SPP-MISO 2021 JOINT TARGETED INTERCONNECTION QUEUE STUDY

SCOPE OF WORK

By SPP-MISO Joint Study Team

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Version 3

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1 OVERVIEW

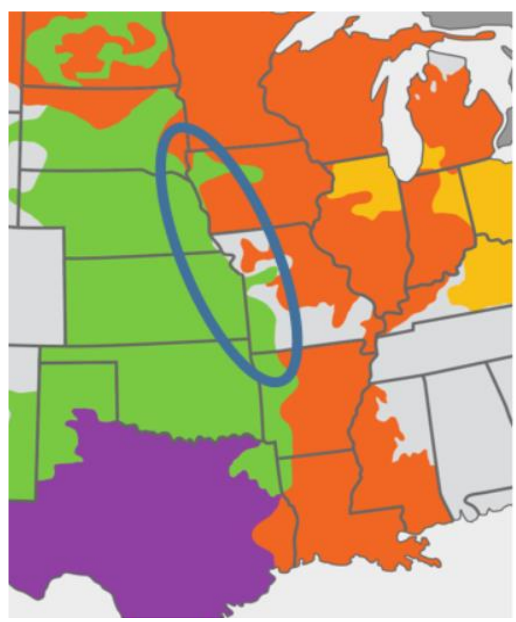
1.1 OVERVIEW

This document presents the scope and schedule of work for the SPP-MISO 2021 Joint Targeted Interconnection Queue (JTIQ) study. The concept of the JTIQ was conceived in mid-2020 through coordination between executives of both Regional Transmission Organizations (RTO) as a means to identify projects required for the interconnection of low cost resources which provide economic benefit to both the MISO and SPP regions. The concept was further developed through SPP and MISO executive outreach to stakeholders of both organizations. A joint press release announcing the intent to perform the study was issued in September of 2020. The initial joint stakeholder meeting to discuss the JTIQ study was held in December of 2020. SPP and MISO staff continued to coordinate in Q4 of 2020 and Q1 of 2021 resulting in the study scope presented in this document. It is the intent of SPP and MISO to complete this study in late 2021.

1.2 STUDY PURPOSE AND GOALS

As observed in the DPP-2017-FEB-West, DPP-2017-AUG-West and DISIS-2017-001 cluster studies, the transmission system is at its capacity and the next iteration of network upgrades are too costly for interconnection projects to proceed. While the additional of renewable resources and transmission along the seam benefit the market, current mechanisms do not provide sufficient cost sharing to facilitate new generator interconnection. Process, criteria, and schedule differences between the RTO's contribute to study delays and introduce questions on study results.

Figure 1: Seams Region of Interest



SPP-MISO JTIQ Study Goals:

- Identify more comprehensive, cost effective and efficient upgrades than would otherwise be identified in the current interconnection queue process where upgrades are identified in the time sequence by one or the other RTO
- Identify solutions that meet the needs of interconnection customers and provide benefits to load in both SPP and MISO near the seam
- Identify opportunities to improve coordination between processes and affected parties both in this instance and on an ongoing basis

2 STUDY SCOPE

2.1 STUDY FRAMEWORK

This study will have two parallel objectives: (1) Identify transmission solutions to interconnection queue generation on seams and (2) align Interconnection processes between SPP and MISO to reduce restudies/delays post GIA uncertainties for Interconnection Customers.

