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

A.8 AECI for Power Balance

Table A-15. AECI for Power Balance

Area #	Area Name
330	AECI

A.9 Contingency Files used in MISO South AFSIS Analysis

Table A-16: List of Contingencies used in the MISO South AFSIS Analysis

Contingency File Name	Description
Automatic single element contingencies	Single element outages at buses 60 kV and above in the study region
MISO20_2025_SUM__TA_P1_South.con	Specified category P1 contingencies in MISO South
MISO20_2025_SUM__TA_P1_P2_P4_P5_NoLoadLoss_South.con	Specified category P1, P2, P4, P5 no load loss contingencies in MISO
MISO20_2025_SUM__TA_P2_P4_P5_P6_P7_LoadLoss_South.con	Specified category P2, P4, P5, P6, P7 load loss contingencies in MISO
AECI-AMMO.CON	Specified category P1, P2 contingencies in AECI-AMMO
AECI-EES.con	Specified category P2, P3, P6 contingencies in AECI-EES

Appendix

B

MISO West AFSIS Model Development for Steady-State and Stability Analysis

B.1 Recently Withdrawn Prior Queued Projects

Table B-1: Recently Withdrawn MISO West and Central Prior Queued Project

Prj #	Bus Number	Bus Name	Id	Status
J1042	40420	J1042 GEN 0.6300	PV	Withdrawn
J1043	40430	J1043 GEN 0.6500	1	Withdrawn
J1074	40740	J1074 GEN 0.6000	1	Withdrawn
J1225	42250	J1225 GEN 0.6300	1	Withdrawn
J1332	43320	J1332 GEN 0.6000	1	Withdrawn
J1350	43500	J1350 GEN 0.6000	1	Withdrawn
J1353	43530	J1353 GEN 0.3850	1	Withdrawn
J1447	44470	J1447 GEN 0.6300	1	Withdrawn
J1474	44740	J1474 GEN 0.6300	1	Withdrawn
J1497	44970	J1497 GEN 0.6300	1	Withdrawn
J1510	45100	J1510 GEN 0.6300	1	Withdrawn
J1567	45670	J1567 GEN 0.6300	1	Withdrawn
J1708	47080	J1708 GEN 0.6300	1	Withdrawn
J1735	47350	J1735 GEN 0.6300	1	Withdrawn
J897	88977	J897 G1 0.6900	W	Withdrawn
J897	88978	J897 G2 0.6900	W	Withdrawn
J1501	45010	J1501 GEN 0.6300	1	Withdrawn
J1517	45170	J1517 GEN 0.5200	1	Withdrawn
J1535	45350	J1535 GEN 0.6300	1	Withdrawn
J1565	45650	J1565 GEN 0.6300	1	Withdrawn
J1585	45850	J1585 GEN 0.6300	1	Withdrawn
J1600	46000	J1600 GEN 0.6300	PV	Withdrawn

Prj #	Bus Number	Bus Name	Id	Status
J1632	46320	J1632 GEN 0.6900	1	Withdrawn
J1632	46321	J1632 GEN1 0.6900	1	Withdrawn
J1652	46520	J1652 GEN 0.6450	1	Withdrawn
J1656	46560	J1656 GEN 0.7200	1	Withdrawn
J1656	46561	J1656 GEN1 0.7200	1	Withdrawn
J1656	46562	J1656 GEN2 0.6600	1	Withdrawn
J1656	46563	J1656 GEN3 0.6600	1	Withdrawn
J1675	46750	J1675 GEN 0.6900	1	Withdrawn
J1675	46751	J1675 GEN1 0.6900	1	Withdrawn
J1681	46810	J1681 GEN 0.6300	1	Withdrawn
J1681	46811	J1681 GEN1 0.6300	1	Withdrawn
J1690	46900	J1690 GEN 0.6450	1	Withdrawn
J1699	46990	J1699 GEN 0.6300	1	Withdrawn
J1703	47030	J1703 GEN 0.6900	1	Withdrawn
J1704	47040	J1704 GEN 0.6300	1	Withdrawn
J1707	47070	J1707 GEN 0.6300	1	Withdrawn
J1731	47310	J1731 GEN 0.3850	1	Withdrawn
J1737	47370	J1737 GEN 0.6300	1	Withdrawn
J1756	47560	J1756 GEN 0.6000	1	Withdrawn
J1756	47561	J1756 GEN1 0.5200	1	Withdrawn
J1765	47650	J1765 GEN 0.6300	1	Withdrawn
J1771	47710	J1771 GEN 0.6300	1	Withdrawn
J1784	47840	J1784 GEN 0.6300	1	Withdrawn
J1806	48060	J1806 GEN 0.6300	1	Withdrawn
J1810	48100	J1810 GEN 0.6300	1	Withdrawn
J1828	48280	J1828 VEST 0.7200	W	Withdrawn
J1828	48284	J1828 GE 0.7200	ES	Withdrawn
J1828	48285	J1828 PE 0.7200	PV	Withdrawn
J1829	48290	J1829 GEN 0.6300	1	Withdrawn
J1837	48370	J1837 GEN 0.7200	1	Withdrawn

