**Report Number: R079-24**

# *MISO Affected System Study on SPP DISIS 2020-001 Phase 2 Projects*

Prepared for

## MISO

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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 2020-001 cycle (Study Projects). The AFSIS results are summarized below.

## 1.1 Project List

Because of a wide geographical region of the DISIS 2020-001 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 2020-001 Phase 2 Study Projects in MISO South region (Study Projects in MISO South) have 21 generation projects with combined energy of 5982.1 MW, which are listed in Table ES-1.

**Table ES-1: DISIS 2020-001 Phase 2 Study Projects in MISO South**

| Project # | Town / County | State | Point of Interconnection | Fuel 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-2020-015 | Johnston | OK | Johnston County 345 kV | Solar | 104 | 0 | 104 |
| GEN-2020-016 | Tillman | OK | Snyder SW-Cache 138 kV | Wind | 202 | 202 | 31.512 |
| GEN-2020-020 | McCurtain | OK | Northwest Texarkana-Valliant 345 kV | Solar / Storage | 201.6 | 100 | 201.6 |
| GEN-2020-023 | Carrier | OK | Woodring 345 kV | Storage | 202 | 202 | 202 |
| GEN-2020-052 | Labette | KS | Neosho-Delaware 345 kV | Wind | 250.999 | 250.999 | 39.156 |
| GEN-2020-054 | Bowie | TX | Lydia 345 kV | Solar | 298 | 0 | 298 |
| GEN-2020-059 | Lovington | NM | Tuco-Yoakum-Hobbs 345 kV | Solar / Storage | 259 | 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 |

| Project # | Town / County | State | Point of Interconnection | Fuel Type | Pmax | SH (MW) | SPK (MW) |
|---|---|---|---|---|---|---|---|
| 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 |

### 1.1.2 Phase 2 Study Projects in MISO West

The DISIS 2020-001 Phase 2 Study Projects in MISO West region (Study Projects in MISO West) have 44 generation projects with combined energy of 8335.4 MW, which are listed in Table ES-2.

**Table ES-2: DISIS 2020-001 Phase 2 Study Projects in MISO West**

| Project # | Town / County | State | Point of Interconnection | Fuel 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-2020-001 | Cheyenne | NE | Sidney 345 kV | Solar | 200 | 0.00 | 200.00 |
| GEN-2020-002 | Yutan | NE | Sub 6846 69 kV | Solar | 81 | 0.00 | 81.00 |
| GEN-2020-006 | Bowman | ND | Bowman 230 kV | Solar | 250 | 0.00 | 250.00 |
| 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 | 214.98 | 214.98 |
| GEN-2020-014 | Alexander | ND | Lonesome Creek 115 kV | CT Gas | 45 | 0.00 | 45.00 |

| Project # | Town / County | State | Point of Interconnection | Fuel Type | Pmax | SH (MW) | SPK (MW) |
|---|---|---|---|---|---|---|---|
| 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-2020-027 | Sarpy | NE | S1281–S1362 161 kV (S1363) | Solar / Storage | 50 | 42.00 | 50.00 |
| GEN-2020-028 | Sarpy | NE | Sub 1363 161 kV | CT Gas | 255 | 0.00 | 255.00 |
| GEN-2020-030 | Sarpy | NE | S1281–S1362 161 kV (S1363) | Solar / Storage | 50 | 36.00 | 50.00 |
| GEN-2020-031 | Sarpy | NE | Sub 1363 161 kV | CT Gas | 303 | 0.00 | 303.00 |
| GEN-2020-033 | Sarpy | NE | S1281–S1362 161 kV (S1363) | Solar / Storage | 50 | 39.00 | 50.00 |
| GEN-2020-036 | Plattsmouth | NE | Sub 3740 345 kV | Solar / Storage | 303 | 289.00 | 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 | CC Gas | 29 | 14.50 | 29.00 |
| 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-2020-070 | Osborne | KS | Postrock-Axtell 345 kV | Wind | 255 | 255.00 | 39.78 |
| GEN-2020-071 | Osage, Shawnee | KS | Swissvale-Morris 230 kV | Wind | 252 | 252.00 | 39.31 |
| 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 | 150.00 | 150.00 |
| GEN-2020-076 | Butler | KS | Benton-Wolf Creek 345 kV | Storage | 200 | 200.00 | 200.00 |
| GEN-2020-077 | Thayer | NE | North Hebron-Fairbury 115 kV | Wind | 151.2 | 151.20 | 23.59 |
| GEN-2020-078 | Washington | NE | Sub 1226-Sub 1237 161 kV | Solar | 100 | 0.00 | 100.00 |

| Project # | Town / County | State | Point of Interconnection | Fuel Type | Pmax | SH (MW) | SPK (MW) |
|---|---|---|---|---|---|---|---|
| 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-2020-086 | El Dorado | KS | Benton-Wolf Creek 345 kV | Solar | 500 | 0.00 | 500.00 |
| GEN-2020-088 | Jasper | MO | La Russell 161 kV | Solar | 150 | 0.00 | 150.00 |
| GEN-2020-089 | Allen, Bourbon | KS | Dakota 161 kV | Solar | 104 | 0.00 | 104.00 |
| GEN-2020-090 | Bourbon | KS | Wolf Creek-Blackberry 345 kV | Solar | 204.3 | 0.00 | 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 |

## 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 2020-001 Study Projects in MISO South were developed from the models used in MISO South AFSIS on AECI GI-105 project, 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 2020-001 Study Projects in MISO South were developed from the Phase 3 models used in MISO South AFSIS on SPP DISIS 18-002 / 19-001 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. No thermal or voltage constraints were identified in the 2025 summer peak (SPK) and summer shoulder (SH) scenarios. No thermal or voltage MISO AFSIS Network Upgrades (NUs) were identified in the steady state analysis.

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.

In conclusion, SPP DISIS 2020-001 Study Projects in MISO South are not responsible for any MISO AFSIS NUs.

### 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 2020-001 Study Projects in MISO West were developed from the models used in MISO West AFSIS on AECI GI-102 project, 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 2020-001 Study Projects in MISO West were developed from the Phase 3 models used in MISO West AFSIS on SPP DISIS 18-002 / 19-001 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 Network Upgrades identified in the summer shoulder scenario for steady state analysis are listed in Table ES-3. OTP intends to self fund the upgrades. No MISO AFSIS voltage Network Upgrades were identified in the summer shoulder scenario.