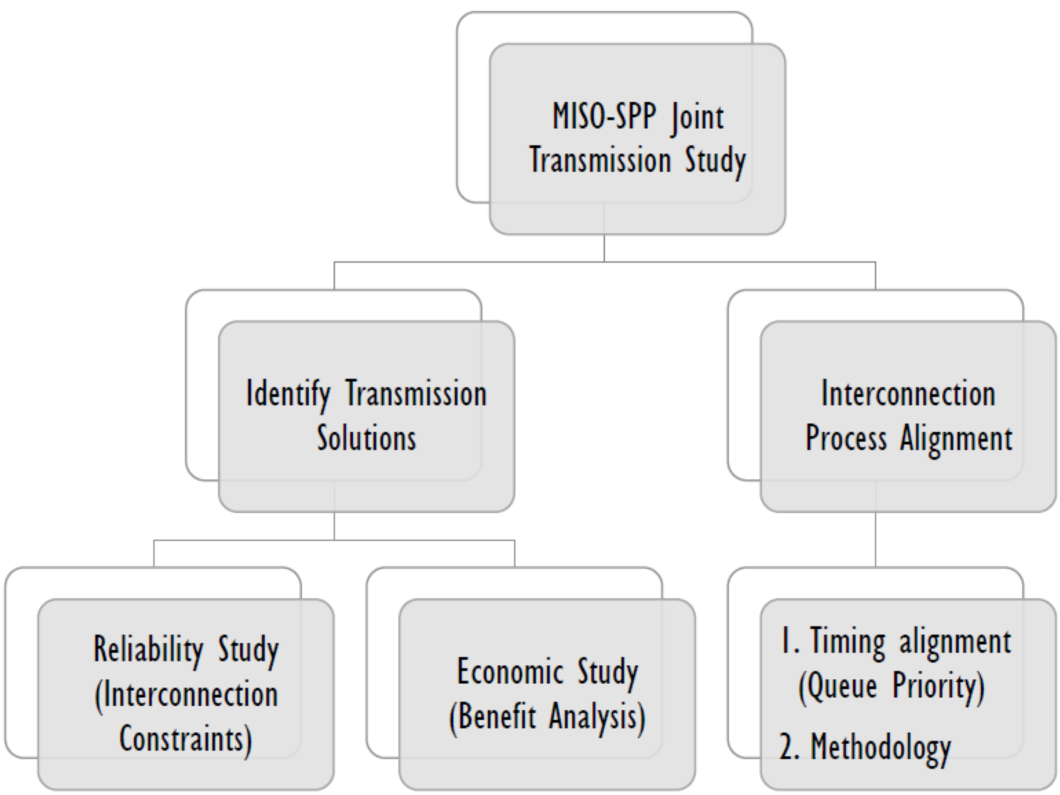


Figure 2: MISO-SPP Joint Study Framework

2.2 RELIABILITY STUDY SCOPE - SPP

2.2.1 STUDY MODELS

The GI study will utilize the following 2021 ITP power flow models:

- 2023 Summer Peak
- 2026 Light Load
- 2026 summer peak
- 2026 Winter Peak

The GI study will include a High Variable Energy Resource (HVER) and Low Variable Energy Resource (LVER) dispatch scenario. For each dispatch scenario, a base (BC) and transfer (TC) case will be created per season which represent the before and after future changes.

Table 1: HVER Study Models

Model Name	Loads	Topology	Study Unit(s)
2021ITPP3b-HVER-BC-23S	Summer Peak	2023	OFF
2021ITPP3b-HVER-BC-26L	Light Load	2026	OFF
2021ITPP3b-HVER-BC-26S	Summer Peak	2026	OFF
2021ITPP3b-HVER-BC-26W	Winter Peak	2026	OFF
2021ITPP3b-HVER-TC-23S	Summer Peak	2023	ON
2021ITPP3b-HVER-TC-26L	Light Load	2026	ON
2021ITPP3b-HVER-TC-26S	Summer Peak	2026	ON
2021ITPP3b-HVER-TC-26W	Winter Peak	2026	ON

Table 2: LVER Models

Model Name	Loads	Topology	Study Unit(s)
2021ITPP3b-LVER-BC-23S	Summer Peak	2023	OFF
2021ITPP3b-LVER-BC-26S	Summer Peak	2026	OFF
2021ITPP3b-LVER-BC-26W	Winter Peak	2026	OFF
2021ITPP3b-LVER-TC-23S	Summer Peak	2023	ON
2021ITPP3b-LVER-TC-26S	Summer Peak	2026	ON
2021ITPP3b-LVER-TC-26W	Winter Peak	2026	ON

Only one set of models will be developed to evaluate the current study interconnection requests in the GI analysis. That is, there will be no “in-group” or “out-group” dispatch. This “model reduction” is meant to highlight potential constraints which may otherwise be overlooked in the “group dispatch” methodology currently utilized by the SPP GI process. This alignment in dispatch approach between MISO and SPP is expected to yield more comparable results than in previous impact studies.