Table B-2: Recently Withdrawn SPP Prior Queued Project

Prj #	Status	Bus Number	Bus Name	Id
GEN-2016-063	TERMINATED	587433	G16-063-GEN10.6900	1
GEN-2017-008	WITHDRAWN	588533	G17-008-GEN10.6900	1
GEN-2017-008	WITHDRAWN	588537	G17-008-GEN20.6900	1
GEN-2017-024	WITHDRAWN	588683	G17-024-GEN10.6000	1
GEN-2017-055	WITHDRAWN	588943	G17-055-GEN10.5500	1
GEN-2017-064	WITHDRAWN	589023	G17-064-GEN10.5500	1
GEN-2017-064	WITHDRAWN	589027	G17-064-GEN20.5500	1
GEN-2017-067	WITHDRAWN	589053	G17-067-GEN10.5500	1
GEN-2017-067	WITHDRAWN	589057	G17-067-GEN20.5500	1
GEN-2017-090	WITHDRAWN	589283	G17-090-GEN10.6900	1
GEN-2017-090	WITHDRAWN	589287	G17-090-GEN20.6900	1
GEN-2017-111	WITHDRAWN	762009	G17-111-GEN10.6300	1
GEN-2017-128	WITHDRAWN	761925	G17-128GEN1 0.6900	1
GEN-2017-148	WITHDRAWN	760896	G17-148GEN1 0.6900	1
GEN-2017-191	WITHDRAWN	761946	G17-191GEN1 0.6900	1
GEN-2017-216	WITHDRAWN	761043	G17-216GEN1 0.6900	1
GEN-2017-229	WITHDRAWN	761757	G17-229GEN1 0.6900	1
GEN-2018-008	WITHDRAWN	762540	G18-008-GEN10.6900	1
GEN-2018-008	WITHDRAWN	762543	G18-008-GEN20.6900	1
GEN-2018-012	WITHDRAWN	762507	G18-012-GEN10.6900	1
GEN-2018-022	WITHDRAWN	762584	G18-022GEN1 0.6000	1
GEN-2018-022	WITHDRAWN	762587	G18-022GEN2 0.6000	1
GEN-2018-022	WITHDRAWN	762588	G18-022GEN3 0.6300	1
GEN-2018-030	WITHDRAWN	762661	G18-030GEN1 0.6600	1
GEN-2018-039	WITHDRAWN	762738	G18-039GEN1 0.6600	1
GEN-2018-054	WITHDRAWN	762892	G18-054-GEN10.6600	1
GEN-2018-056	WITHDRAWN	762914	G18-056-GEN10.6600	1
GEN-2018-062	WITHDRAWN	762979	G18-062-GEN10.6900	1

Table B-3: Removed Withdrawn Generation Projects in DISIS 18-002 / 19-001

Prj #	Status	Bus Number	Bus Name	Id
GEN-2018-070	WITHDRAWN	763057	G18-070-GEN10.6900	1
GEN-2018-090	WITHDRAWN	763199	G18-090-GEN10.6450	1
GEN-2018-121	WITHDRAWN	763364	G18-121-GEN10.6450	1
GEN-2019-029	WITHDRAWN	763662	G19-029-GEN10.5500	1
GEN-2019-029	WITHDRAWN	763665	G19-029-GEN20.5500	1
GEN-2019-033	WITHDRAWN	763684	G19-033-GEN10.6600	1

Table B-4: Removed Withdrawn Generation Projects in DISIS 2020-001

Prj #	Pmax	Fuel Type	Town / County	State	Point of Interconnection
GEN-2020-001	200	Solar	Cheyenne	NE	Sidney 345 kV
GEN-2020-006	250	Solar	Bowman	ND	Bowman 230 kV
GEN-2020-027	50	Solar / Storage	Sarpy	NE	S1281–S1362 161 kV (S1363)
GEN-2020-030	50	Solar / Storage	Sarpy	NE	S1281–S1362 161 kV (S1363)
GEN-2020-033	50	Solar / Storage	Sarpy	NE	S1281–S1362 161 kV (S1363)
GEN-2020-036	303	Solar / Storage	Plattsmouth	NE	Sub 3740 345 kV
GEN-2020-070	255	Wind	Osborne	KS	Postrock-Axtell 345 kV
GEN-2020-071	252	Wind	Osage, Shawnee	KS	Swissvale-Morris 230 kV
GEN-2020-076	200	Storage	Butler	KS	Benton-Wolf Creek 345 kV
GEN-2020-077	151.2	Wind	Thayer	NE	North Hebron-Fairbury 115 kV
GEN-2020-086	500	Solar	El Dorado	KS	Benton-Wolf Creek 345 kV
GEN-2020-089	104	Solar	Allen, Bourbon	KS	Dakota 161 kV