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

**Table ES-3: 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<br>MPC | OTP: OTP equipment is sufficient, MPC conductor is limiter. $0<br>MPC: NU will be determined in MPC study | $0 |
| Sheyenne-Lake Park 230 kV | XEL<br>MPC<br>OTP | OTP: Prior queued upgrade will increase rating to 353.7 MVA (MPC-04300). Additional structure replacements required. $400,000 | $400,000 |
| Audubon-Lake Park 230 kV | OTP | Prior queued upgrade will increase rating to 479.2 / 527.1 MVA (MPC-04300). No upgrade necessary. | $0 |

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-4. No MISO AFSIS Network Upgrades were identified for the SPP DISIS 2020-001 Study Projects in MISO South.

**Table ES-4: Total Cost of MISO AFSIS Network Upgrades for SPP DISIS 2020-001 Study Projects in MISO South**

| Project Num | Network Upgrades ($) | | | Total Network Upgrade Cost ($) |
|---|---|---|---|---|
| | MISO Thermal & Voltage | Transient Stability | Short Circuit | |
| GEN-2020-009 | $0 | $0 | $0 | $0 |
| GEN-2020-010 | $0 | $0 | $0 | $0 |
| GEN-2020-012 | $0 | $0 | $0 | $0 |
| GEN-2020-015 | $0 | $0 | $0 | $0 |
| GEN-2020-016 | $0 | $0 | $0 | $0 |
| GEN-2020-020 | $0 | $0 | $0 | $0 |
| GEN-2020-023 | $0 | $0 | $0 | $0 |
| GEN-2020-052 | $0 | $0 | $0 | $0 |
| GEN-2020-054 | $0 | $0 | $0 | $0 |
| GEN-2020-059 | $0 | $0 | $0 | $0 |
| GEN-2020-060 | $0 | $0 | $0 | $0 |
| GEN-2020-062 | $0 | $0 | $0 | $0 |
| GEN-2020-065 | $0 | $0 | $0 | $0 |
| GEN-2020-067 | $0 | $0 | $0 | $0 |
| GEN-2020-068 | $0 | $0 | $0 | $0 |

| Project Num | Network Upgrades ($) | | | Total Network Upgrade Cost ($) |
|---|---|---|---|---|
| | MISO Thermal & Voltage | Transient Stability | Short Circuit | |
| GEN-2020-074 | $0 | $0 | $0 | $0 |
| GEN-2020-075 | $0 | $0 | $0 | $0 |
| GEN-2020-081 | $0 | $0 | $0 | $0 |
| GEN-2020-085 | $0 | $0 | $0 | $0 |
| GEN-2020-087 | $0 | $0 | $0 | $0 |
| GEN-2020-092 | $0 | $0 | $0 | $0 |
| **Total ($)** | **$0** | **$0** | **$0** | **$0** |

### 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-5. The costs for Network Upgrades are planning level estimates and subject to be revised in the facility studies.

**Table ES-5: 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 | |
| ASGI-2020-001 | $0 | $0 | $0 | $0 |
| ASGI-2020-003 | $0 | $0 | $0 | $0 |
| GEN-2020-001 | $0 | $0 | $0 | $0 |
| GEN-2020-002 | $0 | $0 | $0 | $0 |
| GEN-2020-006 | $0 | $0 | $0 | $0 |
| GEN-2020-007 | $0 | $0 | $0 | $0 |
| GEN-2020-008 | $0 | $0 | $0 | $0 |
| GEN-2020-011 | $0 | $0 | $0 | $0 |
| GEN-2020-013 | $0 | $0 | $0 | $0 |
| GEN-2020-014 | $0 | $0 | $0 | $0 |
| GEN-2020-021 | $400,000 | $0 | $0 | $400,000 |
| GEN-2020-025 | $0 | $0 | $0 | $0 |
| GEN-2020-027 | $0 | $0 | $0 | $0 |
| GEN-2020-028 | $0 | $0 | $0 | $0 |
| GEN-2020-030 | $0 | $0 | $0 | $0 |

| Project Num | Network Upgrades ($) | | | Total Network Upgrade Cost ($) |
|---|---|---|---|---|
| | MISO Thermal & Voltage | Transient Stability | Short Circuit | |
| GEN-2020-031 | $0 | $0 | $0 | $0 |
| GEN-2020-033 | $0 | $0 | $0 | $0 |
| GEN-2020-036 | $0 | $0 | $0 | $0 |
| GEN-2020-038 | $0 | $0 | $0 | $0 |
| GEN-2020-043 | $0 | $0 | $0 | $0 |
| GEN-2020-044 | $0 | $0 | $0 | $0 |
| GEN-2020-045 | $0 | $0 | $0 | $0 |
| GEN-2020-056 | $0 | $0 | $0 | $0 |
| GEN-2020-057 | $0 | $0 | $0 | $0 |
| GEN-2020-058 | $0 | $0 | $0 | $0 |
| GEN-2020-061 | $0 | $0 | $0 | $0 |
| GEN-2020-064 | $0 | $0 | $0 | $0 |
| GEN-2020-069 | $0 | $0 | $0 | $0 |
| GEN-2020-070 | $0 | $0 | $0 | $0 |
| GEN-2020-071 | $0 | $0 | $0 | $0 |
| GEN-2020-072 | $0 | $0 | $0 | $0 |
| GEN-2020-073 | $0 | $0 | $0 | $0 |
| GEN-2020-076 | $0 | $0 | $0 | $0 |
| GEN-2020-077 | $0 | $0 | $0 | $0 |
| GEN-2020-078 | $0 | $0 | $0 | $0 |
| GEN-2020-079 | $0 | $0 | $0 | $0 |
| GEN-2020-083 | $0 | $0 | $0 | $0 |
| GEN-2020-084 | $0 | $0 | $0 | $0 |
| GEN-2020-086 | $0 | $0 | $0 | $0 |
| GEN-2020-088 | $0 | $0 | $0 | $0 |
| GEN-2020-089 | $0 | $0 | $0 | $0 |
| GEN-2020-090 | $0 | $0 | $0 | $0 |
| GEN-2020-091 | $0 | $0 | $0 | $0 |
| GEN-2020-094 | $0 | $0 | $0 | $0 |
| **Total ($)** | **$400,000** | **$0** | **$0** | **$400,000** |

