JTIQ

JOINT TARGETED INTERCONNECTION QUEUE STUDY

EXECUTIVE SUMMARY

MARCH 2022

A MISO - SPP COLLABORATION

MISO

SPP Southwest Power Pool

A message from our Chief Executive Officers

Dear Friends of MISO and SPP,

Our grid is changing. Consumer preferences and public policy goals have increased the demand for renewable energy, and increasingly, our member utilities are moving to address those needs. At the same time, renewable technologies have very different operating characteristics than controllable units. Because of these and other factors, the grid of tomorrow will be very different than the one we see today. These trends transcend boundaries.

John Bear,
MISO CEO

Barbara Sugg,
SPP President and CEO

In late 2020, we began an unprecedented collaboration between MISO and SPP. This joint undertaking focused on identifying projects needed to remedy historical challenges facing generator interconnection projects near the shared boundaries, or seams, between our two Regional Transmission Organizations (RTOs). These challenges have caused projects to drop out of the study process because costly network upgrades are triggered.

Planning teams at SPP and MISO worked side by side for over a year to evaluate transmission solutions and identify reliability issues for interconnection projects. The study included opportunities for stakeholders from both RTOs to vet potential solutions and offer alternatives. Along with the reliability and economic analysis, this effort identified needed changes to our Joint Operating Agreement to improve the coordination between their individual generator queues. The changes will reduce future affected system restudies and improve the accuracy of those studies.

This effort resulted in a jointly selected portfolio of seven projects that better enable interconnection by mitigating dozens of reliability issues across both regions. The projects will allow interconnection requests spanning multiple MISO and SPP queue cycles to connect at lower costs than what would be determined through an individual queue cycle. In doing so, the joint study identified projects that will better prepare both of our systems for future portfolio change.

This effort has paved the way for further collaboration between our two RTOs. As more renewables are connected to both of our respective systems, the ability to move power from where it is generated to where it is needed will only grow in importance. We value the relationships that we have fostered between our teams and stakeholders through the Joint Targeted Interconnection Queue process and look forward to continued collaboration in meeting the challenges of planning today's — and tomorrow's — grid.

Sincerely,

John Bear

Barbara Sugg

JTIQ Solutions Address Interregional Barriers to Reliable Interconnection

The MISO-SPP Joint Targeted Interconnection Queue (JTIQ) Study originated in 2020. Through collaboration between the MISO and SPP Regional Transmission Organizations (RTOs), the study identifies transmission projects required to address the significant transmission limitations restricting the opportunity to interconnect new generating resources near the MISO-SPP seam.

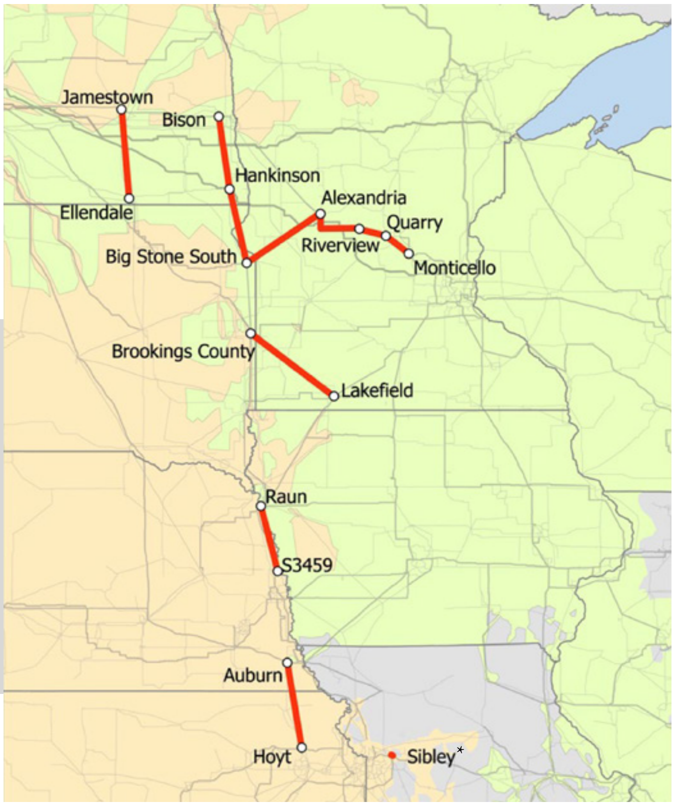
The study identified a seven-project JTIQ Portfolio with a planning level estimated cost of $1.65 billion. The recommended JTIQ Portfolio is expected to fully address the set of transmission constraints evaluated in the JTIQ Study as being significant barriers to the development of new generation along the MISO-SPP seam. In addition to these substantial reliability benefits, economic analysis conducted by the RTOs show customers can anticipate an Adjusted Production Cost (APC) benefit of $724 million in the MISO footprint and $247 million in the SPP region.

Further, the JTIQ Study portfolio would allow an increase in generator connections. A range of between 28 GW and 53 GW of improved interregional generation enablement would be available to new generator interconnection projects near the seam.

MISO SPP Southwest Power Pool

JTIQ Portfolio Map

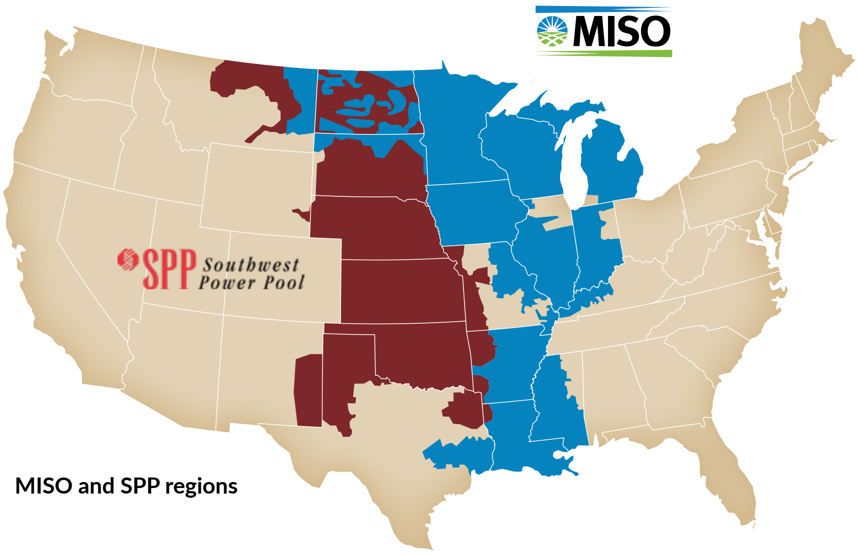
- 345 kV
- Existing Transmission
- MISO Region
- SPP Region