A list of interconnection requests which meet future assumptions for the SPP ITP and MISO MTEP will serve as the "current study" interconnection requests for this analysis. The current study interconnection requests are detailed under Appendices sections **Error! Reference source not found.** and **Error! Reference source not found.**.

Current study interconnection requests which are already modeled in the 2021 ITP will be left as-is. That is, the project will not be modified if the requested queue capacity conflicts with the modeling data submitted to the 2021 ITP model. The Pmax of each existing current study interconnection request as submitted for the 2021 ITP model for summer and winter will be used to determine the capacity of the unit.
Current study interconnection requests which are not modeled in the 2021 ITP will be added to the model as "out of service" at the POI. The Pmax of each project will be modeled consistently with the requested summer and winter capacity amounts requested in the host RTO's public queue.

2.2.2 GENERATION ASSUMPTIONS

Retirements/Deactivations

- SPP
  - SPP Generation deactivations will be modelled offline.
  - Complete list in Section 5.1
- MISO
  - MISO approved Attachment Y (Retirement/Suspension) generation will be modelled offline.
  - MISO age-based retirements as per Futures I will be modelled offline.
  - Complete list in Section 5.2

Generation

- SPP
  - SPP will add Future II generation in SPP footprint.
  - Details in Section 5.1
  - Distributed Generation will be excluded
- MISO
  - MISO will add Future I generation in MISO footprint.
  - Details in Section 5.2
  - Distributed Generation will be excluded.

2.2.3 DISPATCH ASSUMPTIONS

In an attempt to reconcile dispatch discrepancies between MISO West and SPP, SPP groups 9, 13, 15, 16, 17, and 18 will be combined into what will be referred to as "SPP North", which aligns with the MISO West region and includes the area of interest noted in Figure 1. SPP groups 1, 2, 3, 4, 6, 7, 8 10, 12, and 14 will be considered "SPP South".

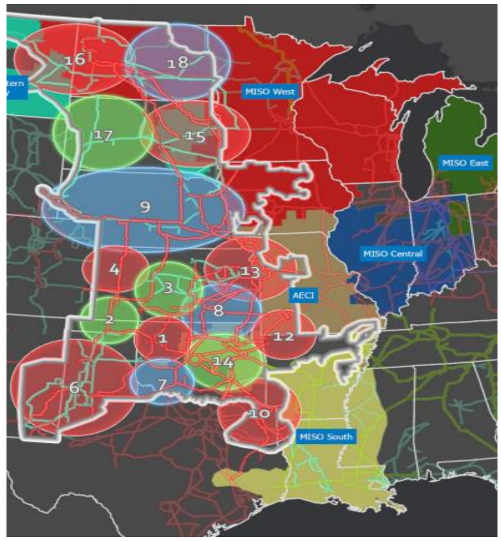


Figure 3: SPP Groups

As MISO will not be evaluating Network Resource Interconnection Service (NRIS) for SPP, the SPP GI study will not evaluate NRIS for MISO. MISO and SPP interconnection requests will be evaluated for ERIS only. As such, SPP will only develop HVER and LVER dispatch scenarios per Table 3.

Dispatch Assumptions consistent with SPP Generator Interconnection DISIS studies will be used for both MISO and SPP generation.

The study units are dispatched at their expected output level as per their fuel type percentage outlined in Table 3. Study units in SPP North are sunk into SPP North, SPP South are sunk into SPP South, MISO North (Classic) are sunk into MISO North (Classic), MISO South are sunk into MISO South, and the existing generation/deactivations is scaled down by the amount of MW study units added.