B.2 SPP Prior Queued Generation Projects

Table B-5: SPP Prior Queued Generation Projects

Projects	Cluster	MW	Generation Type	Town or County	State	Substation or Line	TO at POI
ASGI-2017-013	NA	40	Wind	WAPA	ND	Wolsey 69 kV	WAPA
ASGI-2017-014	NA	40	Solar	NA	KS	Post Oak 34.5 kV	KCPL
ASGI-2018-003	NA	20	Solar	KCPL	KS	Appleton 69 kV	KCPL
ASGI-2018-006	NA	20	Solar	KCPL	KS	Metz 69 kV	KCPL
ASGI-2018-007	NA	20	Solar	KCPL	KS	Salisbury 161 kV	KCPL
ASGI-2018-010	NA	35	Solar	KCPL	KS	Pleasant Valley 161 kV	KCPL
ASGI-2018-011	NA	35	Solar	KCPL	KS	South Ottawa 161 kV	KCPL
GEN-2016-036	DISIS-2016-002-1	44.6	Wind	Chippewa	MN	Granite Falls 115 kV	WAPA
GEN-2016-074	DISIS-2016-002-1	200	Wind	Custer	NE	Sweetwater 345 kV	NPPD
GEN-2016-087	DISIS-2016-002-1	98.9	Wind	Campbell	SD	Bismark-Glenham 230 kV	WAPA
GEN-2016-094	DISIS-2016-002-1	200	Wind	Hyde	SD	Ft Thompson-Oahe 230 kV	WAPA
GEN-2016-115	DISIS-2016-002-1	300	Wind	Atchison	MO	Nebraska City-Mullen Creek 345 kV	GMO
GEN-2016-130	DISIS-2016-002-1	202	Wind	Mercer	ND	Leland Olds 345 kV	BEPC
GEN-2016-147	DISIS-2016-002-1	40	Solar	Cheyenne	NE	Sidney 115 kV	Tri-State
GEN-2016-151	DISIS-2016-002-1	202	Wind	Burke	ND	Tande 345 kV	BEPC
GEN-2017-004	DISIS-2017-001	201.6	Wind	Cloud	KS	Elm Creek-Summit 345 kV	ITCGP
GEN-2017-005	DISIS-2017-001	190	Wind	Bourbon / Crawford	OK	Marmaton-Litchfield 161 kV	WERE
GEN-2017-009	DISIS-2017-001	302	Wind	Neoshoe	KS	Neosho-Caney River 345 kV	WERE
GEN-2017-010	DISIS-2017-001	200.1	Wind	Bowman	ND	Rhame 230 kV	BEPC
GEN-2017-014	DISIS-2017-001	300	Wind	Haakon	SD	Philip Tap 230 kV	WAPA
GEN-2017-048	DISIS-2017-001	300	Wind	Williams	ND	Neset 230 kV	BEPC
GEN-2017-060	DISIS-2017-001	149.4	Wind	Barton	MO	LaRussell Energy Center 161 kV	EDE
GEN-2017-082	DISIS-2017-001	149.4	Wind	Barton / Jasper	MO	Asbury Plant 161 kV	EDE
GEN-2017-094	DISIS-2017-001	200	Wind	Wessington / Hand	SD	Fort Thompson-Huron 230 kV	WAPA
GEN-2017-097	DISIS-2017-001	128	Solar	Pennington	SD	Underwood 115 kV	WAPA
GEN-2017-105	DISIS-2017-002	75	Wind	Burt	NE	Tekamah-Raun 161 kV	OPPD
GEN-2017-108	DISIS-2017-002	400	Solar	Henry	MO	Stillwell-Clinton 161 kV	KCPL

Projects	Cluster	MW	Generation Type	Town or County	State	Substation or Line	TO at POI
GEN-2017-115	DISIS-2017-002	244	Wind	Atchinson / Nodaway	MO	Holt County 345 kV	KCPL
GEN-2017-119	DISIS-2017-002	180	Wind	Cloud / Mitchell	KS	Elm Creek 345 kV	SUNC
GEN-2017-120	DISIS-2017-002	260	Wind	Dickinson / Marion	KS	Abilene Energy Center-Northview 115 kV	WERE
GEN-2017-125	DISIS-2017-002	252	Wind	Osage	KS	Swissvale 345 kV	WERE
GEN-2017-144	DISIS-2017-002	200	Wind	Holt, Antelope, Wheeler	NE	Holt County 345 kV	WAPA
GEN-2017-175	DISIS-2017-002	300	Wind	Turner	SD	Vfodnes-Utica Jct. 230 kV	WAPA
GEN-2017-181	DISIS-2017-002	300	Wind	Lancaster	NE	Tobias 345 kV	NPPD
GEN-2017-182	DISIS-2017-002	128	Wind	Lancaster	NE	Tobias 345 kV	NPPD
GEN-2017-183	DISIS-2017-002	400	Wind	Hodgeman / Ford	KS	Nashua-St. Joe 345 kV	KCPL
GEN-2017-184	DISIS-2017-002	400	Solar	Hodgeman / Ford	KS	Nashua-St. Joe 345 kV	KCPL
GEN-2017-188	DISIS-2017-002	130	Solar	Barry	MO	Asbury 161 kV	EDE
GEN-2017-195	DISIS-2017-002	500.4	Solar	Johnson	KS	West Gardner 345 kV	KCPL
GEN-2017-196	DISIS-2017-002	128	Battery	Johnson	KS	West Gardner 345 kV	KCPL
GEN-2017-201	DISIS-2017-002	250	Wind	Wayne	NE	Hoskins 345 kV	NPPD
GEN-2017-202	DISIS-2017-002	200	Solar	New Madrid	MO	New Madrid-Sikeston 161 kV	SWPA
GEN-2017-209	DISIS-2017-002	300	Hybrid (Solar / Battery)	McPherson	KS	LaCygne-Neosho 345 kV	KCPL
GEN-2017-210	DISIS-2017-002	310	Hybrid (Solar / Battery)	Cedar	NE	McCool 345 kV	NPPD
GEN-2017-214	DISIS-2017-002	100	Wind	Ward	ND	Logan 230 kV	BEPC
GEN-2017-215	DISIS-2017-002	100	Wind	Ward	ND	Logan 230 kV	BEPC
GEN-2017-222	DISIS-2017-002	180	Wind	Denison	IA	Denison 230 kV	WAPA
GEN-2017-234	DISIS-2017-002	115	Wind	Greeley	NE	Spalding-North Loup 115 kV	NPPD
GEN-2018-010	DISIS-2018-001	74.1	Battery	Montrail	ND	Neset 230 kV	BEPC
GEN-2018-013	DISIS-2018-001	74.1	Wind	Dickinson	KS	Abilene Energy Center-Northview 115 kV	WERE
GEN-2018-025	DISIS-2018-001	200	Battery	Washington	NE	Fort Calhoun 345 kV	OPPD
GEN-2018-031	DISIS-2018-001	50	Battery	Jackson	MO	Blue Valley 161 kV	INDN
GEN-2018-032	DISIS-2018-001	310	Wind	McPhearson	KS	Neosho 345 kV	WERE

Projects	Cluster	MW	Generation Type	Town or County	State	Substation or Line	TO at POI
GEN-2018-033	DISIS-2018-001	200	Battery	Cass	NE	Cass County 345 kV	OPPD
GEN-2018-037	DISIS-2018-001	100	Battery	Douglas	NE	Looping in OPPD (S1211) (S1220) (S1211) (S1299) 161 kV	OPPD
GEN-2018-043	DISIS-2018-001	500	Solar	Burt	NE	Ft. Calhoun-Raun 345 kV	OPPD
GEN-2018-057	DISIS-2018-001	203.4	Solar	Sedgwick	KS	Gordon Evans 138 kV	WERE
GEN-2018-060	DISIS-2018-001	50	Wind	Webster	NE	Axtell-Post Rock 345 kV	NPPD