JTIQ Selected Portfolio Estimated APC and Reliability Benefits	MISO APC Benefit ($M)	SPP APC Benefit ($M)	Number of Reliability Constraints resolved in MISO models	Number of Reliability Constraints resolved in SPP models
Big Stone South – Alexandria – Riverview – Quarry – Monticello 345	$487	$32	17	5
Jamestown – Ellendale 345	$405	$56	8	3
Bison – Hankinson – Ellendale 345	$274	$144	11	6
Brookings Co. – Lakefield 345	$278	$8	12	1
Raun – S3452 345	$213	$192	1	0
Auburn – Hoyt 345	$223	$14	2	2
Sibley 345 Bus Reconfiguration*	-	-	9	6
JTIQ Selected Portfolio	**$724**	**$247**	**33**	**15**

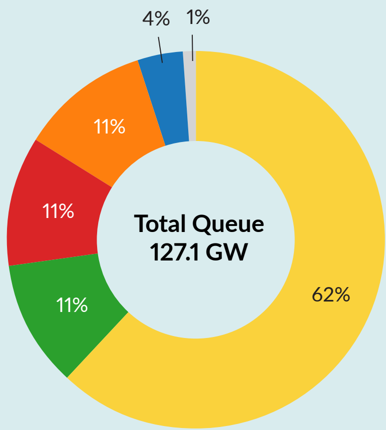
*The economic benefits of Sibley 345 kV bus upgrades are not quantified as this bus upgrade could not be simulated in the tools available. This upgrade changes the bus configuration and the definition of current contingencies, and hence mitigates the constraint.

Customer preference and changing policies have increased the demand for renewable resources, like wind and solar generation technologies. As a result, MISO and SPP's respective generator interconnection queues have experienced a transformational shift in the types, locations, and quantity of new generation seeking to interconnect to the transmission grid. SPP's Definitive Interconnection System Impact Study (DISIS), MISO's Definitive Planning Phase (DPP), and Affected System (AFS) studies coordinated between the RTOs all indicate that interconnecting new generation along the MISO-SPP seam is increasingly difficult. The existing transmission system was not designed with the intent of facilitating the interconnection of electrically remote resources to demand locations.



MISO and SPP regions

MISO and SPP generator interconnection queues reflect overall fleet change

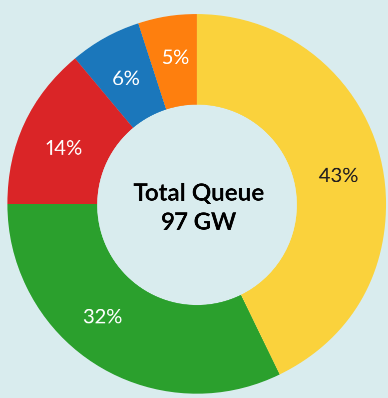


MISO Generator Interconnection Queue
March 2, 2022

Fuel Type

- Solar (78,289 MW)
- Wind (14,550 MW)
- Storage (13,424 MW)
- Gas/Thermal (4,552 MW)
- Hybrid (14,633 MW)
- Other (1,519 MW)*

*'Other' is the combination of hydro, pumped storage hydro, diesel, demand response resources, external asynchronous resources and a varied assortment of solid waste, garbage and wood pulp burners.



SPP Generator Interconnection Queue
January 28, 2022

Fuel Type

- Solar (41,578 MW)
- Wind (31,257 MW)
- Storage (13,214 MW)
- Gas/Thermal (6,038 MW)
- Hybrid (5,163 MW)

In addition to identifying key projects to enable generator interconnections at the seams, and considering the economic and reliability benefits these projects could provide to customers within the RTOs, this study was designed to identify efficiencies between both RTOs' generator interconnection processes.

The JTIQ Study closely coordinated technical analyses performed by MISO and SPP utilizing each RTO's respective transmission and generation planning methodologies to determine the transmission project requirements that would cost effectively resolve the transmission constraints inhibiting the interconnection of new generation near the MISO-SPP seam. MISO and SPP staff performed reliability, economic, and generation enablement studies and coordinated with stakeholders on the development of transmission solutions to meet the JTIQ Study's objectives.

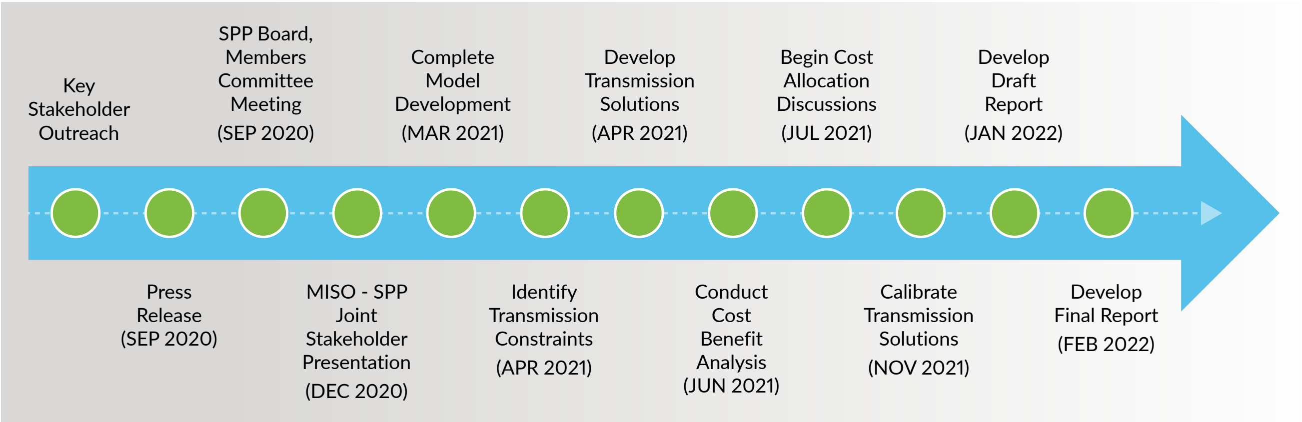
JTIQ Selected Portfolio Costs	Location by RTO	Cost ($M)
Big Stone South – Alexandria – Riverview – Quarry – Monticello 345 kV	MISO	$424.5
Jamestown – Ellendale 345 kV	MISO	$165
Bison – Hankinson – Big Stone South 345 kV	MISO	$476
Brookings Co – Lakefield 345 kV	MISO	$331
Raun – S3452 345 Kv	MISO - SPP	$144.4
Auburn – Hoyt 345 kV	SPP	$90.5
Sibley 345 Bus Reconfiguration	SPP	$18.8
Total Cost of Portfolio of Projects	**MISO - SPP**	**$1,650.2**

Transparency and Stakeholder Engagement Guide Study

MISO and SPP conceived the JTIQ study in mid-2020, and their outreach to their respective stakeholders served to further develop the idea. In September 2020, the RTOs issued a joint press release announcing the study. Joint stakeholder meetings began in 2020 to develop the study scope, which was posted in February 2021.