Table 3: Fuel-Type Dispatch for Current Study Interconnection Requests

	HVER Dispatched %	LVER Dispatched %
Fuel Type	Summer, Winter, & Light Load	Winter & Summer
Combustion Cycle	20%	100%
Combustion Turbine	20%	100%
Diesel Engines	20%	100%
Hydro	20%	100%
Nuclear	20%	100%
Storage	100%	20%
Steam – Coal	20%	100%
Oil	20%	100%
Waste Heat	20%	100%
Wind	100%	20%
Solar	100%	20%

2.2.4 TRANSMISSION ASSUMPTIONS

Topology data in the 2021 ITP base reliability models was incorporated in accordance with the ITP Manual. For items not specified in the ITP Manual, SPP followed the MDWG Model Development Procedure Manual. The topology for areas external to SPP was consistent with the 2019 Eastern Interconnection Reliability Assessment Group Multi-Regional Modeling Working Group (MMWG) model series.

2.2.5 MONITORING AND CONTINGENCIES

Monitor

All control areas in the SPP internal footprint will be monitored.

Monitor files built for the 2021 ITP will be used to monitor SPP control areas for this study. MISO will provide MISO's monitor file.

Contingencies

The following contingencies in the study region (all control areas in MISO and SPP) will be considered in the steady state analysis:

1) NERC Category P0 (system intact - no contingencies)

2) NERC Category P1 contingencies

    a. Single element outages, at buses with a nominal voltage of 68 kV and above

    b. Multiple element NERC Category P1 contingencies

3) NERC Category P2, P4, P5 and P7 contingencies

4) For all the contingencies 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.

2.2.6 STUDY PERFORMANCE

Under NERC category P0 conditions (system intact) branches will be monitored for loading above the normal rating (PSS®E Rating A), and for NERC category P1-P7 conditions branches will be monitored for emergency rating (PSS®E Rating B). Voltage limits for system intact and contingent conditions are as per applicable Transmission Owner Planning Criteria.

Transfer cases will be compared with base cases to see if the new interconnection projects are responsible of causing criteria violations.

To further filter down constraints, SPP ERIS constraint criteria may be used:

The generator has a larger than 20% sensitivity factor on the overloaded facilities under post contingent condition or 3% sensitivity factor under system intact condition.

2.2.7 MITIGATION SOLUTIONS

Thermal and voltage constraints identified in SPP study cases that meet Study performance criteria will be mitigated in accordance with existing procedures used in SPP Transmission Expansion Planning studies and/or Generator Interconnection studies.

2.3 RELIABILITY STUDY SCOPE - MISO

2.3.1 STUDY MODELS

Studies will be performed using the following power flow models:

- The near-term starting models will be from MISO MTEP20_2025 case
    - 2025 Summer Shoulder MTEP20_2025_SH40_TA
    - 2025 Summer Peak MTEP20_2025_SUM_TA
- The out-term starting models will be from MISO MTEP20_2030 case
    - 2030 Summer Shoulder MTEP20_2030_SH40_TA
    - 2030 Summer Peak MTEP20_2030_SUM_TA
- MISO will perform one group study for all MISO and SPP regions.

For each model, two scenarios will be created which represent before and after Future I changes.

Table 4: Study Models

Model Name	Loads	Topology	Study Unit(s)
2025SH_BENCH_OFF	Summer Shoulder	2025	OFF
2025SH_STUDY_ON	Summer Shoulder	2025	ON
2025SP_ BENCH _OFF	Summer Peak	2025	OFF
2025SP_STUDY_ON	Summer Peak	2025	ON
2030SH_ BENCH _OFF	Summer Shoulder	2030	OFF
2030SH_STUDY_ON	Summer Shoulder	2030	ON
2030SP_ BENCH _OFF	Summer Peak	2030	OFF
2030SP_STUDY_ON	Summer Peak	2030	ON

2.3.2 GENERATION ASSUMPTIONS

- MISO Deactivations
  - MISO approved Attachment Y (Retirement/Suspension) generation will be modelled offline.
  - MISO age-based retirements as per Future I will be modelled offline
  - Complete list is in Appendix
- SPP Deactivations
  - SPP Generation deactivations provided by SPP will be modelled offline
  - Complete list is in Appendix