Table B-6: SPP DISIS 18-002 / 19-001 Generation Projects in MISO West

Projects	Town / County	State	Point of Interconnection	Generation Type	Pmax	SH (MW)	SPK (MW)
GEN-2018-063	Greene	MO	Sedalia Marshfield Springfield Nichols Street 69kV	Solar	57	0	57.0
GEN-2018-065	Madison	NE	Antelope 345 kV	Wind	19.8	19.8	3.1
GEN-2018-067	Williams	ND	Strandahl 115kV	Wind	255	255	39.8
GEN-2018-068	Madison	NE	Antelope 345 kV	Wind	302.4	302.4	47.2
GEN-2018-069	Wibaux	MT	WAPA-UGP Mingusville 230kV	Wind	125	125	19.5
GEN-2018-074	Crawford and Carrol	IA	Denison 230kV Substation	Wind	72	72	11.2
GEN-2018-083	Madison	NE	Shell Creek-Hoskins 345kv	Wind	250	250	39.0
GEN-2018-125	Lincoln	NE	Gentleman-Sweetwater 345kV	Wind	231	231	36.0
GEN-2018-131	Pierce	NE	Antelope 345kV	Solar	221.4	0	221.4
GEN-2018-132	Pierce	NE	Antelope 345kV	Solar	201.6	0	201.6
GEN-2019-009	Nemaha	NE	S1263 Brock 161kV	Solar	100	0	100.0
GEN-2019-016	Polk and Dade	MO	Dadeville 161kV	Solar	200	0	200.0
GEN-2019-019	Sioux	IA	Siouxland 69kV	Thermal (CT)	15.15	0	15.2
GEN-2019-023	Wibaux	MT	WAPA-UGP Mingusville 230kV	Wind / Storage	110	110	67.16
GEN-2019-037	Mercer	ND	Leland Olds 345kV	Solar	150	0	150.0
GEN-2019-039	Butler	NE	Columbus Southeast-Rising City 115kV	Solar	174.5	0	174.5
GEN-2019-041	Lancaster	NE	Monolith 115kV	Solar	78	0	78.0

Projects	Town / County	State	Point of Interconnection	Generation Type	Pmax	SH (MW)	SPK (MW)
GEN-2019-048	Jackson	MO	Duncan 69kV	Battery	50	50	50.0
GEN-2019-069	Madison	NE	Shell Creek-Hoskins 345kV	Solar	100	0	100.0
GEN-2019-070	Madison	NE	Shell Creek-Hoskins 345kv	Solar	50	0	50.0
GEN-2019-073	Madison	NE	Shell Creek-Hoskins 345kv	Solar	100	0	100.0

Table B-7: SPP DISIS 2020-001 Generation Projects in MISO West

Projects	Town / County	State	Point of Interconnection	Generation Type	Pmax	SH (MW)	SPK (MW)
ASGI-2020-001	Saline	MO	South Waverly 69 kV	Solar / Storage	35	10.00	35.00
ASGI-2020-003	Carroll	MO	Carrollton 161 kV	Solar / Storage	35	10.00	35.00
GEN-2020-002	Yutan	NE	Sub 6846 69 kV	Solar	81	0.00	81.00
GEN-2020-007	Linn, Bates	KS	Evergy La Cygne-Wolf Creek 345 kV	Solar / Storage	650	500.00	650.00
GEN-2020-008	Stevens	KS	Corporation Carpenter 345 kV	Solar / Storage	250	125.00	250.00
GEN-2020-011	Funk	NE	Axtell-Sweetwater 345 kV	Solar / Storage	320	320.00	320.00
GEN-2020-013	Orleans	NE	Orleans-Holdrege 115 kV	Solar / Storage	214.98	215.00	214.98
GEN-2020-014	Alexander	ND	Lonesome Creek 115 kV	Gas	45	0.00	45.00
GEN-2020-021	Sioux	ND	LeLand Olds-Chapelle Creek 345 kV	Wind	235	235.00	36.66
GEN-2020-025	Sarpy	NE	Sub 1363 161 kV	CT Gas	255	0.00	255.00
GEN-2020-028	Sarpy	NE	Sub 1363 161 kV	CT Gas	255	0.00	255.00
GEN-2020-031	Sarpy	NE	Sub 1363 161 kV	CT Gas	303	0.00	303.00
GEN-2020-038	Plattsmouth	NE	Sub 3740 345 kV	CT Gas	303	0.00	303.00
GEN-2020-043	Douglas	NE	Sub 1209-Sub 1252 161 kV	Reciprocating Engine	56.52	0.00	56.52
GEN-2020-044	Douglas	NE	Sub 1209-Sub 1252 161 kV	Reciprocating Engine	56.52	0.00	56.52
GEN-2020-045	Douglas	NE	Sub 1209-Sub 1252 161 kV	Reciprocating Engine	56.52	0.00	56.52
GEN-2020-056	Russell	KS	Russell 115 kV	Solar	20	0.00	20.00
GEN-2020-057	Garner	KS	Atlantic 345 kV	Storage	424.5	424.50	424.50
GEN-2020-058	Garner	KS	Evergy Atlantic 345 kV	Solar	424.5	0.00	424.50
GEN-2020-061	Pleasant Hill	MO	Pleasant Hill 345/161/69 kV	Gas	29	14.50	29.00

