MISO Affected System Studies
for
SPP DISIS-2018-001 Phase III

Role	Name	Date
Prepared:	**CF Power Ltd.**	**August 24, 2023**

Version: V1R2

CF Power Ltd.
#500, 602 –12th Avenue SW, Calgary, Alberta T2R 1J3
Tel: +1 403 891 3174 Email: fchen@cfpowerltd.com Website: http://www.cfpowerltd.com

Revision Table

Revision	Issue Date	Description
V1R2	08/24/ 2023	First round of revision

Table of Contents

List of Tables

Executive Summary

Midcontinent Independent System Operator ("MISO") has contracted with CF Power Ltd. ("CFP") to perform Affected System Studies ("AFS") for the interconnection requests in the Southwest Power Pool ("SPP") queue (the "Projects"). SPP is commencing the Definitive Interconnection System Impact Studies ("DISIS") for their DISIS-2018-001 cycle Projects. The MISO AFS is intended to identify the impacts of these Projects on the MISO system.

Because of the wide geographical region of the SPP Projects, the Projects were divided in two groups to identify the impacts on the MISO System.

The study is done in two phases. Phase II study was completed in March 2023, only steady state thermal and voltage violations were identified for DISIS-2018-001 cycle projects studied in MISO West region. Therefore, it is determined that only steady state thermal and voltage analysis were performed for the West region Projects in Phase III, and no study is needed for the projects studied in MISO South region under current model assumptions.

The Phase III study identified thermal violations in the MISO system due to SPP Projects studied in West region. However, based on the feedback from MISO and Transmission Owners, no Network Upgrade is required for the Projects studied.

It should be noted that, if any of assumptions in the model changes, including but not limited to, the higher queued and/or same group study generators, the associated network upgrades in the model, the Interconnection Customer may be subject to restudy.

Contingent Network Upgrades are identified to allow for the Interconnection Service for the studied projects. If the Contingent Network Upgrades are not completed or significantly modified, the Interconnection Service of study unit may be restricted until a re-study is performed to determine the applicable service level that results. If there are no modifications to the table, the study projects will be included in MISO's Annual studies to determine available injection until assumptions reach their expected In-Service Date.

A short circuit screening analysis was conducted by comparing three phase fault currents in the benchmark and study cases for the DISIS-2018-001 cycle Projects. Based on the screening results, no additional short circuit studies were required.

1 Introduction

1.1 Background

Midcontinent Independent System Operator ("MISO") has contracted with CF Power Ltd. ("CFP") to perform Affected System Studies ("AFS") for the interconnection requests in the Southwest Power Pool ("SPP") queue (the "Projects"). SPP is commencing the Definitive Interconnection System Impact Studies

("DISIS") for their DISIS-2018-001 cycle Projects. The MISO AFS is intended to identify the impacts of these Projects on the MISO system.

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

The study is done in two phases. Phase II study was completed in March 2023, only steady state thermal and voltage violations were identified for DISIS-2018-001 cycle projects studied in MISO West region. Therefore it is determined that only steady state thermal and voltage analysis need to be performed for the West region Projects in Phase III, and no restudy is needed for the projects studied in MISO South region under current model assumptions.

Table 1-1: MISO Study Groups for the DISIS-2018-001 Phase III

Group	Total Requests	Total Capacity (MW)	Geographical Region of the Requests
MISO West Region	24	3127.9	CO, MO, ND, NE, KS, SD

1.2 Project Description

SPP Projects, to be studied as part of Phase III analysis for MISO West region, are listed in Table 1-2.