## 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 2020-001 cycle.

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

- SPP Study Projects in MISO South:
  - GEN-2020-009, GEN-2020-010, GEN-2020-012, GEN-2020-015, GEN-2020-016, GEN-2020-020, GEN-2020-023, GEN-2020-052, GEN-2020-054, GEN-2020-059, GEN-2020-060, GEN-2020-062, GEN-2020-065, GEN-2020-067, GEN-2020-068, GEN-2020-074, GEN-2020-075, GEN-2020-081, GEN-2020-085, GEN-2020-087, GEN-2020-092.
- SPP Study Projects in MISO West:
  - ASGI-2020-001, ASGI-2020-003, GEN-2020-001, GEN-2020-002, GEN-2020-006, GEN-2020-007, GEN-2020-008, GEN-2020-011, GEN-2020-013, GEN-2020-014, GEN-2020-025, GEN-2020-027, GEN-2020-028, GEN-2020-030, GEN-2020-031, GEN-2020-033, GEN-2020-036, GEN-2020-038, GEN-2020-043, GEN-2020-044, GEN-2020-045, GEN-2020-056, GEN-2020-057, GEN-2020-058, GEN-2020-061, GEN-2020-064, GEN-2020-069, GEN-2020-070, GEN-2020-071, GEN-2020-072, GEN-2020-073, GEN-2020-076, GEN-2020-077, GEN-2020-078, GEN-2020-079, GEN-2020-083, GEN-2020-084, GEN-2020-086, GEN-2020-088, GEN-2020-089, GEN-2020-090, GEN-2020-091, GEN-2020-094.

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

### 1.4.1 GEN-2020-021 Summary

| Network Upgrade | Owner | Cost | GEN-2020-021 | NUs Type |
|---|---|---|---|---|
| Sheyenne-Lake Park 230 kV | XEL<br>MPC<br>OTP | $400,000 | $400,000 | SH |
| **Total Cost Per Project** | | | **$400,000** | |

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.

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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 2020-001 Study Projects in MISO South were developed from the models used in MISO South AFSIS on AECI GI-105 project, 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 2020-001 Study Projects in MISO South were developed from the Phase 3 models used in MISO South AFSIS on SPP DISIS 18-002 / 19-001 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 2020-001 Study are listed below:

- 2025 summer peak model: AECI-GI-105_AFSIS-2025SUM-Ph3-Study_230622.sav
- 2025 summer shoulder model: SPP-DISIS-South_AFSIS-Ph3-2025SH90-Study_231030.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-11).
- 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-10).
- Removed recently withdrawn SPP prior queued generation projects (Table A-3). Power mismatch was balanced by scaling generation in SPP market (Table A-12) 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, which are listed in Table A-4. Power mismatch was balanced by scaling generation in SPP market (Table A-12) based on the load-ratio share of the TO power flow modeling areas.

- SPP prior queued generation projects (Table A-5) close to MISO South were modeled. SPP DISIS 18-002 / 19-001 generation projects in MISO South (Table A-6) were also updated and dispatched.
- AECI prior queued generation projects (Table A-7) were modeled. Power mismatch was balanced by scaling generation in AECI (Table A-13).
- Removed recently retired MISO generation in MISO South area. These recently retired MISO South generation are listed in Table A-8. Power mismatch was balanced by scaling generation in the MISO South (Table A-11).
- Removed recently retired MISO generation in MISO Central area. These recently retired generation projects in MISO Central are listed in Table A-8. Power mismatch was balanced by scaling generation in the MISO North (Table A-10).
- Turned off MISO generation projects in DPP 2020 Central area. Power mismatch was balanced by scaling generation in the MISO North (Table A-10).
- Added the SPP Study Projects with offline status in DISIS 2020-001 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 2020-001 Study Projects in MISO West were developed from the models used in MISO West AFSIS on AECI GI-102 project, 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 2020-001 Study Projects in MISO West were developed from the Phase 3 models used in MISO West AFSIS on SPP DISIS 18-002 / 19-001 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 2020-001 Study are listed below:

- 2025 summer peak model: AECI-GI-102_AFSIS_West-2025SUM-Ph3-Study_230908.sav
- 2025 summer shoulder model: SPP DISIS-West_AFSIS-Ph3-2025SH90-Study_231030.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-10).
- Removed recently withdrawn SPP prior queued generation projects (Table B-2). Power mismatch was balanced by scaling generation in SPP market (Table A-12) 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, which are listed in Table B-3. Power mismatch was balanced by scaling generation in SPP market (Table A-12) based on the load-ratio share of the TO power flow modeling areas.
- SPP prior queued generation projects (Table B-4) close to MISO West were modeled. SPP DISIS 18-002 / 19-001 generation projects in MISO West (Table B-5) were also updated and dispatched.
- MPC prior queued generation projects (Table B-6) were modeled. Power mismatch was balanced by scaling generation in the MISO North (Table A-10) except generation in Dakotas.
- AECI prior queued generation projects (Table B-7) were modeled. Power mismatch was balanced by scaling generation in AECI (Table A-13).
- 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.
- Removed recently retired MISO generation in MISO West and Central areas. These recently retired MISO Central generation are listed in Table B-8. Power mismatch was balanced by scaling generation in the MISO North (Table A-10).
- Turned off MISO generation projects in DPP 2020 Central area. Power mismatch was balanced by scaling generation in the MISO North (Table A-10).
- Added NUs required for SPP West projects prior to DISIS 18-002 / 19-001 cycle (Table B-9); Added NUs required for SPP West projects in DISIS 18-002 / 19-001 cycle (Table B-10).
- Added NUs required for MPC Group 2021 projects (Table B-11); Added several NUs required for MPC 04300 project (Table B-12).
- Added the SPP Study Projects with offline status in DISIS 2020-001 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. 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) |
|---|---|---|---|---|
| DPP 2020 West Ph3 Shoulder Model | 100 | 300 | 300 | 4×50 |
| MISO AFS on DISIS 2020-001 Shoulder Model | 300 | 300 | 600 | 4×50 |

### 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 |
| 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 2020-001 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, no thermal constraints (Table C-1) or voltage constraints (Table C-2) were identified.

#### 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, no thermal constraints (Table C-3) or voltage constraints (Table C-4) were identified.

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

#### 2.1.1.3 Summary of Summer Peak Results

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

### 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

Based on the MISO South AFSIS steady state analysis, no thermal constraints or voltage constraints were identified in MISO system for the SPP Study Projects in MISO South; No MISO AFSIS thermal or voltage Network Upgrades (NUs) are required for the SPP Study Projects in MISO South.