Projects	Town / County	State	Point of Interconnection	Generation Type	Pmax	SH (MW)	SPK (MW)
GEN-2020-064	Joplin	MO	4544 Stateline CC 161 kV	CT Gas	64	0.00	64.00
GEN-2020-069	Cherry	NE	Cody-Valentine 115 kV	Wind	52.85	52.85	8.24
GEN-2020-072	Windsor	MO	Windsor-AEC Sedalia 161 kV	Solar / Storage	150	150.00	150.00
GEN-2020-073	Franklin	KS	SE Ottawa-Pleasant Valley 161 kV	Solar / Storage	150	101.00	80.75
GEN-2020-078	Washington	NE	Sub 1226-Sub 1237 161 kV	Solar	100	0.00	100.00
GEN-2020-079	Cherokee	KS	Riverton-Neosho 161 kV	Solar / Storage	225	225.00	225.00
GEN-2020-083	Fairview	MT	Fairview 115 kV	Solar / Storage	74.5	24.50	74.50
GEN-2020-084	Burt	NE	Raun-Fort Calhoun 345 kV	Solar	350	0.00	350.00
GEN-2020-088	Jasper	MO	La Russell 161 kV	Solar	150	0.00	150.00
GEN-2020-090	Bourbon	KS	Wolf Creek-Blackberry 345 kV	Battery	204.3	204.30	204.30
GEN-2020-091	McKenzie	ND	Patent Gate 345 kV	Solar	150	0.00	150.00
GEN-2020-094	Syracuse	NE	Neb. City-103rd & Rokeby 345 kV	Solar	250	0.00	250.00

B.3 MPC Prior Queued Generation Projects

Table B-8: MPC Prior Queued Generation Projects

Projects	Cluster	MW	Generation Type	Town or County	State	Substation or Line	TO at POI
MPC03600	MPC Group 2020	170	Solar	Richland	ND	Frontier-Wahpeton 230 kV	MPC
MPC03700	MPC Group 2020	130	Solar	Richland	ND	Frontier-Wahpeton 230 kV	MPC
MPC03800	MPC Group 2021	250	Wind	Eddy; Wells	ND	Center-Prairie 345 kV	MPC
MPC03900	MPC Group 2021	151.2	Wind	Eddy; Wells	ND	Center-Prairie 345 kV	MPC
MPC04000	MPC Group 2021	284	Wind	Oliver; Morton	ND	Square Butte 230 kV	MPC
MPC04300	NA	400	Wind	Steele	ND	Center-Prairie 345 kV	MPC

B.4 AECI Prior Queued Generation Projects

Table B-9: AECI Prior Queued Generation Projects

Projects	MW	Generation Type	Town or County	State	Substation or Line
GIA-61	230	Wind	Nodaway	MO	Maryville 161 kV
GIA-83	1018	Wind	Randolph	MO	McCredie 345 kV
GIA-86	100	Solar	Clifton Hill	MO	Thomas Hill 69 kV
GIA-90	100	Solar	Randolph	MO	Montgomery City 161 kV
GIA-91	96	Solar	Carroll	MO	Sedalia 69 kV
GIA-93	100	Solar	Macon		Palmyra 161 kV
GIA-95	247	Wind	Dade	MO	Jasper-Morgan 345 kV
GIA-96	97.5	Wind	Lincoln	OK	Stroud 138kV
GIA-099	470	CT Gas	Butler	MO	Gobbler Knob 345 kV
GIA-100	40	CT Gas	Butler	MO	Gobbler Knob 345 kV
GIA-101	460	CT Gas	Clinton	MO	Rockies Express 161 kV
GIA-102	75	CT Gas	Clinton	MO	Rockies Express 161 kV

B.5 Removed Recently Retired MISO Generation

Table B-10: Removed Recently Retired MISO Generation in MISO West & Central Area

Unit(s) Description	State	Power Flow Area	Bus Name	Bus Number	Unit ID	Derate To MW	Requested Change of Status
Genoa Unit 3	WI	DPC	GENOA53G	681522	3	0	Retirement
Grand Tower Units 1-4	IL	AMIL	1GRTW 1	347170	1	0	Retirement
Grand Tower Units 1-4	IL	AMIL	1GRTW 2	347171	2	0	Retirement
Grand Tower Units 1-4	IL	AMIL	1GRTW 3	347168	3	0	Retirement
Grand Tower Units 1-4	IL	AMIL	1GRTW 4	347169	4	0	Retirement
Riverside Unit 5	IA	MEC	RIVERSIDE 5G	636655	5	0	Retirement
Meramec CTG 2	MO	AMMO	1MER 6	345172	6	0	Retirement
Elk River Station	MN	GRE	GRE-ELK RIV869	615020	1	0	Retirement
Elk River Station	MN	GRE	GRE-ELK RIV869	615020	2	0	Retirement
Elk River Station	MN	GRE	GRE-ELK RIV869	615020	3	0	Retirement
Dallman Units 31 & 32	IL	CWLP	1DALMAN 31	343549	1	0	Retirement
Dallman Units 31 & 32	IL	CWLP	1DALMAN 32	343550	2	0	Retirement
Meramec CTG 1	MO	AMMO	1MER 5	345164	5	0	Retirement
Bailly Unit 10	IN	NIPS	17BAILLY-10	255246	10	0	Retirement
Coffeen Units 1 and 2	IL	AMIL	1COFFEN 1	346896	1	0	Retirement
Coffeen Units 1 and 2	IL	AMIL	1COFFEN 2	346897	2	0	Retirement
Hennepin Units 1 and 2	IL	AMIL	1HENNEPIN G1	349106	1	0	Retirement
Hennepin Units 1 and 2	IL	AMIL	1HENNEPIN G2	349107	H	0	Retirement
Hennepin Units 1 and 2	IL	AMIL	1HENNEPIN G2	349107	L	0	Retirement
Havana Unit 6	IL	AMIL	1HAVANA G6	349121	6	0	Retirement
Duck Creek Unit 1	IL	AMIL	1DCK GEN1	349633	1	0	Retirement
Baldwin 3	IL	AMIL	1BALDWIN G3	349128	3	0	Retirement
Reid Unit1	KY	BREC	1REID1	340574	5	0	Retirement
Bay Front Unit 4	WI	XEL (NSP)	BFTG4DSG	600016	4	0	Retirement
Plant D7	MO	CWLD	2PLANT2	343051	7	0	Retirement
Northeast - NET Units 1 & 2	IN	SIGE	10NE_GT	253512	1	0	Retirement
Henderson Municipal Power & Light Units 1&2	KY	BREC	HMP&L1	340577	3	0	Retirement
Henderson Municipal Power & Light Units 1&2	KY	BREC	HMP&L2	340578	4	0	Retirement