Table 1-2: SPP Projects List for MISO West Region

Project	Capacity	Fuel Type	Area Name	State
ASGI-2017-013	40	Wind	WAPA	SD
ASGI-2018-003	20	Solar	KCPL	KS
ASGI-2018-006	20	Solar	KCPL	KS
ASGI-2018-007	20	Solar	KCPL	KS
ASGI-2018-010	35	Solar	KCPL	KS
ASGI-2018-011	35	Solar	KCPL	KS
GEN-2018-008	252	Wind	WAPA	ND
GEN-2018-010	74.1	Battery/Storage	WAPA	ND
GEN-2018-012	74.1	Wind	NPPD	NE
GEN-2018-013	74.1	Wind	WERE	KS
GEN-2018-022	300	Solar	KCPL	MO
GEN-2018-025	200	Battery/Storage	OPPD	NE
GEN-2018-030	200	Battery/Storage	SPS	CO
GEN-2018-031	50	Battery/Storage	KCPL	MO
GEN-2018-032	310	Wind	WERE	KS
GEN-2018-033	200	Battery/Storage	OPPD	NE
GEN-2018-037	100	Battery/Storage	OPPD	NE
GEN-2018-039	72	Solar	WAPA	ND
GEN-2018-043	500	Solar	OPPD	NE
GEN-2018-054	120	Solar	KCPL	KS
GEN-2018-056	102.6	Solar	WAPA	NE

Project	Capacity	Fuel Type	Area Name	State
GEN-2018-057	203.4	Solar	WERE	KS
GEN-2018-060	50	Wind	NPPD	NE
GEN-2018-062	75.6	Solar	KACY	KS

2 Assumptions and Methodology

2.1 Study Models

Phase III model was developed from MISO_AFS_Models_DISIS-2018-001_West models that were used for Phase II studies.

2.2 Model Development

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

2.2.1 Higher Queued Projects

The models for both west and south region also included upgrades from the higher-queued (HQ) Projects in the SPP generator interconnection queue. Five (5) withdrawn from 2017-002 queue in west model. So, Thirty (30) and nineteen (19) higher-queued (2017-002) were added to the model for west and south region respectively. The models for both west and south region also included upgrades from the higher-queued (HQ) Projects in the SPP generator interconnection queue (i.e., 2017-001 and 2016-002 queue). fifty-six (56) higher-queued Projects were added. Also, six (6) and seven (7) higher-queued projects in the MPC and AECI area included in the model, respectively. The included higher queued projects are listed in Appendix B.

2.2.2 Higher Queued Network Upgrades

MISO Provided a list of network upgrades with associated idev files to model the upgrades. The following upgrades were added to the base cases:

- DPP19-Restudy-Astoria-Brookings345-2.idv
- Byron-PV 345 kV uprate.idv
- Hankinson-Wahpeton Rebuild_bus updated for DPP20 by LQ.idv
- 2020DPP2_OTP_mitigations.idv
- Byron - North Rochester 345kV Upgrade.idv

2.2.3 Study Projects Modeling

MISO also provided the idevs for twenty-one (21) SPP Projects for west cases (listed in **Error! Reference source not found.**) and twelve (12) SPP Projects for the south case (listed in **Error! Reference source not found.**) to be studied. To create Post-Project cases, CFP added these projects to the study cases and dispatched these Projects according to Load Ratio Share (LRS) of various SPP control areas per the SPP practices. Projects were dispatched based on the fuel type in accordance with the MISO business practices as listed in Table 2-1 below.

Table 2-1: Projects Dispatch based on the Fuel Type

uel type	Summer Case	Shoulder Case
Solar/CT/Diesel/Oil	100%	0%
Wind	15.6%	100%
Coal/Hydro/Nuclear/Waste Heat	100%	100%
Combined Cycle	100%	50%
Storage	100%	±100%

2.3 Methodology

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

2.3.1 Power Flow Analysis

An AC contingency analysis was performed for the selected North American Electric Reliability Corporation (NERC) Reliability Standard TPL-001-4 Category P1 through P7 contingencies within the MISO and external region as previously defined by the MISO transmission owners and available in the MISO model package. MISO facilities of 69 kV and higher voltage levels and relevant third-party facilities were monitored in the study region. CFP used Siemens PSS/E v34 and PowerGEM TARA v2202_2 software tools to perform the analysis.

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

A 60% loading cut-off was used for Pre Project AC run and 90% is used for Post Project AC run. All MISO facilities listed in the MON file were monitored. CFP also generated distribution factors (DFs) for the study Projects to identify their impacts on the constraints.

Pre- and Post-Project power flow analyses were conducted, and results were compared to identify the impacts of the SPP DISIS-2018-001 cycle Projects on the system performance.