MISO and SPP teams began meeting on weekly basis in 2021, as part of coordination and planning for this study. MISO and SPP hosted seven joint public stakeholder meetings over the course of 2020 and 2021, throughout the JTIQ study timeline. These meetings informed stakeholders from both RTOs of the progress of the study and elicited feedback.

Stakeholder Engagement Timeline	Completion Date
Joint Stakeholder meeting – Study Kick-off	Dec. 11, 2020
Post Detailed Scope	Feb. 19, 2021
Joint Stakeholder meeting – Model Development & Results	Apr. 9, 2021
Joint Stakeholder meeting – Initial Solutions and Benefits Review	Jun. 28, 2021
Joint Stakeholder meeting – Cost Allocation Discussion Kick-off	Jul. 7, 2021
Joint Stakeholder meeting – Draft Cost Allocation Framework	Aug. 13, 2021
Joint Stakeholder meeting - Study Update	Oct. 8, 2021
Joint Stakeholder meeting – Final Portfolio	Dec. 3, 2021
Review Final Report	Mar. 2, 2022



Study Timeline

A Simple Yet Flexible Cost Allocation Methodology

The proposed JTIQ Portfolio, determined through engineering analysis and collaboration, has an investment estimate of $1.65 billion. A next step in JTIQ progression will include the development of an equitable cost allocation mechanism between interconnection customers and load in MISO and SPP. A cost allocation process that utilizes a framework considering project benefits is in progress. The allocation determinants may rely on a scoring system that reflects multiple weighted factors, with costs split between generators and load based benefits.

Over the course of 2021, the JTIQ public stakeholder process included an exploration of potential methodologies. At the outset, simplicity and flexibility for use in the future were key attributes identified for the potential methodology. Primary sources of funding under consideration include generator interconnection customers as well as load that receive economic benefit from the identified projects.

Next steps focus on developing a framework aligning costs with beneficiaries

Cost allocation framework refinements will continue with stakeholder input, until the final cost allocation methodology is complete and submitted for approval by FERC. The JTIQ Portfolio will be considered by each RTO's Board of Directors following FERC approval. Continued stakeholder engagement through future cost allocation workshops are planned for Spring 2022.

JTIQ

JOINT TARGETED INTERCONNECTION QUEUE STUDY

TECHNICAL REPORT

MARCH 2022

A MISO - SPP COLLABORATION

MISO

SPP Southwest Power Pool

Table of Contents

1. Introduction

1.1. Background

The JTIQ Study, which started in December 2020 and concluded in December 2021, identifies projects required for the interconnection of low-cost resources and that provide economic and reliability benefits to the MISO and SPP regions.

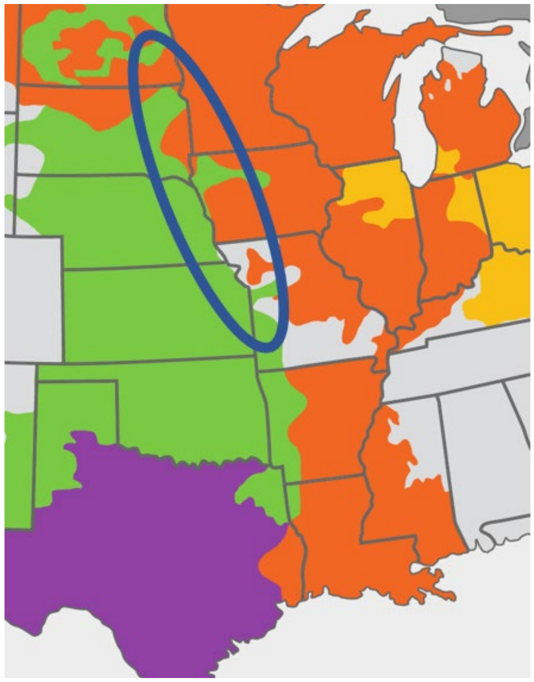
The JTIQ Study is a result of the RTOs' cluster study[1] observations that show the transmission system is at its capacity and that the necessary network upgrades are too costly for individual or small groups of interconnection projects to proceed. While the addition of renewable resources and transmission along the SPP-MISO seam provides benefits to the markets, current tariff and Joint Operating Agreement (JOA) mechanisms do not provide a cost-sharing approach that can facilitate the construction of the large-scale transmission needed to interconnect expected levels of new generation near the seam. Process, criteria, and schedule differences between the respective RTOs contribute to study delays and introduce questions on study results. The JTIQ Study takes these various barriers into consideration.

1.2. Purpose and Goals

Representatives from MISO and SPP determined three primary goals for the SPP-MISO JTIQ Study:

1. Identify more comprehensive, cost-effective and efficient network upgrades than would otherwise be identified in the current interconnection queue and affected system coordination processes where upgrades are identified in the time sequence by either RTO
2. Identify solutions that meet the needs of interconnection customers and provide benefits to load in both SPP and MISO near the seam (Figure 1)
3. Identify opportunities to improve coordination between the RTOs' planning processes and affected system coordination both in this instance and on an ongoing basis

[1] Cluster studies observed are: DPP-2017-FEB-West, DPP-2017-AUG-West and DISIS-2017-001



1.3. Findings — The Selected JTIQ Portfolio

Transmission solutions were identified to resolve the transmission constraints along the SPP-MISO seam and to enable new generator interconnection projects to connect in this region. The list of constraints mitigated by the JTIQ Portfolio is provided in Section 2.1. Table 1 and Figure 2 provide an overview of the JTIQ Portfolio.

Economic analysis conducted by the RTOs indicates that the JTIQ Portfolio is further expected to deliver $724.23 million and $246.74 million of APC benefit to customers in the MISO and SPP footprints, respectively, and the combined APC-only benefit-to-cost (B/C) ratio of the portfolio is 0.60 (Table 2). These are the only benefits to load estimated at this time; other benefits to load may be considered in the future.