Unit(s) Description	State	Power Flow Area	Bus Name	Bus Number	Unit ID	Derate To MW	Requested Change of Status
FibroMinn	MN	OTP	FIBROMN7	603185	1	0	Retirement
Bailly 7 & 8	IN	NIPS	17BAILLY-7	255234	7	0	Retirement
Bailly 7 & 8	IN	NIPS	17BAILLY-8	255235	8	0	Retirement
Coleman 1,2,3	KY	BREC	COLEMAN1	340579	1	0	Retirement
Coleman 1,2,3	KY	BREC	COLEMAN2	340580	2	0	Retirement
Coleman 1,2,3	KY	BREC	COLEMAN3	340581	3	0	Retirement
Flambeau CT	WI	XEL (NSP)	FLAMSTN9	605465	1	0	Retirement
Wheaton Unit 5	WI	XEL (NSP)	WHT 55G	600036	5	0	Retirement
Hoot Lake 1	MN	OTP	HOOT LK7	620223	1	0	Retirement
Silver Lake 1, 2, 3 & 4	MN	MMPA	SILVER L	625440	1	0	Retirement
Silver Lake 1, 2, 3 & 4	MN	MMPA	SILVER L	625440	2	0	Retirement
Silver Lake 1, 2, 3 & 4	MN	MMPA	SILVER L	625440	3	0	Retirement
Silver Lake 1, 2, 3 & 4	MN	MMPA	SILVER L	625440	4	0	Retirement
Stoneman 1 & 2	WI	DPC	STONE	186860	1	0	Retirement

B.6 Network Upgrades Required for Prior Queued Projects

Table B-11: NUs Required for SPP West Projects Prior to DISIS 18-002 / 19-001 Cycle

NUs	Study Cycle
Capacitor at Bagley 115: 1x20 Mvar	DISIS-2016-002
100 MVAR Capacitor Bank at Montezuma 345 kV (MEC)	DISIS-2017-001
100 MVAR Capacitor Bank at Blackhawk 345 kV (MEC)	DISIS-2017-001
40 MVar switched cap at Wahpeton 230 kV (620329) [1]	DISIS-2017-001
60 MVar switched cap at Buffalo 345 kV (620358) [1]	DISIS-2017-001
Capacitor at Maynard 115: 1x40 Mvar	DISIS-2018-001

Note 1: NU was only modeled in summer shoulder cases

Table B-12: NUs Required for SPP West Projects in DISIS 18-002 / 19-001 Cycle

Network Upgrades	Owner	Study Cycle	Comments
Build a 2nd Astoria-Brookings County 345 kV line	OTP	DPP 2019 West	Only in SH case
Build Brookings Co-Lyon Co 2nd 345 kV line; Build Helena-Hampton Corner 345 kV line	XEL	MTEP Appendix A	Only in SH case
±150 MVAr STATCOM at Wahpeton 230 kV (620329)	OTP	MPC04300 MPC NU	Only in SH case
4×40 MVar switched cap at Panther 230 kV (615529)	GRE	DISIS 18-002 / 19-001	Only in SH case
4×40 MVar switched cap at McLeod 230 kV (658276)	MRES	DISIS 18-002 / 19-001	Only in SH case
1×40 MVar switched cap at Paynesville 230 kV (602036)	XEL	DISIS 18-002 / 19-001	Only in SH case
±150 MVAr STATCOM at Audubon 230 (620336)	OTP	MPC04300 MPC NU	Only in SH case

Table B-13: NUs Required for MPC Group 2021 Projects

Bus #	Bus Name	MPC Group 2021
658047	ALEXMRES3 345.00	MSC: 1x75 MVar
601067	BISON 3 345.00	MSC: 2x75 MVar (additions. Total is 3 x 75 MVar)
657758	WINGER 4 230.00	MSC: 1x30 MVar STATCOM: ±50 MVar

Table B-14: NUs Required for MPC 04300 Project

NUs	Comments
New 345 kV outlet line from MPC04300 to a new substation tapping the Buffalo-Jamestown 345 kV line.	Stability NU
Drayton 230 (657752) 2x40 MVar MSC	Steady State NU (only in SH case)
Jamestown 345 (620369) 4x75 MVar MSC	Steady State NU (only in SH case)
Maple River 230 (657754) 2x40 MVar MSC	Steady State NU (only in SH case)
Winger 230 (657758) 1x30 MVar MSC (addition)	Steady State NU (only in SH case)