## 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 2020-001 Study Projects in MISO South was created from stability package used in MISO South AFSIS on AECI GI-105 project. 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 2020-001 Study Projects in MISO South was created from stability package used in MISO South

AFSIS on SPP DISIS 18-002 / 19-001 Phase 3 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 2-1. 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 2-1.

**Table 2-1: Dynamic Models for SPP DISIS 2020-001 Study Projects in MISO South**

| SPP Project # | Fuel Type | Generator / Inverter / Turbine Type |
|---|---|---|
| GEN-2020-009 | Solar / Storage | REGCAU (solar)<br>REGCAU (battery) |
| GEN-2020-010 | Solar / Storage | REGCAU (solar) |
| GEN-2020-012 | Solar / Storage | REGCAU (solar) |
| GEN-2020-015 | Solar | REGCAU |
| GEN-2020-016 | Wind | GEWTG0705 |
| GEN-2020-020 | Solar / Storage | REGCAU (solar)<br>REGCAU (battery) |
| GEN-2020-023 | Storage | REGCAU |
| GEN-2020-052 | Wind | GEWTG0705 |
| GEN-2020-054 | Solar | REGCAU |
| GEN-2020-059 | Solar / Storage | REGCA1 (solar)<br>REGCA1 (battery) |
| GEN-2020-060 | Storage | REGCAU |
| GEN-2020-062 | Solar | REGCA1 |
| GEN-2020-065 | CC | GENTPJ1 |
| GEN-2020-067 | Wind | REGCA1 |
| GEN-2020-068 | Solar | REGCA1 |
| GEN-2020-074 | Storage | REGCAU |

| SPP Project # | Fuel Type | Generator / Inverter / Turbine Type |
|---|---|---|
| GEN-2020-075 | Storage | REGCAU |
| GEN-2020-081 | Storage | REGCA1 |
| GEN-2020-085 | Solar | REGCAU |
| GEN-2020-087 | Solar | REGCAU |
| GEN-2020-092 | Solar | REGCA1 |

### 2.2.3 Disturbance Criteria

The stability simulations performed as part of this study considered all the regional and local contingencies listed in Table 2-2. 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 2-3. 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 2-2: MISO South AFSIS Regional and Local Disturbance Descriptions**

**CEII Redacted**

**Table 2-3: 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 2-2 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 Generation Tripping Due to Instability

Under two contingencies (Table 2-4), Gaines 1003 MW plant (GEN-2020-065) was tripped due to instability. About 1000 MW generation was forced through a 448 MVA 345/115 kV xfmr at Andrews (528604). GEN-2020-065 (Gaines plant) is fully responsible for mitigating the instability of the power plant. No MISO Network Upgrades are required.

**Table 2-4: Gaines Plant Tripping Due to Instability**

**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. The instability of GEN-2020-065 was caused by limited outlets after the contingency. The GEN-2020-065 generation project is responsible for mitigating the instability of the power plant. No MISO AFSIS stability NUs are required in summer peak stability study.

### 2.2.7 Summer Shoulder Stability Results

The contingencies listed in Table 2-2 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 three NERC Category P6 contingencies (Table 2-5), 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 2-5: Local Generation Tripping Due to Instability / 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 2020-001 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, no thermal constraints (Table E-11) or voltage constraints (Table E-12) were identified.

#### 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. No voltage constraints were identified.

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

| Generator | Constraint | Rating | Owner | Worst Loading | | Contingency | Cont Type |
|---|---|---|---|---|---|---|---|
| | | | | (MVA) | (%) | | |
| GEN-2020-021, GEN-2020-083 | New Sub - Buffalo 345 kV | 956 | OTP MPC | 1044.6 | 109.3 | CEII Redacted | P0 |
| GEN-2020-021 | New Sub - Buffalo 345 kV | 1041.6 | OTP MPC | 1076.4 | 103.3 | CEII Redacted | P1 |
| GEN-2020-021 | Sheyenne-Lake Park 230 kV | 300.8 | XEL MPC OTP | 381.2 | 126.7 | CEII Redacted | P1 |
| GEN-2020-021 | Audubon-Lake Park 230 kV | 293.6 | OTP | 373.2 | 127.1 | 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.

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

| Generator | Constraint | Owner | Mitigation | Cost ($) |
|---|---|---|---|---|
| GEN-2020-021, GEN-2020-083 | New Sub - Buffalo 345 kV | OTP<br>MPC | OTP: OTP equipment is sufficient, MPC conductor is limiter. $0<br>MPC: NU will be determined in MPC study | $0 |
| GEN-2020-021 | Sheyenne-Lake Park 230 kV | XEL<br>MPC<br>OTP | OTP: Prior queued upgrade will increase rating to 353.7 MVA (MPC-04300). Additional structure replacements required. $400,000 | $400,000 |
| GEN-2020-021 | Audubon-Lake Park 230 kV | OTP | Prior queued upgrade will increase rating to 479.2 / 527.1 MVA (MPC-04300). No upgrade necessary. | $0 |

### 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 3-3. No voltage constraints were identified.

**Table 3-3: Combined Thermal Constraints and Network Upgrades**

| Generator | Constraint | Owner | Mitigation | Cost ($) |
|---|---|---|---|---|
| GEN-2020-021, GEN-2020-083 | New Sub - Buffalo 345 kV | MPC | OTP: OTP equipment is sufficient, MPC conductor is limiter. $0<br>MPC: NU will be determined in MPC study | $0 |
| GEN-2020-021 | Sheyenne-Lake Park 230 kV | XEL<br>MPC<br>OTP | OTP: Prior queued upgrade will increase rating to 353.7 MVA (MPC-04300). Additional structure replacements required. $400,000 | $400,000 |
| GEN-2020-021 | Audubon-Lake Park 230 kV | OTP | Prior queued upgrade will increase rating to 479.2 / 527.1 MVA (MPC-04300). No upgrade necessary. | $0 |

## 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 2020-001 Study Projects in MISO West was created from stability package used in MISO West AFSIS on AECI GI-102 project. 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 2020-001 Study Projects in MISO West was created from stability package used in MISO West AFSIS on SPP DISIS 18-002 / 19-001 Phase 3 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 3-4. 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 3-4.