Results were screened based on the following MISO criteria:

- Thermal Loading Criteria
    - Branch loading is >100% applicable normal or emergency rating and generator has:

- P0 (No Contingency) : 5% DF Cutoff, or
- P1 & P2 (Single Contingency) : 20% DF Cutoff, or
- P4 (Fault plus stuck breaker) : 20% DF Cutoff, or
- P7 (Common Structure): 20% DF Cutoff, or

- MW Impact from study generator greater than or equal to 20% of the applicable line rating (normal or emergency), or
- Overloaded facility or overload-causing contingency at generator's outlet
- Cumulative MW Impact from study generators greater than or equal to 20% of the applicable line rating (normal or emergency), where study generators whose individual MW Impact is greater than 5% of the rating and has DFAX of greater than 5% will be responsible to mitigate the cumulative MW Impact Constraint
- Any Transmission Owner (TO) planning criteria

■ Voltage Criteria

- Bus voltage is outside of applicable normal or emergency limits, and
- Voltage degradation is greater than 1%

3 Steady State Analysis

3.1 West Region

3.1.1 Thermal Results

As per the planning criteria listed in Section 2 of this report, thermal violations were identified due to the SPP Projects in Summer Shoulder case. However, based on the feedback from the Transmission Owners. No Network Upgrades are required for the study projects. The detailed list of violations is provided in Appendix A.

3.1.2 Voltage Results

As per the planning criteria listed in Section 2 of this report, no network upgrade is required for the SPP Projects in West region for the voltage violations identified in the study.

3.1.3 Network Upgrades and Cost Allocation

As mentioned above, no Network Upgrades are required for the SPP Projects in West region, therefore no cost responsibility to the Projects.

3.2 South Region

Based on Phase II result, South region Study is not needed for Phase III.

4 Contingent Facilities

The table below describes transmission assumptions modeled in the studies that were deemed necessary to allow for the Interconnection Service of study unit. If the transmission assumptions are not completed or significantly modified, the Interconnection Service of study unit may be restricted until a re-study is performed to determine the applicable service level that results. If any of the higher queued and/or same group study generators in the model drop out, the Interconnection Customer may be subject to restudy. If there are no modifications to the table, the study projects will be included in MISO's Annual studies to determine available injection until assumptions reach their expected In-Service Date.

Table 4-1: Contingent Facilities

Project Name	Status	MTEP ID	MOD ID	Project Name	MTEP Cycle	Project Description	Project Status	Expected completion Date
ASGI-2017-013	DISIS STAGE	N/A	N/A	PJM baseline upgrade #B3775	N/A	Crete-St. John Area Improvement	Planning	12/01/2026
GEN-2018-008	DISIS STAGE	N/A	N/A	PJM baseline upgrade #B3775	N/A	Crete-St. John Area Improvement	Planning	12/01/2026
GEN-2018-010	DISIS STAGE	N/A	N/A	PJM baseline upgrade #B3775	N/A	Crete-St. John Area Improvement	Planning	12/01/2026
GEN-2018-039	DISIS STAGE	N/A	N/A	PJM baseline upgrade #B3775	N/A	Crete-St. John Area Improvement	Planning	12/01/2026
GEN-2018-037	DISIS STAGE	15669	116740	Sub 701: Install 2nd 161-69 kV transformer	MTEP 19	Install a second 161-69 kV transformer and complete the 161 kV ring bus at Sub 701. Install two new 161 kV circuit breakers.	Under Construction	05/15/2024

5 Short Circuit Analysis Results

A short circuit screening analysis was conducted by comparing three phase fault currents in the benchmark and study cases for the DISIS-2018-001 cycle Projects. Based on the screening results, no additional short circuit studies were required.