B.7 Contingency Files used in MISO West AFSIS Analysis

Table B-15: List of Contingencies used in the MISO West AFSIS Analysis

Contingency File Name	Description
Automatic single element contingencies	Single element outages at buses 60 kV and above in the study region
MISO20_2025_SUM__TA_P1_AMRN.con	Specified category P1 contingencies in Ameren
MISO20_2025_SUM__TA_P1_IOWA.con	Specified category P1 contingencies in Iowa
MISO20_2025_SUM__TA_P1_IOWA_ITCM_MPW.con	Specified category P1 contingencies in ITCM and MPW
MISO20_2025_SUM__TA_P1_IOWA_MEC.con	Specified category P1 contingencies in MEC
MISO20_2025_SUM__TA_P1_MINN-DAKS.con	Specified category P1 contingencies in MN, ND and SD
HVDC_Red_2025PK.con	Specified contingencies related to HVDC reduction in SPK
HVDC_Red_2025SH.con	Specified contingencies related to HVDC reduction in SH
MISO20_2025_SUM__TA_P1_P2_P4_P5_NoLoadLoss.con	Specified category P1, P2, P4, P5 contingencies in MISO
MISO20_2025_SUM__TA_P2_P7_MEC.con	Specified category P2, P7 contingencies in MEC
MISO20_2025_SUM__TA_P2_P4_P5_P6_P7_LoadLoss.con	Specified category P2, P4, P5, P7 contingencies in MISO
AECI-AMMO.CON	Specified category P1, P2 contingencies in AECI-AMMO
AECI-EES.con	Specified category P2, P3, P6 contingencies in AECI-EES
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

Appendix

C

MISO South AFSIS Thermal and Voltage Analysis Results

C.1 2025 Summer Peak (SPK) MISO South AFSIS Constraints

Table C-1. 2025 SPK System Intact MISO South Thermal Constraints

Table C-2. 2025 SPK System Intact MISO South Voltage Constraints

Table C-3. 2025 SPK Category P1 MISO South Thermal Constraints

Table C-4. 2025 SPK Category P1 MISO South Voltage Constraints

Table C-5. 2025 SPK Category P2-P7 MISO South Thermal Constraints

Table C-6. 2025 SPK Category P2-P7 MISO South Voltage Constraints

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C.2 2025 Summer Shoulder (SH) MISO South AFSIS Constraints

Table C-7. 2025 SH System Intact MISO South Thermal Constraints

Table C-8. 2025 SH System Intact MISO South Voltage Constraints

Table C-9. 2025 SH Category P1 MISO South Thermal Constraints

Table C-10. 2025 SH Category P1 MISO South Voltage Constraints

Table C-11. 2025 SH Category P2-P7 MISO South Thermal Constraints

Table C-12. 2025 SH Category P2-P7 MISO South Voltage Constraints

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Appendix

D

MISO South AFSIS Stability Analysis Results

D.1 2025 Summer Peak (SPK) MISO South AFSIS Stability Results

Stability simulation was performed in the 2025 summer peak (SPK) stability model.

D.1.1 2025 SPK MISO South AFSIS Stability Summary

MISO South AFSIS summer peak stability study results are summarized in Table D-1.

Table D-1: 2025 Summer Peak MISO South AFSIS Stability Analysis Results Summary

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D.1.2 2025 SPK MISO South AFSIS Stability Plots

Plots of stability simulations for 2025 summer peak study case are in separate files which are listed below:

AppendixD1-2_2025SPK_SPP South_Study_Plots.zip

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D.2 2025 Summer Shoulder MISO South AFSIS Stability Results

Stability simulation was performed in the 2025 summer shoulder (SH) stability model.

D.2.1 2025 SH MISO South AFSIS Stability Summary

MISO South AFSIS summer shoulder stability study results are summarized in Table D-2.

Table D-2: 2025 Summer Shoulder MISO South AFSIS Stability Analysis Results Summary

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D.2.2 2025 SH MISO South AFSIS Stability Plots

Plots of stability simulations for 2025 summer shoulder study case are in separate files which are listed below:

AppendixD2-2_2025SH_SPP South_Study_Plots.zip

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Appendix E

MISO West AFSIS Thermal and Voltage Analysis Results

E.1 2025 Summer Peak (SPK) MISO West AFSIS Constraints

Table E-1. 2025 SPK System Intact MISO West Thermal Constraints

Table E-2. 2025 SPK System Intact MISO West Voltage Constraints

Table E-3. 2025 SPK Category P1 MISO West Thermal Constraints

Table E-4. 2025 SPK Category P1 MISO West Voltage Constraints

Table E-5. 2025 SPK Category P2-P7 MISO West Thermal Constraints

Table E-6. 2025 SPK Category P2-P7 MISO West Voltage Constraints

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E.2 2025 Summer Shoulder (SH) MISO West AFSIS Constraints

Table E-7. 2025 SH System Intact MISO West Thermal Constraints

Table E-8. 2025 SH System Intact MISO West Voltage Constraints

Table E-9. 2025 SH Category P1 MISO West Thermal Constraints

Table E-10. 2025 SH Category P1 MISO West Voltage Constraints

Table E-11. 2025 SH Category P2-P7 MISO West Thermal Constraints

Table E-12. 2025 SH Category P2-P7 MISO West Voltage Constraints

Table E-13. 2025 SH MISO West Non-Converged Contingencies

Table E-14. 2025 SH MISO West Non-Converged Contingencies DCCC Results

Table E-15. 2025 SH MISO West Worst Voltage Constraints

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Appendix

F

MISO West AFSIS Stability Analysis Results

F.1 2025 Summer Peak (SPK) MISO West AFSIS Stability Results

Stability simulation was performed in the 2025 summer peak (SPK) stability model.

F.1.1 2025 SPK MISO West AFSIS Stability Summary

MISO West AFSIS summer peak stability study results are summarized in Table F-1.

Table F-1: 2025 Summer Peak MISO West AFSIS Stability Analysis Results Summary

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F.1.2 2025 SPK MISO West AFSIS Stability Plots

Plots of stability simulations for 2025 summer peak study case are in separate files which are listed below:

AppendixF1-2_2025SPK_SPP West_Study_Plots.zip

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F.2 2025 Summer Shoulder MISO West AFSIS Stability Results

Stability simulation was performed in the 2025 summer shoulder (SH) stability model.

F.2.1 2025 SH MISO West AFSIS Stability Summary

MISO West AFSIS summer shoulder stability study results are summarized in Table F-2.