JTIQ Portfolio	Location by RTO	Cost ($M)
Bigstone – Alexandria – Riverview – Quarry – Monticello 345 kV	MISO	424.5
Jamestown – Ellendale 345 kV	MISO	165
Bison – Hankinson – Big Stone South 345 kV	MISO	476
Brookings Co – Lakefield 345 kV	MISO	331
Raun – S3452 345 kV	MISO - SPP	144.4
Auburn – Hoyt 345 kV	SPP	90.5
Sibley 345 Bus Reconfiguration	SPP	18.8
Total Cost of Portfolio of Projects	**MISO - SPP**	**1,650.2**

Table 1: List of Projects Compromising the JTIQ Portfolio

Project Name	Cost in $M	MISO PV Benefit ($M)	SPP F2 20Y Benefit ($M)	SPP-MISO Combined B/C
JTIQ Portfolio	1,631.4[2]	724.23	246.74	0.60

Table 2: Economic Benefit Analysis Summary

Figure 2: JTIQ Portfolio Map

[2] Does not include cost for Sibley 345 kV bus reconfiguration project. The economic benefits of Sibley 345 kV bus reconfiguration are similarly not quantified as this bus upgrade could not be simulated in the tools available. This upgrade changes the bus configuration and the definition of current contingencies, and hence mitigates the constraint.

1.4. Study Framework

The JTIQ Study had two key objectives (Figure 3) to meet the JTIQ goals:

A. Identify transmission solutions to resolve constraints inhibiting the interconnection of generation on the SPP-MISO seam

B. Align the interconnection processes between SPP and MISO to reduce restudies/delays for interconnection customers impacted by the coordination of affected system studies between SPP and MISO

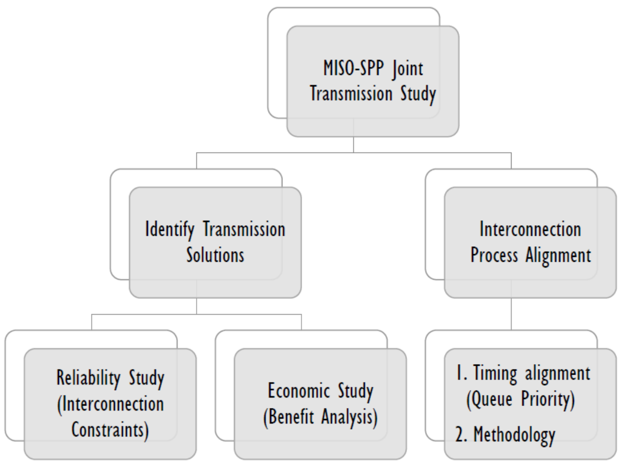
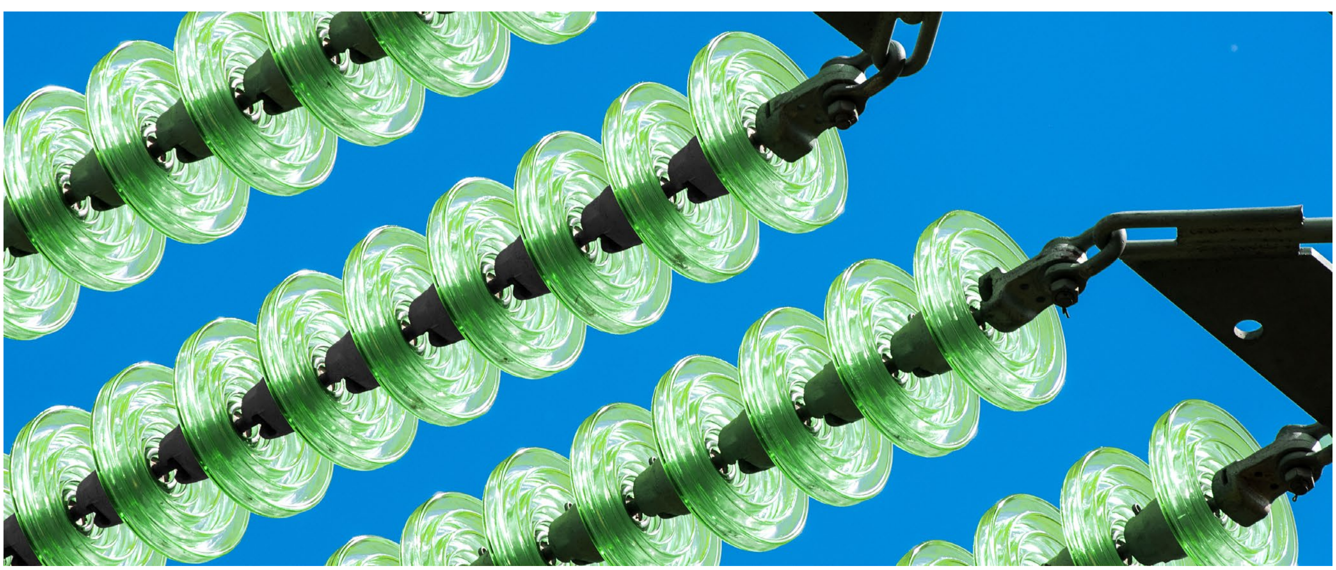


Figure 3: MISO-SPP JTIQ Framework



2. JTIQ Portfolio Projects — Details

The JTIQ Study evaluated several projects and portfolios of projects (see Section 3.2 for a complete list) to meet the study's objectives. The JTIQ Study determined that seven of the projects proved to be technically feasible and provided greater reliability and economic benefits. At this stage in the process, detail of terminal connections, right-of-way and other design specifications have not been determined. Seven selected projects comprise the JTIQ Portfolio (Table 1).

2.1. Reliability Constraints Resolved

The JTIQ Portfolio resolves most of the constraints that meet the constraint identification criteria across all the study models.

Both MISO and SPP conducted reliability studies to determine what constraints, within the final JTIQ Portfolio, could be resolved (Table 3 and Table 4). Contingency analysis results obtained from post-mitigation reliability models were compared with results from pre-mitigation reliability models to quantify the performance of mitigation projects in the reliability models. The constraints were considered to be mitigated if the loading level on the constrained monitored elements was reduced below 95 percent with the inclusion of the JTIQ Portfolio.

Constraint	Control Area	Region
532913 KELLY 5 161 997595 KELL TX-1 115 1	WERE	SPP
532913 KELLY 5 161 997597 KELL TX-1 115 1	WERE	SPP
541201 SIBLEY 7 345 997456 SIBLEY11 161 11	KCPL	SPP
541201 SIBLEY 7 345 997458 SIBLEY11 161 11	KCPL	SPP
541202 SIBLEY 5 161 541250 SIBLEYPL 161 1	KCPL	SPP
541202 SIBLEY 5 161 997456 SIBLEY11 161 11	KCPL	SPP
541202 SIBLEY 5 161 997458 SIBLEY11 161 11	KCPL	SPP
542972 HAWTH 7 345 997433 HAWTHORN22 161 22	KCPL	SPP
542972 HAWTH 7 345 997434 HAWTHORN20 161 20	KCPL	SPP
543665 HAWTHN5 161 997433 HAWTHORN22 161 22	KCPL	SPP
543665 HAWTHN5 161 997434 HAWTHORN20 161 20	KCPL	SPP
601006 SPLT RK3 345 652537 WHITE 3 345 1	XEL/WAPA	MISO/SPP
601006 SPLT RK3 345 997369 SPLT 11 115 11	XEL	MISO
601015 BLUE LK3 345 997364 7000550 115 9	XEL	MISO
602004 SPLT RK4 230 652523 SIOUXFL4 230 1	XEL/WAPA	MISO/SPP
602008 MINVALT4 230 652550 GRANITF4 230 1	XEL/WAPA	MISO/SPP
603016 SPLT RK7 115 997329 SPLT RK4 115 7	XEL	MISO
603016 SPLT RK7 115 997369 SPLT 11 115 11	XEL	MISO
603062 BLUE LK7 115 997364 7000550 115 9	XEL	MISO
615529 GRE-PANTHER4 230 658276 HUC-MCLEOD 4 230 1	XEL	MISO