NEW INTERCONNECTION GENERATION

- MISO will add Future I generation in MISO footprint
  - Distributed Generation will be excluded
  - Details in Appendix
- SPP Future generation information will be provided by SPP.
  - Distributed Generation will be excluded
  - Details in Appendix

2.3.3 TRANSMISSION ASSUMPTIONS

MISO MTEP20 2025 TA series models include all future transmission Appendix A and Target Appendix A projects with in-service date of or before July 15, 2025

MISO MTEP20 2030 TA series models include all future transmission Appendix A and Target Appendix A projects with in-service date of or before July 15, 2030

SPP will provide modeling information for major transmission upgrades in SPP's footprint by year 2030 along with in-service date. This will be added to applicable MISO MTEP20 2025 or/and 2030 models.

2.3.4 DISPATCH ASSUMPTIONS

Dispatch Assumptions consistent with MISO Generator Interconnection DPP studies will be used.

The study units added to the starting case are dispatched at their expected output level as per fuel type Table 5 such the study units in MISO North (Classic) are sunk into MISO North (Classic) and generators in MISO South are sunk into MISO South, the existing generation/deactivations is scaled down by the amount of MW study units added.

Same Fuel type methodology will be used for SPP Futures generation, SPP Futures generation will be sunk into SPP control areas and the existing generation/deactivations is scaled down by the amount of MW SPP Futures generation added.

Table 5: MISO Fuel Type dispatch for study units

Fuel Type	Summer Peak Dispatched %	Summer Shoulder Dispatched %
Combustion Cycle	100%	50%
Combustion Turbine	100%	0%
Diesel Engines	100%	0%
Hydro	100%	100%
Nuclear	100%	100%
Storage[1]	100%	0%
Steam - Coal	100%	100%
Oil	100%	0%
Waste Heat	100%	100%
Wind	15.6%	100%
Solar	100%	0%

2.3.5 MONITORING AND CONTINGENCIES

MONITOR

All control areas in MISO and SPP footprint will be monitored. Details in Appendix
Monitor files build for MTEP2020 study will be used to monitor MISO control areas for this study. SPP will provide SPP's monitor file.

[1] Only Battery Discharge scenario will be studied. Battery Charging additional Scenarios will not be created.

CONTINGENCIES

The following contingencies in the study region (all control areas in MISO and SPP) will be considered in the steady state analysis:

1) NERC Category P0 (system intact -- no contingencies)
2) NERC Category P1 contingencies
    a. Single element outages, at buses with a nominal voltage of 68 kV and above
    b. Multiple element NERC Category P1 contingencies
3) NERC Category P2, P4, P5 and P7 contingencies
4) For all the contingencies 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.

2.3.6 STUDY PERFORMANCE (CONSTRAINT) CRITERIA

Under NERC category P0 conditions (system intact) branches will be monitored for loading above the normal rating (PSS®E Rating A), and for NERC category P1-P7 conditions branches will be monitored for emergency rating (PSS®E Rating B). Voltage limits for system intact and contingent conditions are as per applicable Transmission Owner Planning Criteria.
Study cases will be compared with Bench cases to see if the new interconnection projects are responsible of causing criteria violations.

To further filter down constraints, MISO ERIS constraint criteria may be used:
The generator has a larger than 20% sensitivity factor on the overloaded facilities under post contingent condition or 5% sensitivity factor under system intact condition (Details in BPM015 – Generator Interconnection)

2.3.7 MITIGATION SOLUTIONS

Thermal and voltage constraints identified in MISO study cases that meet Study performance criteria will be mitigated in accordance with existing procedures used in MISO Transmission Expansion Planning studies and/or Generator Interconnection studies.

2.4 ECONOMIC STUDY SCOPE - SPP

2.4.1 STUDY MODELS

Economic models will be developed based on assumptions included in the 2021 ITP assessment for the Emerging Technologies Future (Future 2) and modified as necessary to meet the needs of this study. These modifications will generally be limited to adjustment of resource siting locations consistent with queue requests included in the reliability models developed for this study, with the overall goal of meeting certain total installed capacity amounts on the SPP transmission system for different resource types, specifically renewable generation.