Table F-2: 2025 Summer Shoulder MISO West AFSIS Stability Analysis Results Summary

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F.2.2 2025 SH MISO West AFSIS Stability Plots

Plots of stability simulations for 2025 summer shoulder study case are in separate files which are listed below:

AppendixF2-2_2025SH_SPP West_Study_Plots.zip

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Appendix G

2025 Cost Allocation Results

G.1 MISO South AFSIS Network Upgrade Cost Allocation

G.1.1 Distribution Factor (DF) and MW Contribution Results for MISO South AFSIS Cost Allocation

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

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G.1.2 MISO South AFSIS Network Upgrade Cost Allocation Details

Table G-2: MISO South Affected System Network Upgrades Cost Allocation

Table G-2: MISO South Affected System Network Upgrades Cost Allocation

Monitored Element	English Name	Owner	Cost	GEN-2021-001	GEN-2021-016	GEN-2021-018	GEN-2021-033	GEN-2021-036	GEN-2021-038	GEN-2021-041	GEN-2021-047	GEN-2021-052	GEN-2021-053	GEN-2021-063	GEN-2021-064	GEN-2021-075	GEN-2021-086	GEN-2021-088	GEN-2021-090	Upgrade for
337502 3COUCH% 115 338874 3LEWISVILLE# 115 1	Couch-Lewisville 115 kV	EES-EAI	$10,983,745	$0	$0	$0	$0	$4,066,211	$0	$0	$0	$0	$0	$0	$0	$0	$6,917,534	$0	$0	SUM
338874 3LEWISVILLE# 115 338875 3PATMOS.W# 115 1	Lewisville-Patmos 115 kV	EES-EAI	$12,802,852	$0	$0	$0	$0	$4,739,649	$0	$0	$0	$0	$0	$0	$0	$0	$8,063,203	$0	$0	SUM
338875 3PATMOS.W# 115 503912 FULTON 3 115 1	Patmos-Fulton 115 kV	EES-EAI AEPW	$15,493,561	$0	$0	$0	$0	$5,735,756	$0	$0	$0	$0	$0	$0	$0	$0	$9,757,805	$0	$0	SUM
Total Cost Per Project for each Project	**Total Cost Per Project**		**$39,280,158**	**$0**	**$0**	**$0**	**$0**	**$14,541,615**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$24,738,543**	**$0**	**$0**	

G.2 MISO West AFSIS Network Upgrade Cost Allocation

G.2.1 Distribution Factor (DF), Voltage Impact, and MW Contribution Results for MISO West AFSIS Cost Allocation

Table G-3: Distribution Factor and MW Contribution on Constraints for MISO West Affected System Thermal NU Cost Allocation

Table G-4: Voltage Impact on MISO West Voltage NUs Cost Allocation

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G.2.2 MISO West AFSIS Network Upgrade Cost Allocation Details

Table G-5: MISO West Affected System Network Upgrades Cost Allocation

Table G-5: MISO West Affected System Network Upgrades Cost Allocation

Monitored Element	English Name	Owner	Cost	GEN-2021-005	GEN-2021-006	GEN-2021-007	GEN-2021-008	GEN-2021-017	GEN-2021-023	GEN-2021-024	GEN-2021-027	GEN-2021-029	GEN-2021-030	GEN-2021-034	GEN-2021-037	GEN-2021-039	GEN-2021-040	GEN-2021-042	GEN-2021-043	GEN-2021-048	GEN-2021-049	GEN-2021-050	GEN-2021-051	GEN-2021-056	GEN-2021-057	GEN-2021-068	GEN-2021-069	GEN-2021-070	GEN-2021-072	GEN-2021-073	GEN-2021-076	GEN-2021-077	GEN-2021-096	GEN-2021-101	GEN-2021-103	GEN-2021-106	GEN-2021-107	GEN-2021-108
65700 NEW SUB 345 620358 BUFFALO3 345 1	New Sub - Buffalo 345 kV	OTP MPC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
602006 SHEYNNE4 230 620337 LAKE PARK T4 230 1	Sheyenne-Lake Park 230 kV	XEL MPC OTP	$100,000	$0	$0	$0	$0	$0	$0	$100,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
602006 SHEYNNE4 230 652435 FARGO 4 230 1	Sheyenne-Fargo 230 kV	XEL WAPA	$46,700,000	$0	$0	$0	$0	$0	$0	$46,700,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
615341 GRE-HUBBARD4 230 608610 BADOURA4 230 1	Hubbard-Badoura 230 kV	GRE MP	$1,348,200	$0	$0	$0	$0	$0	$0	$1,348,200	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
615341 GRE-HUBBARD4 230 620326 ERIEJCT 230 1	Hubbard-Erie Jct 230 kV	GRE MP	$407,700	$0	$0	$0	$0	$0	$0	$407,700	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
620326 ERIEJCT 230 620336 AUDUBON4 230 1	Erie Jct-Audubon 230 kV	OTP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
620329 WAHPETN4 230 658109 FERGSFL4 230 1	Wahpeton-Fergus Falls 230 kV	OTP MRES	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
620336 AUDUBON4 230 620337 LAKE PARK T4 230 1	Audubon-Lake Park 230 kV	OTP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
635200 RAUN 3 345 762779 G18-043-TAP 345 1	Raun - G18-043 Tap 345 kV	MEC OPPD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
LRTP #2: Big Stone South – Alexandria – Cassie's Crossing	LRTP #2: Big Stone South – Alexandria – Cassie's Crossing	TBD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
LRTP #4: Wilmarth - North Rochester - Tremval	LRTP #4: Wilmarth - North Rochester - Tremval	TBD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Cost Per Project for each Project	**Total Cost Per Project**		**$48,555,900**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$48,555,900**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

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Siemens Industry, Inc.
Siemens Power Technologies International
10900 Wayzata Boulevard
Minnetonka, Minnesota 55305 USA
Tel: +1 (952) 607-2270 • Fax: +1 (518) 346-2777

www.siemens.com/power-technologies