**Table 3-4: Dynamic Models for SPP Study Projects in MISO West**

| SPP Project # | Fuel Type | Generator / Inverter / Turbine Type |
|---|---|---|
| ASGI-2020-001 | Solar / Storage | REGCA1 (solar)<br>REGCA1 (battery) |
| ASGI-2020-003 | Solar / Storage | REGCA1 (solar)<br>REGCA1 (battery) |
| GEN-2020-001 | Solar | REGCAU |
| GEN-2020-002 | Solar | REGCA1 |
| GEN-2020-006 | Solar | REGCA1 |
| GEN-2020-007 | Solar / Storage | REGCAU (solar)<br>REGCAU (solar) |

| SPP Project # | Fuel Type | Generator / Inverter / Turbine Type |
|---|---|---|
| GEN-2020-008 | Solar / Storage | REGCA1 (solar)<br>REGCA1 (battery) |
| GEN-2020-011 | Solar / Storage | REGCA1 (solar)<br>REGCA1 (battery) |
| GEN-2020-013 | Solar / Storage | REGCAU (solar)<br>REGCAU (battery) |
| GEN-2020-014 | Gas | GENROE |
| GEN-2020-021 | Wind | REGCA1 |
| GEN-2020-025 | CT Gas | GENTPJU1 |
| GEN-2020-027 | Solar / Storage | REGCAU (solar)<br>REGCAU (battery) |
| GEN-2020-028 | CT Gas | GENTPJU1 |
| GEN-2020-030 | Solar / Storage | REGCAU (solar)<br>REGCAU (battery) |
| GEN-2020-031 | CT Gas | GENTPJU1 |
| GEN-2020-033 | Solar / Storage | REGCAU (solar)<br>REGCAU (battery) |
| GEN-2020-036 | Solar / Storage | REGCAU (solar)<br>REGCAU (battery) |
| GEN-2020-038 | CT Gas | GENTPJU1 |
| GEN-2020-043 | Reciprocating Engine | GENTPJU1 |
| GEN-2020-044 | Reciprocating Engine | GENTPJU1 |
| GEN-2020-045 | Reciprocating Engine | GENTPJU1 |
| GEN-2020-056 | Solar | REGCAU |
| GEN-2020-057 | Storage | REGCAU |
| GEN-2020-058 | Solar | REGCA1 |
| GEN-2020-061 | CC Gas | GENROU |
| GEN-2020-064 | CT Gas | GENTPJ1 |
| GEN-2020-069 | Wind | CP220961102<br>VPPC51100V61102 |
| GEN-2020-070 | Wind | REGCA1 |
| GEN-2020-071 | Wind | CP220961102<br>VPPC51100V61102 |

| SPP Project # | Fuel Type | Generator / Inverter / Turbine Type |
|---|---|---|
| GEN-2020-072 | Solar / Storage | REGCA1 (solar)<br>REGCA1 (battery) |
| GEN-2020-073 | Solar / Storage | REGCA1 (solar)<br>REGCA1 (battery) |
| GEN-2020-076 | Storage | REGCAU |
| GEN-2020-077 | Wind | EV212260602<br>VPPC50800V60602 |
| GEN-2020-078 | Solar | REGCA1 |
| GEN-2020-079 | Solar / Storage | REGCAU (solar)<br>REGCAU (battery) |
| GEN-2020-083 | Solar / Storage | REGCAU (solar)<br>REGCAU (battery) |
| GEN-2020-084 | Solar | REGCA1 |
| GEN-2020-086 | Solar | REGCAU |
| GEN-2020-088 | Solar | REGCA1 |
| GEN-2020-089 | Solar | REGCAU |
| GEN-2020-090 | Solar | REGCAU |
| GEN-2020-091 | Solar | REGCA1 |
| GEN-2020-094 | Solar | REGCA1 |

### 3.2.3 Disturbance Criteria

The stability simulations performed as part of this study considered all the regional and local contingencies listed in Table 3-5. 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 2-3. 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 3-5: MISO West AFSIS Regional and Local Disturbance Descriptions**

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### 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 3-5 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 Post-Fault Small Oscillation of Generation Output

Under several contingencies listed in Table 3-6, 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 3-6: Post-Fault Small Oscillation of Generation Output**

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#### 3.2.5.2 Power Oscillation from GEN-2020-006 Output

Under two contingencies (Table 3-7) at GEN-2020-006 POI (Bowman 230 kV), active power and reactive power outputs were oscillating after the fault was cleared (Figure 3-1). The post-fault Short Circuit Ratio (SCR) at the POI was only 2.02. GEN-2020-006 power plant controller model (REPCA1) has Kp (Volt/VAR regulator proportional gain) set at 50 and Ki (Volt/VAR regulator integral gain) set at 5. If the Kp is reduced to 5 and Ki is reduced to 0.5, the active power output and reactive power output from GEN-2020-006 become stable (Figure 3-2). The power oscillation from GEN-2020-006 output was caused by GEN-2020-006 generation project. The GEN-2020-006 generation project is responsible for fixing this issue.

**Table 3-7: Power Oscillation from GEN-2020-006 Output**

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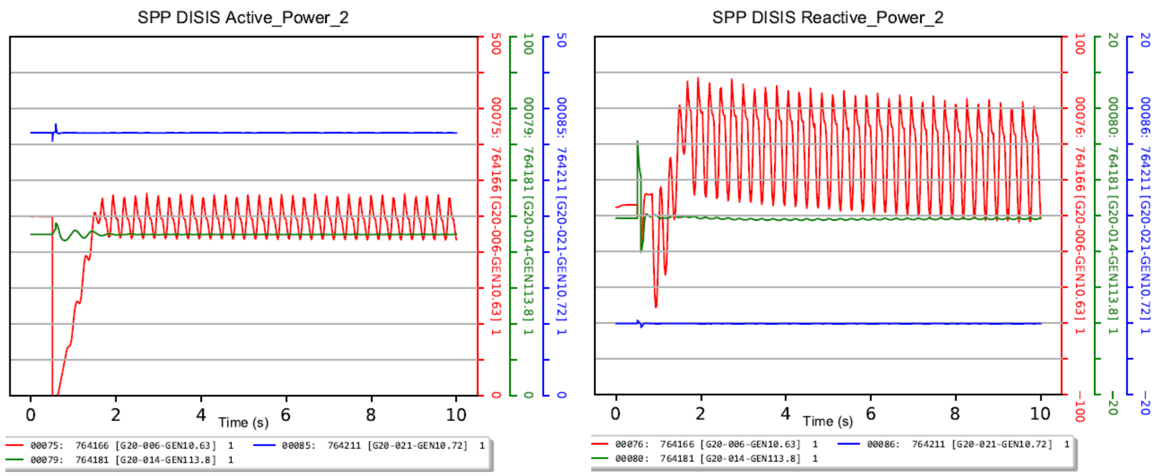