Appendix A : Steady State Thermal Results

Table 5-1: Thermal results for West Region, Shoulder Case

Redacted

Appendix B List of Higher Queued Projects

Table 5-2: DISIS-2017-002 SPP Project List for West Region

Project	Capacity	Fuel Type	Area Name
ASGI-2017-014	40	Solar	KCPL
GEN-2017-105	75	Wind	OPPD
GEN-2017-108	200	solar	KCPL
GEN-2017-108	200	Solar	KCPL
GEN-2017-111	152	Solar	KCPL
GEN-2017-115	122	Wind	KCPL
GEN-2017-115	122	Wind	KCPL
GEN-2017-119	90	Wind	SUNC
GEN-2017-119	90	Wind	SUNC
GEN-2017-120	130	Wind	WERE
GEN-2017-120	130	Wind	WERE
GEN-2017-125	252	Wind	WERE
GEN-2017-128	202	Wind	WERE
GEN-2017-144	100	Wind	WERE
GEN-2017-144	100	Wind	WERE
GEN-2017-148	202	Wind	EMDE
GEN-2017-175	150	Wind	WAPA
GEN-2017-175	150	Wind	WAPA
GEN-2017-181	300	Wind	NPPD
GEN-2017-182	128	Wind	NPPD
GEN-2017-183	200	Wind	KCPL
GEN-2017-183	200	Wind	KCPL
GEN-2017-184	200	Solar	KCPL
GEN-2017-184	200	Solar	KCPL
GEN-2017-188	85	Solar	EMDE
GEN-2017-188	85	Solar	EMDE
GEN-2017-191	201.6	Solar	WERE
GEN-2017-195	500.4	Solar	KCPL
GEN-2017-196	128	Battery	KCPL
GEN-2017-201	250	Wind	NPPD
GEN-2017-202	200	Solar	SWPA
GEN-2017-209	350	Solar	KCPL
GEN-2017-210	310	Solar	NPPD
GEN-2017-214	100	Wind	WAPA
GEN-2017-215	100	Wind	WAPA
GEN-2017-216	100	Wind	WAPA
GEN-2017-222	90	Wind	WAPA
GEN-2017-222	90	Wind	WAPA
GEN-2017-229	76	Storage	KCPL
GEN-2017-234	115	Wind	NPPD

Table B-2: DISIS-2017-001 Higher Queued Project List in SPP

Project	Capacity	Fuel Type	Area Name
GEN-2017-057	72.5	solar	AEWP
GEN-2017-060	24	wind	EMDE
GEN-2017-060	125.4	wind	EMDE
GEN-2017-061	101.5	solar	GRDA
GEN-2017-071	124.7	solar	OKGE
GEN-2017-075	200	solar	OKGE
GEN-2017-077	124.7	solar	AEWP
GEN-2017-082	24	Wind	EMDE
GEN-2017-082	125.4	Wind	EMDE
GEN-2017-092	80.6	solar	OKGE
GEN-2017-092	119.4	solar	OKGE
GEN-2017-094	100	Wind	WAPA
GEN-2017-094	100	Wind	WAPA
GEN-2017-097	64	solar	WAPA
GEN-2017-097	64	solar	WAPA
GEN-2016-037	300	Wind	AEWP
GEN-2017-004	201.6	wind	SUNC
GEN-2017-005	190	wind	WERE
GEN-2017-009	151	wind	WERE
GEN-2017-009	151	wind	WERE
GEN-2017-010	200.1	wind	WAPA
GEN-2017-014	162	wind	WAPA
GEN-2017-014	138	wind	WAPA
GEN-2017-023	85	solar	WFEC
GEN-2017-027	140	wind	OKGE
GEN-2017-040	96.6	solar	OKGE
GEN-2017-040	103.5	solar	OKGE
GEN-2017-048	300	Wind	WAPA

Table 5-3: DISIS-2016-002 Higher Queued Project List in SPP

Project	Capacity	Fuel Type	Area Name
GEN-2016-094	200	Wind	WAPA
GEN-2016-115	300	Wind	KCPL
GEN-2016-130	202	Wind	WAPA
GEN-2016-147	40	solar	NPPD
GEN-2016-151	202	Wind	BEPC-SPP
GEN-2016-036	44.6	Wind	WAPA
GEN-2016-074	200	wind	NPPD
GEN-2016-087	98.9	wind	WAPA
GEN-2016-063	200	wind	OKGE

Table 5-4: AECI Higher Queued Project List

Project	Capacity	Fuel Type	Area Name
GI-061	230	Wind	AECI
GI-83	1018	Wind	
GI-086	100	Solar	
GI-090	108	Solar	
GI-091	99	Solar	
GI-093	112.87	Solar	
GI-095	251.2	Wind	
GI-096	100.4	Wind	

Table 5-5: MPC Higher Queued Project List

Project	Capacity	Fuel Type	Area Name
MPC03600	200	solar	MPC
MPC3700	150	solar	
MPC03800	250	wind	
MPC03900	150	wind	
MPC04000	150	wind	