Constraint	Control Area	Region
620314 BIGSTON4 230 620325 BROWNSV4 230 1	OTP	MISO
620314 BIGSTON4 230 655465 BLAIR-ER4 230 1	OTP/WAPA	MISO/SPP
620325 BROWNSV4 230 620328 NEW EFFNGTN4 230 1	OTP	MISO
620327 HANKSON4 230 620328 NEW EFFNGTN4 230 1	OTP	MISO
620327 HANKSON4 230 620829 WAHPETON XF4 230 1	OTP	MISO
620329 WAHPETN4 230 620829 WAHPETON XF4 230 Z	OTP	MISO
620329 WAHPETN4 230 658109 FERGSFL4 230 1	OTP	MISO
620362 OAKES 4 230 661098 ELLENDL345 4 230 1	OTP/MDU	MISO
646209 S1209 5 161 646252 S1252 5 161 1	OPPD	SPP
652550 GRANITF4 230 655465 BLAIR-ER4 230 1	WAPA	SPP
652550 GRANITF4 230 658259 WMU-WILLMAR4 230 1	WAPA/GRE	MISO/SPP
652555 MORRIS 7 115 658102 GRANTCO7 115 1	OTP	MISO
660006 YKNTJCT7 115 660026 NAPA JCT7 115 1	WAPA	SPP

Table 3: Constraints Resolved MISO Powerflow Models

Constraint	Control Area	Region
541202 SIBLEY 5 161 541201 SIBLEY11 _1 161 11	KCPL	SPP
532913 KELLY 5 161 532920 TECHILL5 161 1	WERE	SPP
601010 MNTCELO3 345 601011 SHERCO 3 345 1	XEL	MISO
661042 HESKETT4 230 661094 WISHEK 4 230 1	MDU	MISO
541201 SIBLEY 7 345 541202 SIBLEY11 _1 161 11	KCPL	SPP
620314 BIGSTON4 230 655465 BLAIR-ER4 230 1	OTP	MISO
541202 SIBLEY 5 161 541250 SIBLEYPL 161 1	KCPL	SPP
620314 BIGSTON4 230 620325 BROWNSV4 230 1	OTP	MISO
541202 SIBLEY 5 161 541250 SIBLEYPL 161 1	KCPL	SPP
541201 SIBLEY 7 345 997460 SIBLEY11 _1 161 11	KCPL	SPP
603016 SPLT RK7 115 601006 SPLT 10 115 10	XEL	MISO
620327 HANKSON4 230 620329 WAHPETN4 230 1	OTP	MISO
620327 HANKSON4 230 620329 WAHPETN4 230 1	OTP	MISO
635201 Raun 5 – 640377 Tekamah 161kV CKT 1	MEC/OPPD	MISO/SPP
635200 Raun 3 – 645451 Ft. Calhoun 345kV (S3451 3)	MEC/OPPD	MISO/SPP

Table 4: Constraints Resolved SPP Powerflow Models

2.2. Economic Benefit Analysis Results

Both SPP and MISO used their respective production cost tools and models to evaluate the economic benefit for each individual project and the project portfolios considered. The RTOs used these analyses to optimize the projects included in the JTIQ Portfolio based on the reliability and economic performance of individual projects. The JTIQ Portfolio is expected to provide $724.2 million in APC benefits within the MISO footprint and $246.74 million in APC benefits in the SPP footprint (Table 5). The combined APC-only B/C ratio for the JTIQ Portfolio is 0.60.

The economic benefits of Sibley 345 kV bus upgrades are not quantified, as this bus upgrade could not be simulated in the tools available. This upgrade changes the bus configuration and the definition of current contingencies, mitigating the constraint but does not increase the transfer capability.

Project name	Cost in $M	MISO PV Benefit ($M)	SPP F2 20Y Benefit ($M)	SPP-MISO Combined B/C
JTIQ Portfolio	1,631.4[3]	724.2	246.74	0.60
Big Stone – Alexandria – Riverview – Quarry – Monticello 345	424.5	487.11	31.74	1.22
Jamestown – Ellendale 345	165	404.84	55.87	2.79
Bison – Hankinson – Big Stone South 345	476	273.54	143.95	0.88
Brookings Co. – Lakefield 345	331	277.75	8.48	0.86
Raun – S3452 345	144.4	213.45	192.35	2.81
Auburn – Hoyt 345	90.5	223.29	14.06	2.62
Sibley 345 Bus Reconfiguration	18.8	-	-	-

Table 5: JTIQ Portfolio Benefit/Cost Analysis

2.3. New Interconnection Capacity Enabled

The JTIQ Portfolio resolved constraints mentioned in Table 3 and Table 4 and hence resolving those constraints would allow newly interconnecting generation to inject more energy into the Bulk Electric System.

The JTIQ Study utilized the contingency analysis results from the reliability portion of the study to calculate the amount of unused capacity on JTIQ mitigated constraints and the JTIQ Portfolio to estimate new interconnection capacity enabled by the portfolio.

MISO's contingency analysis results estimates that 28,325 MW of additional generation interconnected along the seam could benefit from the JTIQ Portfolio; SPP's contingency analysis results estimates that 53,481 MW of new generation could benefit. This analysis focused on the region along the SPP-MISO seam of interest for the JTIQ Study. This analysis is anticipated to be further refined and presented to stakeholders in greater detail as a part of continued cost allocation methodology development.

Additional details on the MW Enabled Calculations are included in Appendix Section 8.9.

[3] Does not include cost for Sibley 345 kV bus reconfiguration project.

2.4. Interface with other Ongoing Planning Studies

2.4.1. SPP Related Studies

SPP commissioned a consultant to investigate the impacts of implementing the JTIQ Portfolio against the mitigations identified in a prior affected system study as well as a prior iteration of the a DISIS cluster study.