**Figure 3-1: GEN-2020-006 Power Oscillation with Original Kp=50 & Ki=5 under the Fault "BOWMAN__-BE4_3PH_POI_RHAME___-BE4_Fault"**

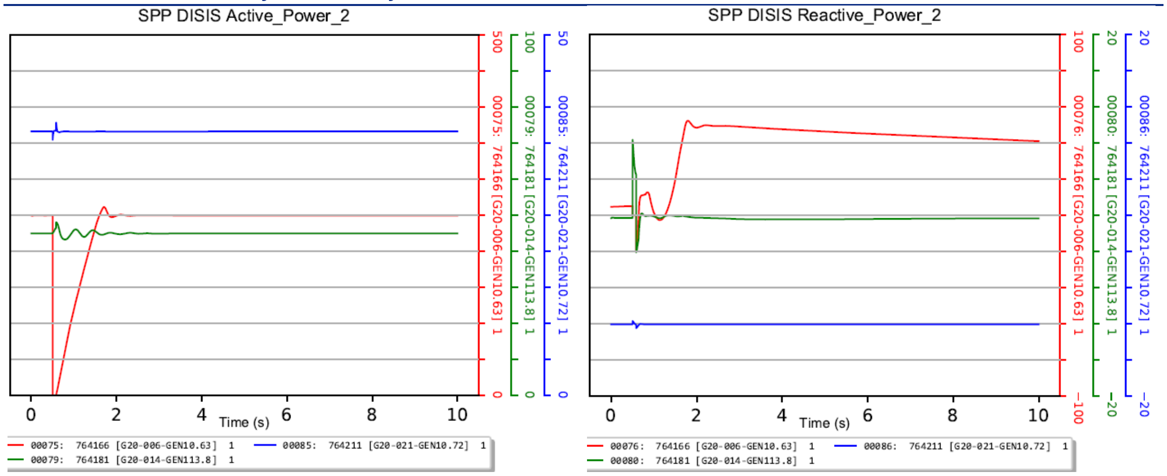


**Figure 3-2: GEN-2020-006 Power Oscillation with Updated Kp=5 & Ki=0.5 under the Fault "BOWMAN__-BE4_3PH_POI_RHAME___-BE4_Fault"**

### 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 power oscillation from GEN-2020-006 output was caused by GEN-2020-006 generation project. The GEN-2020-006 generation project is 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 3-5 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, four (4) 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 Voltage Collapse at Post Rock and Red Willow

Under two contingencies listed in Table 3-8, voltage collapse was observed at Post Rock and Red Willow 345 kV buses. In the summer shoulder power flow case, 300 MVar fictitious shunt capacitor was modeled at Red Willow 345 kV bus and 600 MVar fictitious shunt capacitor was modeled at Post Rock 345 kV bus. The identified voltage collapse in SPP system should be investigated in detail through SPP DISIS study. MISO Affected System Network Upgrade is not required.

**Table 3-8: Voltage Collapse at Post Rock and Red Willow**

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#### 3.2.8.2 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 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 3-9: Post-Fault Small Oscillation of Generation Output**

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#### 3.2.8.3 Transient High Voltage Violations in OTP, GRE, MRES

Under six contingencies listed in Table 3-10, transient high voltage violations (>1.2 p.u. for more than 0.012 sec) 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 3-10: Transient High Voltage Violations in OTP, GRE, MRES**

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### 3.2.9 Stability Constraints Identified in Summer Shoulder

In summary, no MISO Affected System stability constraints were identified in the summer shoulder scenario. The voltage collapse at Post Rock and Red Willow in SPP system is unrelated to MISO Affected System. 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 2020-001 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 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 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 | Project Name | Project Description | Expected ISD | Conditional Projects |
|---|---|---|---|---|---|
| TBD | TBD | MPC04300 Upgrade:<br>Sheyenne-Lake Park 230 kV Rating Increase | OTP: Prior queued upgrade will increase rating to 353.7 MVA (MPC-04300). | TBD | GEN-2020-021 |
| TBD | TBD | MPC04300 Upgrade:<br>Audubon-Lake Park 230 kV | OTP: Prior queued upgrade will increase rating to 479.2 / 527.1 MVA (MPC-04300). | TBD | GEN-2020-021 |

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Section
5

# Network Upgrades and Cost Allocation

## 5.1 Cost Assumptions for Network Upgrades

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

## 5.2 Cost Allocation Methodology

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

## 5.3 AFSIS Network Upgrades Required for the SPP DISIS 2020-001 Phase 2 Study Projects

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

#### 5.3.1.1 MISO South AFSIS Network Upgrades

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

In conclusion, SPP Study Projects in MISO South are not responsible for any MISO AFSIS NUs.

#### 5.3.1.2 MISO South AFSIS NU Cost Allocation

A summary of the costs for total MISO AFSIS NUs allocated to the SPP Study Projects in MISO South is listed in Table 5-1.

**Table 5-1: 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-2020-009 | $0 | $0 | $0 | $0 |
| GEN-2020-010 | $0 | $0 | $0 | $0 |
| GEN-2020-012 | $0 | $0 | $0 | $0 |
| GEN-2020-015 | $0 | $0 | $0 | $0 |
| GEN-2020-016 | $0 | $0 | $0 | $0 |
| GEN-2020-020 | $0 | $0 | $0 | $0 |
| GEN-2020-023 | $0 | $0 | $0 | $0 |
| GEN-2020-052 | $0 | $0 | $0 | $0 |
| GEN-2020-054 | $0 | $0 | $0 | $0 |
| GEN-2020-059 | $0 | $0 | $0 | $0 |
| GEN-2020-060 | $0 | $0 | $0 | $0 |
| GEN-2020-062 | $0 | $0 | $0 | $0 |
| GEN-2020-065 | $0 | $0 | $0 | $0 |
| GEN-2020-067 | $0 | $0 | $0 | $0 |
| GEN-2020-068 | $0 | $0 | $0 | $0 |
| GEN-2020-074 | $0 | $0 | $0 | $0 |
| GEN-2020-075 | $0 | $0 | $0 | $0 |
| GEN-2020-081 | $0 | $0 | $0 | $0 |
| GEN-2020-085 | $0 | $0 | $0 | $0 |
| GEN-2020-087 | $0 | $0 | $0 | $0 |
| GEN-2020-092 | $0 | $0 | $0 | $0 |
| **Total ($)** | **$0** | **$0** | **$0** | **$0** |

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

#### 5.3.2.1 MISO West AFSIS Network Upgrades

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

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

The total costs of MISO West AFSIS Network Upgrades for SPP Study Projects in MISO West are summarized in Table 5-2.