Table 6 details the assumptions included in the 2021 ITP assessment models.

Table 6: 2021 ITP Assessment Assumptions

<table>
<tr><th rowspan="3">Key Assumptions</th><th colspan="5">Drivers</th></tr>
<tr><th rowspan="2">Year 2</th><th colspan="2">Reference Case</th><th colspan="2">Emerging Technologies</th></tr>
<tr><th>Year5</th><th>Year 10</th><th>Year5</th><th>Year 10</th></tr>
<tr><td>Fossil Fuel Retirements</td><td>Current forecast</td><td colspan="2">Coal age-based 56+, Gas/Oil age-based 50+, subject to generator owner review</td><td colspan="2">Coal age-based 52+, Gas/Oil age-based 48+, subject to GO review and ESWG approval</td></tr>
<tr><td>Wind (GW)</td><td>Existing + RARs</td><td>29</td><td>32</td><td>33</td><td>37</td></tr>
<tr><td>Solar (GW)</td><td>Existing + RARs</td><td>6</td><td>9</td><td>7</td><td>11</td></tr>
<tr><td>Storage</td><td>None</td><td colspan="2">20% of projected solar</td><td colspan="2">35% of projected solar</td></tr>
</table>

The following models from the 2021 ITP assessment will be utilized:

- Year 2
- Future 2 year 5
- Future 2 year 10

To appropriately constrain the economic model during SCUC/SCED simulations, the event file developed for the 2021 ITP assessment will be utilized as a base set of flowgates. This includes current operational flowgates as well as flowgates included via analysis of the impact of the Futures assumptions developed for the 2021 ITP on the transmission system. Additional flowgates may be identified for this study based on resource inclusion/location changes deemed necessary to meet the needs of the study. This flowgate identification process will generally follow the requirements outlined in section 2.2.3 of the ITP Manual, "Constraint Assessment".

2.4.2 ECONOMIC BENEFIT ANALYSIS

Economic analysis will be performed on all candidate projects identified during the constraint identification portion of the reliability assessment. Additional solutions may be developed based on the performance of the economic models and the need to address additional system congestion on the SPP-MISO seam.

Solutions will be tested for Adjusted Production Cost (APC) savings, or "benefit" to quantify the economic value of each of the proposed solutions or solutions sets. Benefit will be quantified for both regional load and specific interconnection customers to be used in supporting approval of those projects as well as potential allocation of costs between the "four entities" participating in the study

(SPP load, MISO load, SPP generator interconnection customers, MISO generator interconnection customers).

2.5 ECONOMIC STUDY SCOPE - MISO

Economic analysis will be performed on all candidate projects identified during the constraint identification portion of the reliability assessment. Additional solutions may be developed based on the performance of the economic models and the need to address additional system congestion on the SPP-MISO seam.

Solutions will be tested for Adjusted Production Cost (APC) savings, or "benefit" to quantify the economic value of each of the proposed solutions or solutions sets. Benefit will be quantified for both regional load and specific interconnection customers to be used in supporting approval of those projects as well as potential allocation of costs between the "four entities" participating in the study (SPP load, MISO load, SPP generator interconnection customers, MISO generator interconnection customers).

MISO is currently proposing to use "Future I" as defined in the MTEP21 MTEP PROMOD models. This Future's assumptions are heavily driven by our stakeholders, members and state commissions mandates and goals. There are 4 model years that we can run (5, 10, 15, 20). MISO will use the 5, 10- and 15-year models to get a closer study timeline with SPP's economic models. MISO creates 5- and 10-year Summer Powerflow models that are used for the PROMOD models.

Approved Generation Interconnection projects are added to the model as of October 2020, and active queue generation POI information is used in the futures siting process. Real Time (RT) and Day Ahead (DA) market identified flowgates are added to our event file annually. Additionally, when the futures have been added to the model, we will run Contingency Analysis using PAT Tool to identify any additional flowgates or events to monitor based on our future assumptions or updated BES parameters.