The analysis performed by the consultant utilized the steady state models for groups 00, 15 and 18 for the affected system study and steady state models for groups 08, 09, 13, 14, 15 and 16 for the DISIS study. The steady state analysis was performed with and without the JTIQ Portfolio to identify the indicative impacts on the previously completed studies.

Consistent with other analysis performed as part of the JTIQ Study, this supplemental analysis found that the JTIQ Portfolio would be expected to have a material positive impact in reducing the number and cost of network upgrades that would otherwise be assigned to interconnection requests within a particular affected system or SPP DISIS study. In the supplemental analysis of an affected system study, 60 percent of the constraints that were assigned to interconnection customers in MISO (representing over $65 million of the assigned network upgrade costs) for mitigation could be addressed by the JTIQ Portfolio. Additionally, the supplemental analysis indicated the JTIQ Portfolio alleviated the need to mitigate 44 percent of the constraints (representing over $301 million of the assigned network upgrade costs) identified in the DISIS cluster for the groups studied.

The results of the supplemental analysis further indicate that the JTIQ Portfolio would be expected to have no adverse impact on the affected system study as no new constraints were observed after the inclusion of the portfolio. Regarding the DISIS cluster, the results of the supplemental analysis indicate that the JTIQ Portfolio may increase the loading of three additional constraints that were previously not overloaded or directly mitigated in the DISIS study, however these additional constraints were located in areas outside of the groups evaluated in the supplemental analysis.

3. Constraints and Mitigation(s) Considered

The JTIQ Study evaluated the interconnection of new generation across large geographic portions of the SPP-MISO seam. Contingency analysis indicated a large number of constraints spread all over the MISO-SPP footprint would require mitigation in order to facilitate the studied interconnections of new generation.

JTIQ Study models and the results of the RTOs' contingency analysis were posted for stakeholder review in April 2021. These results included all the constraints observed in the JTIQ Study.

On May 11, 2021, the first set of selected transmission constraints were posted along with RTO staff-developed initial mitigation ideas as well as an invitation for stakeholders to provide mitigation projects for consideration.

On August 13, 2021, an updated final list of selected transmission constraint were posted for stakeholder review. SPP and MISO stakeholders were further invited to submit mitigation proposals for the identified facilities.

By the conclusion of the JTIQ Study a total of 75 mitigation staff developed and stakeholder submitted projects/mitigation portfolios were evaluated.

3.1. JTIQ Selected Transmission Constraints

The JTIQ Study used distribution factor criteria to filter constraints impacted by new generator(s) in both MISO and SPP regions in order to focus on the transmission constraints limiting the interconnection of new generation along the MISO-SPP seam.

MISO utilized distribution factor criteria: 5 percent distribution factor of at least one study unit in one RTO and 3 percent distribution factor of at least one study unit in the other RTO resulted in 52 selected constraints (Table 6).

Overloaded Facility	Control Area	Region
345409 5OVERTON 1 161 345411 5OVERTON 2 161 Z	AMMO	MISO
532772 STRANGR7 345 532775 87TH 7 345 1	WERE	SPP
532775 87TH 7 345 542977 CRAIG 7 345 1	WERE	SPP
532913 KELLY 5 161 997595 KELL TX-1 115 1	WERE	SPP
532913 KELLY 5 161 997597 KELL TX-1 115 1	WERE	SPP
541199 ST JOE 7 345 542980 NASHUA 7 345 1	KCPL	SPP
541201 SIBLEY 7 345 542972 HAWTH 7 345 1	KCPL	SPP
541201 SIBLEY 7 345 997456 SIBLEY11 161 11	KCPL	SPP
541201 SIBLEY 7 345 997458 SIBLEY11 161 11	KCPL	SPP
541202 SIBLEY 5 161 541250 SIBLEYPL 161 1	KCPL	SPP
541202 SIBLEY 5 161 997456 SIBLEY11 161 11	KCPL	SPP
541202 SIBLEY 5 161 997458 SIBLEY11 161 11	KCPL	SPP
542972 HAWTH 7 345 542980 NASHUA 7 345 1	KCPL	SPP
542972 HAWTH 7 345 997433 HAWTHORN22 161 22	KCPL	SPP
542972 HAWTH 7 345 997434 HAWTHORN20 161 20	KCPL	SPP
542980 NASHUA 7 345 997426 NASHUA11 161 11	KCPL	SPP

Overloaded Facility	Control Area	Region
542980 NASHUA 7 345 997428 NASHUA11 161 11	KCPL	SPP
543028 NASHUA-5 161 997426 NASHUA11 161 11	KCPL	SPP
543028 NASHUA-5 161 997428 NASHUA11 161 11	KCPL	SPP
543665 HAWTHN5 161 997433 HAWTHORN22 161 22	KCPL	SPP
543665 HAWTHN5 161 997434 HAWTHORN20 161 20	KCPL	SPP
601005 ELM CRK3 345 601010 MNTCELO3 345 1	XEL	MISO
601005 ELM CRK3 345 601022 PARKERS3 345 1	XEL	MISO
601006 SPLT RK3 345 652537 WHITE 3 345 1	XEL/WAPA	MISO/SPP
601006 SPLT RK3 345 997369 SPLT 11 115 11	XEL	MISO
601010 MNTCELO3 345 601011 SHERCO 3 345 1	XEL	MISO
601015 BLUE LK3 345 997364 7000550 115 9	XEL	MISO
601028 EAU CL 3 345 997344 EAU CL 3_1 161 9	XEL	MISO
601028 EAU CL 3 345 997346 EAU CL 3_1 161 9	XEL	MISO
602004 SPLT RK4 230 652523 SIOUXFL4 230 1	XEL/WAPA	MISO/SPP
602008 MINVALT4 230 652550 GRANITF4 230 1	XEL/WAPA	MISO/SPP
603016 SPLT RK7 115 997329 SPLT RK4 115 7	XEL	MISO
603016 SPLT RK7 115 997369 SPLT 11 115 11	XEL	MISO
603062 BLUE LK7 115 997364 7000550 115 9	XEL	MISO
615529 GRE-PANTHER4 230 658276 HUC-MCLEOD 4 230 1	XEL	MISO
620314 BIGSTON4 230 620325 BROWNSV4 230 1	OTP	MISO
620314 BIGSTON4 230 655465 BLAIR-ER4 230 1	OTP/WAPA	MISO/SPP
620325 BROWNSV4 230 620328 NEW EFFNGTN4 230 1	OTP	MISO
620327 HANKSON4 230 620328 NEW EFFNGTN4 230 1	OTP	MISO
620327 HANKSON4 230 620829 WAHPETON XF4 230 1	OTP	MISO
620329 WAHPETN4 230 620829 WAHPETON XF4 230 Z	OTP	MISO
620329 WAHPETN4 230 658109 FERGSFL4 230 1	OTP	MISO
620362 OAKES 4 230 661098 ELLENDL345 4 230 1	OTP/MDU	MISO
635701 SYCAMORE 5 161 635703 DELAWARE5 161 1	MEC	MISO
646209 S1209 5 161 646252 S1252 5 161 1	OPPD	SPP
652512 GROTON 7 115 652568 GROTONSOUTH7 115 Z	WAPA	SPP
652550 GRANITF4 230 655465 BLAIR-ER4 230 1	WAPA	SPP
652550 GRANITF4 230 658259 WMU-WILLMAR4 230 1	WAPA/GRE	MISO/SPP
652552 SIOUXCY2 230 652565 SIOUXCY4 230 Z	WAPA	SPP
652555 MORRIS 7 115 658102 GRANTCO7 115 1	OTP	MISO
652626 UTICAJC7 115 660026 NAPA JCT7 115 1	WAPA	SPP
660006 YKNTJCT7 115 660026 NAPA JCT7 115 1	WAPA	SPP