**Table 5-2: Summary of MISO West AFSIS Network Upgrades**

| Category of Network Upgrades | Cost ($) |
|---|---|
| Thermal Network Upgrades Identified in MISO Steady-State Analysis | $400,000 |
| 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** | **$400,000** |

MISO West AFSIS Network Upgrades for SPP Study Projects in MISO West are listed below. OTP intends to self-fund the upgrade.

**Table 5-3: MISO West Thermal NUs and Cost**

| Constraint | Owner | Mitigation | Cost ($) |
|---|---|---|---|
| New Sub - Buffalo 345 kV | OTP<br>MPC | OTP: OTP equipment is sufficient, MPC conductor is limiter. $0<br>MPC: NU will be determined in MPC study | $0 |
| Sheyenne-Lake Park 230 kV | XEL<br>MPC<br>OTP | OTP: Prior queued upgrade will increase rating to 353.7 MVA (MPC-04300). Additional structure replacements required. $400,000 | $400,000 |
| Audubon-Lake Park 230 kV | OTP | Prior queued upgrade will increase rating to 479.2 / 527.1 MVA (MPC-04300). No upgrade necessary. | $0 |

**Table 5-4: MISO West Steady-State Voltage NUs and Cost**

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

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

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

**Table 5-6: MISO West Short Circuit Network Upgrades**

| NUs | Cost ($) |
|---|---|
| No short circuit NUs | $0 |

**Table 5-7: MISO West Contingent Facility and Conditional Projects**

| MTEP ID | MTEP Cycle | Project Name | Expected ISD | Conditional Projects |
|---|---|---|---|---|
| TBD | TBD | MPC04300 Upgrade:<br>Sheyenne-Lake Park 230 kV Rating Increase | TBD | GEN-2020-021 |
| TBD | TBD | MPC04300 Upgrade:<br>Audubon-Lake Park 230 kV | TBD | GEN-2020-021 |

#### 5.3.2.2 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.1. The cost allocation for each NU is calculated based on the contribution of each generating facility, as detailed in Appendix G.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 5-8.

**Table 5-8: 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 | |
| ASGI-2020-001 | $0 | $0 | $0 | $0 |
| ASGI-2020-003 | $0 | $0 | $0 | $0 |
| GEN-2020-001 | $0 | $0 | $0 | $0 |
| GEN-2020-002 | $0 | $0 | $0 | $0 |
| GEN-2020-006 | $0 | $0 | $0 | $0 |
| GEN-2020-007 | $0 | $0 | $0 | $0 |

| Project Num | Network Upgrades ($) | | | Total Network Upgrade Cost ($) |
|---|---|---|---|---|
| | MISO Thermal & Voltage | Transient Stability | Short Circuit | |
| GEN-2020-008 | $0 | $0 | $0 | $0 |
| GEN-2020-011 | $0 | $0 | $0 | $0 |
| GEN-2020-013 | $0 | $0 | $0 | $0 |
| GEN-2020-014 | $0 | $0 | $0 | $0 |
| GEN-2020-021 | $400,000 | $0 | $0 | $400,000 |
| GEN-2020-025 | $0 | $0 | $0 | $0 |
| GEN-2020-027 | $0 | $0 | $0 | $0 |
| GEN-2020-028 | $0 | $0 | $0 | $0 |
| GEN-2020-030 | $0 | $0 | $0 | $0 |
| GEN-2020-031 | $0 | $0 | $0 | $0 |
| GEN-2020-033 | $0 | $0 | $0 | $0 |
| GEN-2020-036 | $0 | $0 | $0 | $0 |
| GEN-2020-038 | $0 | $0 | $0 | $0 |
| GEN-2020-043 | $0 | $0 | $0 | $0 |
| GEN-2020-044 | $0 | $0 | $0 | $0 |
| GEN-2020-045 | $0 | $0 | $0 | $0 |
| GEN-2020-056 | $0 | $0 | $0 | $0 |
| GEN-2020-057 | $0 | $0 | $0 | $0 |
| GEN-2020-058 | $0 | $0 | $0 | $0 |
| GEN-2020-061 | $0 | $0 | $0 | $0 |
| GEN-2020-064 | $0 | $0 | $0 | $0 |
| GEN-2020-069 | $0 | $0 | $0 | $0 |
| GEN-2020-070 | $0 | $0 | $0 | $0 |
| GEN-2020-071 | $0 | $0 | $0 | $0 |
| GEN-2020-072 | $0 | $0 | $0 | $0 |
| GEN-2020-073 | $0 | $0 | $0 | $0 |
| GEN-2020-076 | $0 | $0 | $0 | $0 |
| GEN-2020-077 | $0 | $0 | $0 | $0 |
| GEN-2020-078 | $0 | $0 | $0 | $0 |
| GEN-2020-079 | $0 | $0 | $0 | $0 |
| GEN-2020-083 | $0 | $0 | $0 | $0 |

| Project Num | Network Upgrades ($) | | | Total Network Upgrade Cost ($) |
|---|---|---|---|---|
| | MISO Thermal & Voltage | Transient Stability | Short Circuit | |
| GEN-2020-084 | $0 | $0 | $0 | $0 |
| GEN-2020-086 | $0 | $0 | $0 | $0 |
| GEN-2020-088 | $0 | $0 | $0 | $0 |
| GEN-2020-089 | $0 | $0 | $0 | $0 |
| GEN-2020-090 | $0 | $0 | $0 | $0 |
| GEN-2020-091 | $0 | $0 | $0 | $0 |
| GEN-2020-094 | $0 | $0 | $0 | $0 |
| **Total ($)** | **$400,000** | **$0** | **$0** | **$400,000** |

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 |
| J1353 | 43530 | J1353 GEN 0.3850 | 1 | Withdrawn |

**Table A-3: Recently Withdrawn SPP Prior Queued Project**

| Prj # | Status | Bus Number | Bus Name | Id |
|---|---|---|---|---|
| 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 |