Key future assumptions are generation additions and retirements, the MISO total numbers are shown below for Future 1. Additional metrics now shown here are demand and energy forecasts and Natural Gas forecast (we are using GPCM Base forecast with MISO customized pipeline market points).

Figure 4: Futures I MISO Interconnections Summary

Future 1 Resource Additions (MW) - Cumulative											
Zone	**Model Year**	**CC**	**CT**	**CC+CCS**	**Wind**	**Solar**	**Hybrid**	**Battery**	**Distributed Solar**	**Hydro**	**Totals**
MISO Total	**2025**	11,303	1,946	0	9,282	13,857	2,400	0	1,320	82	40,190
	2030	23,829	10,138	0	9,865	26,401	2,400	0	1,994	82	74,710
	2035	31,035	13,748	0	14,300	33,339	9,600	200	2,949	82	105,253
	2040	37,126	14,094	0	18,505	33,953	12,000	600	3,474	82	119,834

Figure 5: Futures I MISO Retirements Summary

Future 1 Resource Retirements (MW) - Cumulative									
	Model Year	**Coal**	**Gas**	**Nuclear**	**Oil**	**Wind**	**Solar**	**Other**	**Totals**
MISO Total	**2025**	26,553	10,687	1,267	1,790	373	0	36	40,705
	2030	38,091	12,767	1,267	1,830	928	0	36	54,918
	2035	40,397	18,453	2,359	1,904	6,229	0	36	69,377
	2040	44,827	18,683	2,359	2,004	9,520	21	36	77,450

*Retirement totals include age based and announced/planned retirements

2.6 INTERCONNECTION PROCESS ALIGNMENT

While the JTIQ study provides an opportunity for MISO and SPP to evaluate the economic benefit of network upgrades required for interconnection service, any proposed interconnection process improvements must be fully vetted by each RTO prior to implementation.

Any insights gained through the JTIQ study will certainly be shared with the appropriate stakeholder forums, including but not limited to the SPP's Generation Interconnection User Forum (GIUF) and MISO's Interconnection Process Working Group (IPWG).

3 STUDY SCHEDULE

Below is the current schedule, this schedule may change as study progresses.

Table 7: Tentative Study Schedule

Milestone	Completion Date
Press Release	September 01, 2020
Key stakeholder Outreach	September 14, 2020
MISO-SPP Joint Stakeholder Kick-off	December 11, 2020
Power Flow models developed and posted for review	March, 2021
Power Flow model review completed	March, 2021
Power Flow Analysis / results posted for review	April, 2021
Identify Transmission Projects	April, 2021
Mitigation Testing	May, 2021
Economic Studies/ End-Customer cost benefit analysis	June, 2021
Finalizing Mitigation	September, 2021
Draft Report	October, 2021
Final Report	November, 2021
Study Completion	November, 2021

4 STAKEHOLDER INVOLVEMENT

SPP and MISO will be holding joint public stakeholder meetings throughout the JTIQ study timeline. The purpose of JTIQ joint stakeholder meetings will be to information stakeholders from both RTOs of the progress study and solicit feedback.

JTIQ study information will be made available on both the SPP and MISO websites.

Table 8: Stakeholder Outreach Plan

Milestone	Completion Date
Post detailed Scope	Feb 19, 2021
Joint Stakeholder meeting – Model Development & Results	April 09, 2021
Joint Stakeholder meeting – Initial Solutions and Benefits Review	June 25, 2021
Cost Allocation Discussion Kick-off	July 07, 2021
Joint Stakeholder meeting – Solutions Refinement	Sept 22, 2021
Joint Stakeholder meeting – Review Draft Report	Oct 18, 2021
Joint Stakeholder meeting – Final Report	Dec 13, 2021

5 APPENDICES

5.1 SPP GENERATION AND RETIREMENT ASSUMPTIONS

SPP JTIQ SOW (Gen & Retirements) r3.xls

5.2 MISO GENERATION AND RETIREMENT ASSUMPTIONS

MISO JTIQ SOW (Gen & Retirements)