Table 6: MISO Selected Constraints

SPP utilized distribution factor criteria: 3 percent distribution factor of at least one study unit in SPP and 5 percent distribution factor of at least one study unit in MISO which resulted in 33 selected constraints (Table 7). Some constraints are out of scope for the purposes of this study (as these constraints were not in the targeted MISO-SPP seams region) and were not targeted for mitigation.

Overloaded Facility	Control Area	Region
345408 7OVERTON 345 541201 SIBLEY 7 345 1	AMMO	MISO
532913 KELLY 5 161 532920 TECHILL5 161 1	WERE	SPP
532913 KELLY 5 161 997584 KELL TX-1 _1 115 1	WERE	SPP
646209 S1209 5 161 646231 S1231 5 161 1	OPPD	SPP
652512 GROTON 7 115 652568 GROTONSOUTH7 115 Z	WAPA	SPP
542972 HAWTH 7 345 997431 HAWTHORN20 _ 161 20	KCPL	SPP
543665 HAWTHN5 161 997431 HAWTHORN20 _ 161 20	KCPL	SPP
541201 SIBLEY 7 345 997456 SIBLEY11 _1 161 11	KCPL	SPP
541202 SIBLEY 5 161 541250 SIBLEYPL 161 1	KCPL	SPP
541202 SIBLEY 5 161 997456 SIBLEY11 _1 161 11	KCPL	SPP
603016 SPLT RK7 115 997363 SPLT 11 115 11	XEL	MISO
603016 SPLT RK7 115 997364 SPLT 10 115 10	XEL	MISO
620314 BIGSTON4 230 655465 BLAIR-ER4 230 1	OTP/WAPA	MISO/SPP
620327 HANKSON4 230 620329 WAHPETN4 230 1	OTP	MISO
541199 ST JOE 7 345 640139 COOPER 3 345 1	KCPL	SPP
300739 7BLACKBERRY 345 532793 NEOSHO 7 345 1	AECI	SPP
640302 OGALALA4 230 659134 SIDNEY__TS4 230 1	NPPD	SPP
640305 ONEILL 7 115 640349 SPENCER7 115 1	NPPD	SPP
640349 SPENCER7 115 652510 FTRANDL7 115 1	NPPD	SPP
652216 WATFORD4 230 659302 CHARL_CK-BE4 230 1	WAPA	SPP
659101 ANTELOPE-BE3 345 659183 CHARL_CK-BE3 345 1	WAPA	SPP
659101 ANTELOPE-BE3 345 659420 AV.LS-BD-BE3 345 Z	WAPA	SPP
661042 HESKETT4 230 661094 WISHEK 4 230 1	MDU	MISO
652519 OAHE 4 230 655487 SULLYBT-ER4 230 1	WAPA	SPP
655487 SULLYBT-ER4 230 655510 SB.LS-WK-ER4 230 Z	WAPA	SPP
655510 SB.LS-WK-ER4 230 655765 WHITLOCK_-RM 230 1	WAPA	SPP
532793 NEOSHO 7 345 997618 N345 TX-1 _1 138 1	WERE	SPP
541400 EASTOWN7 345 997438 EASTOWNE11 _ 161 11	KCPL	SPP
532791 BENTON 7 345 532794 ROSEHIL7 345 1	WERE	SPP
601005 ELM CRK3 345 601010 MNTCELO3 345 1	XEL	MISO
620314 BIGSTON4 230 620325 BROWNSV4 230 1	OTP	MISO
615901 GRE-STANTON4 230 657756 SQBUTTE4 230 1	GRE	MISO
601010 MNTCELO3 345 601011 SHERCO 3 345 1	XEL	MISO

Table 7: SPP Selected Constraints

3.2. Mitigation Projects Evaluated

The JTIQ Study evaluated 59 individual projects, which includes mitigation solution ideas submitted by stakeholder groups as well as those developed by MISO and SPP. The evaluation examined 16 portfolios representing various combinations of the 59 individual projects, including the JTIQ Portfolio. The proposed portfolio of projects includes different combinations of the best-performing individual projects that most effectively met the objectives of the JTIQ Study.

To better coordinate the analysis of individual projects and the various portfolios of projects, each one received a unique JTIQ project identification number. The performance of all individual projects were evaluated against the selected constraints (see Section 3.1) in all reliability study models. Then, a subset of projects with acceptable reliability results underwent an economic benefit analysis.

Find the JTIQ Reliability Matrix and Economic Results workbooks of mitigation projects in Appendix Sections 8.5 and 8.6.

3.2.1. Individual Mitigation Projects Evaluated

The JTIQ study evaluated 59 individual projects (Table 8). Of these projects, 30 were submitted by the MISO-SPP stakeholder group and 29 projects were developed by MISO and SPP staff.

JTIQ project ID	Project name	Cost ($M)	Submitted by
1	Stranger Creek - Eastown	143	Stakeholder Group
2	Turney - Nashua	160	Stakeholder Group
3	Astoria - Broadland	204	Stakeholder Group
4	Big Stone South - Alexandria	192	Stakeholder Group
5	Big Stone South - Hazel Creek	140	Stakeholder Group
6	Jamestown - Ellendale	160	Stakeholder Group
7	Twinbrooks - Watertown	64	Stakeholder Group
8	Raun - Ft. Calhoun - Council Bluffs - Fairport	721	Stakeholder Group
9	Nashua - Hawthorn - Sibley 345	111	Stakeholder Group
10	Sherco -Benton Co. - Monticello 345 (Option 1DC) Remove Benton - Mont 230	70	Stakeholder Group
11	Benton Co. - Monticello 345 (Option 1SC) Remove Benton - Mont230 kV line	70.4	Stakeholder Group
12	Monticello - Benton Co. - Quarry 345 (Option 2DC)	230.4	Stakeholder Group
13	Benton Co. - Quarry 345 (Option 2SC1)	160	Stakeholder Group
14	Benton Co. - Monticello 345 (Option 2SC2)	70.4	Stakeholder Group
15	Orient -Dekalb-Zachary-Maywood -Herleman - Mdoes, Dekalb - Fairport 345	871.5	Stakeholder Group
16	Orient- Dekalb - Zachary, Dekalb - Fairport 345	555.5	Stakeholder Group
17	Orient - Dekalb - Fairport 345	225.7	Stakeholder Group
18	Sioux City and Fallow Ave -Overland Trail 345 kV	362	Stakeholder Group
19	Ellendale - Fergus Falls 345 kV	459	MISO
20	Hazel Creek - Helena	375	MISO
21	Alexandria - Monticello	324	MISO
22	Monticello - Parkers	121	MISO
23	Hawthorne - Sibley	32	SPP