## A.2 SPP Prior Queued Generation Projects

**Table A-5: 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-2017-132 | DISIS-2017-002 | 400 | Wind | Oklahoma | OK | Arcadia 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-6: 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 |

## A.3 AECI Prior Queued Generation Projects

**Table A-7: 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-8: 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 |
| Morrow Units 1 and 2 | MS | SMEPA | MOR GEN 1 | 318600 | 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 2 | 318601 | 1 | 0 | Retirement |

**Table A-9: 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 |
| 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-10. MISO North for Power Balance**

| Area # | Area Name | Area # | Area Name |
|---|---|---|---|
| 207 | HE | 600 | Xcel |
| 208 | DEI | 608 | MP |
| 210 | SIGE | 613 | SMMPA |
| 216 | IPL | 615 | GRE |
| 217 | NIPS | 620 | OTP |
| 218 | METC | 627 | ALTW |
| 219 | ITC | 633 | MPW |
| 295 | WEC | 635 | MEC |
| 296 | MIUP | 661 | MDU |
| 314 | BREC | 663 | BEPC-MISO |
| 315 | HMPL | 680 | DPC |
| 333 | CWLD | 694 | ALTE |
| 356 | AMMO | 696 | WPS |
| 357 | AMIL | 697 | MGE |
| 360 | CWLP | 698 | UPPC |
| 361 | SIPC | 701 | Classic Prior |
| 362 | GLH | 740 | MPC Prior |

## A.6 MISO South for Power Balance

**Table A-11. 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-12. SPP Market for Power Balance**

| Area # | Area Name | Area # | Area Name |
|---|---|---|---|
| 515 | SWPA | 542 | KACY |
| 520 | AEPW | 544 | EMDE |
| 523 | GRDA | 545 | INDN |
| 524 | OKGE | 546 | SPRM |
| 525 | WFEC | 640 | NPPD |
| 526 | SPS | 641 | HAST |
| 527 | OMPA | 642 | KACY |
| 531 | MIDW | 645 | OPPD |
| 534 | SUNC | 650 | LES |
| 536 | WERE | 652 | WAPA |
| 541 | KCPL | 659 | BEPC-SPP |

## A.8 AECI for Power Balance

**Table A-13. AECI for Power Balance**

| Area # | Area Name |
|---|---|
| 330 | AECI |

## A.9 Contingency Files used in MISO South AFSIS Analysis

**Table A-14: 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 |

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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 |
| J1350 | 43500 | J1350 GEN 0.6000 | 1 | Withdrawn |
| J1353 | 43530 | J1353 GEN 0.3850 | 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 |

**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 |

| Prj # | Status | Bus Number | Bus Name | Id |
|---|---|---|---|---|
| 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-2018-030 | WITHDRAWN | 762661 | G18-030GEN1 0.6600 | 1 |
| GEN-2018-054 | WITHDRAWN | 762892 | G18-054-GEN10.6600 | 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 |

## B.2 SPP Prior Queued Generation Projects

**Table B-4: 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-2018-022 | DISIS-2018-001 | 300 | Solar | Nodaway | MO | Mullen Creek 345 kV | GMO |
| 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 |

| Projects | Cluster | MW | Generation Type | Town or County | State | Substation or Line | TO at POI |
|---|---|---|---|---|---|---|---|
| GEN-2018-032 | DISIS-2018-001 | 310 | Wind | McPhearson | KS | Neosho 345 kV | WERE |
| 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-2018-039 | DISIS-2018-001 | 72 | Solar | LaMoure | ND | Edgeley 115 kV | WAPA |
| GEN-2018-043 | DISIS-2018-001 | 500 | Solar | Burt | NE | Ft. Calhoun-Raun 345 kV | OPPD |
| GEN-2018-056 | DISIS-2018-001 | 102.6 | Solar | Knox / Holt | NE | Grand Prairie 345 kV | WAPA |
| 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 |
| GEN-2018-062 | DISIS-2018-001 | 75.6 | Solar | Wyandotte | KS | Nearman 161 kV | KACY |

**Table B-5: 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 | 78 | 78 | 12.2 |
| 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 |

| Projects | Town / County | State | Point of Interconnection | Generation Type | Pmax | SH (MW) | SPK (MW) |
|---|---|---|---|---|---|---|---|
| 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 |
| 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 |

## B.3 MPC Prior Queued Generation Projects

**Table B-6: 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-7: 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-8: 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-9: 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-10: 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 OTP LPC | 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-11: 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<br>STATCOM: ±50 MVar |

**Table B-12: 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-13: 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 |

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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**

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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 Distribution Factor (DF), Voltage Impact, and MW Contribution Results for Cost Allocation in 2025

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

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## G.2 Cost Allocation Details

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

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

| Monitored Element | English Name | Owner | Cost | ASGI-2020-001 | ASGI-2020-003 | GEN-2020-001 | GEN-2020-002 | GEN-2020-006 | GEN-2020-007 | GEN-2020-008 | GEN-2020-011 | GEN-2020-013 | GEN-2020-014 | GEN-2020-021 | GEN-2020-025 | GEN-2020-027 | GEN-2020-028 | GEN-2020-030 | GEN-2020-031 | GEN-2020-033 | GEN-2020-036 | GEN-2020-038 | GEN-2020-043 | GEN-2020-044 | GEN-2020-045 | GEN-2020-056 | GEN-2020-057 | GEN-2020-058 | GEN-2020-061 | GEN-2020-064 | GEN-2020-069 | GEN-2020-070 | GEN-2020-071 | GEN-2020-072 | GEN-2020-073 | GEN-2020-076 | GEN-2020-077 | GEN-2020-078 | GEN-2020-079 | GEN-2020-083 | GEN-2020-084 | GEN-2020-086 | GEN-2020-088 | GEN-2020-089 | GEN-2020-090 | GEN-2020-091 | GEN-2020-094 | Upgrade for |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65700 NEW SUB 345 620358 BUFFALO3 345 1 | New Sub - Buffalo 345 kV | OTP<br>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 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | SH |
| 602006 SHEYNNE4 230 620337 LAKE PARK T4 230 1 | Sheyenne-Lake Park 230 kV | XEL<br>MPC<br>OTP | $400,000 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $400,000 | $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 | $0 | $0 | $0 | $0 | $0 | SH |
| 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 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | SH |
| **Total Cost Per Project for each Project** | **Total Cost Per Project** | | **$400,000** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$400,000** | **$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** | **$0** | **$0** | **$0** | **$0** | **$0** | |

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