JTIQ project ID	Project name	Cost ($M)	Submitted by
24	Bigstone - Hazel - Helena (Project 5 and 20)	515	MISO
25	Bigstone - Alex - Monticello (Project 4 and 21)	516	MISO
25A	Bigstone - Alex – River View - Quarry - Monticello	424.5	MISO
30	Tap Shelbourne County - Coon Creek existing line into Monticello	6	Stakeholder Group
31	Atchison Co - Rock Creek 345	54	Stakeholder Group
32	Stranger Creek - Midland 230	24	Stakeholder Group
33	Bigstone - Hazel – Blue lake 345	633	MISO
34	Jamestown - Ellendale 345	165	MISO
35	Bison - Hankinson - Bigstone 345	476	MISO
36	Big Stone - Quarry - Monticello - Parkers 345	651	MISO
36A	Bigstone - Quarry -Monticello	530	MISO
38	Brookings Co. - Lakefield 345	331	MISO
38A	Lyon Co - Chanarambie - Nobles 345	295.2	MISO
39	Split Rock - Sioux Falls 2nd Ckt 230	13	MISO
40P	1231 - 1209 - 1252 and Cooper - St Joe	33.94	Stakeholder Group
40	1209 - 1231	3.3	Stakeholder Group
41	1209 - 1252	1	Stakeholder Group
42	Cooper - St Joe	29.64	Stakeholder Group
43	Crowned Ridge 2 - Watertown 230kV	33.5	Stakeholder Group
44	Eau Clair Transformer	4.356	Stakeholder Group
45	Iatan - Metropolitan	97.74	Stakeholder Group
46	Nashua-Hawthorn	58.18	Stakeholder Group
47	Stranger-87th-Craig 345	99	Stakeholder Group
48	Rebuild Maryille - Midway 161, St. Joe - Avenue City -Midway 161	43.3	SPP
49	Rebuild RNRidge - Nashua 161	6	SPP
50	Rebuild Split Rock-White 345kV	68.9	SPP
51	Raun-Council Bluffs 345	156.5	SPP
52	Raun - S3451 345	106	SPP
53	Rebuild Raun - Tekemah, Tekemah - S1226	213	SPP
53A	Raun - S3452 345	144.4	SPP
54	New Branch Raun - S3452 345kV	152.3	SPP
56	SPP2020ITP TPL and Raun - S3452	33.94	SPP
58	Kelly Constraint Project	90.5	SPP
61	Ellendale - Hankinson 345	311	MISO
71	Nashua 2nd Transformer	8.5	SPP
72	Sibley Bus Reconfiguration	18.8	SPP

Table 8: Mitigation Projects

3.2.2. Portfolio of Mitigation Projects Evaluated

The JTIQ Study evaluated 16 portfolio combinations of individual projects. The individual projects that performed well in reliability analysis were included in the various portfolios of individual projects (Table 9).

JTIQ Project ID numbers from Table 8 can be used as reference for portfolio details mentioned in Table 9.

The JTIQ Portfolio (JTIQ Project ID No. 62A) is highlighted in yellow color in Table 9.

JTIQ project ID	Individual projects included in Portfolio	Cost ($M)
26	19+22+24+25	1,611
27	19+22+23+24+25	1,643
28	4+9+22	424
29	4+9+21+22	728
37	9+33+34+35+36	2,055
55	9+34+36A+38+43+47	1,357.5
57	9+35+36A+38+43+45+47+53+54+58	2,134.05
59	9+34+36A+38+43+45+47+53+54+58	1,911.04
60	9+34+35+36A+38+43+45+47+53+54+58	2,387.05
62	9+35+36A+38+43+45+47+53+54+58+ 61	2,445.04
62A	25A+34+35+38+53A+58+72	1,650.2
62B	25A+34+35+38A+53A+58+72	1,719.9
63	9+35+36A+38+47+53A+58+61	2,092.9
64	9+34+35+36A+38+47+53A+58	1,946.9
65	9+25A+34+35+38+47+53A+58	1,946.9
73	35+38+53A+53+72	1,060.7

Table 9: Portfolio of Projects Evaluated

4. Stakeholder Engagement and Study Schedule

In mid-2020, executives from both MISO and SPP conceived of the JTIQ Study as a means to identify projects required for the interconnection of low-cost resources that provide economic benefit to both regions. Executive outreach to stakeholders of both organizations served to further develop and build support for the study. In September 2020, a joint press release announcing the study was issued. Joint stakeholder meetings served to further develop the objectives of the JTIQ Study, beginning in December 2020. Staff of the two RTOs coordinated on the development of the JTIQ Study scope throughout the last quarter of 2020 and the first quarter of 2021.

Starting in 2021, MISO and SPP teams met on a weekly basis as part of ongoing coordination and planning for the JTIQ Study.

As of the writing of this report, MISO and SPP hosted eight joint public stakeholder meetings beginning in late 2020, throughout 2021, and at the beginning of 2022. These meetings informed stakeholders from both RTOs of the progress of the study and ensured stakeholders that the opportunity to provide feedback on the conduct of the JTIQ Study (Table 10 and Figure 4).

Milestone	Completion Date
Joint Stakeholder meeting – Study Kick-off	11-Dec-20
Post Detailed Scope	19-Feb-21
Joint Stakeholder meeting – Model Development & Results	9-Apr-21
Joint Stakeholder meeting – Initial Solutions and Benefits Review	28-Jun-21
Joint Stakeholder meeting – Cost Allocation Discussion Kick-off	7-Jul-21
Joint Stakeholder meeting – Draft Cost allocation Framework	13-Aug-21
Joint Stakeholder meeting - Study Update	8-Oct-21
Joint Stakeholder meeting – Final Portfolio	3-Dec-21
Joint Stakeholder meeting – Review Final Report	27-Jan-22

Table 10 Stakeholder Engagement Timeline

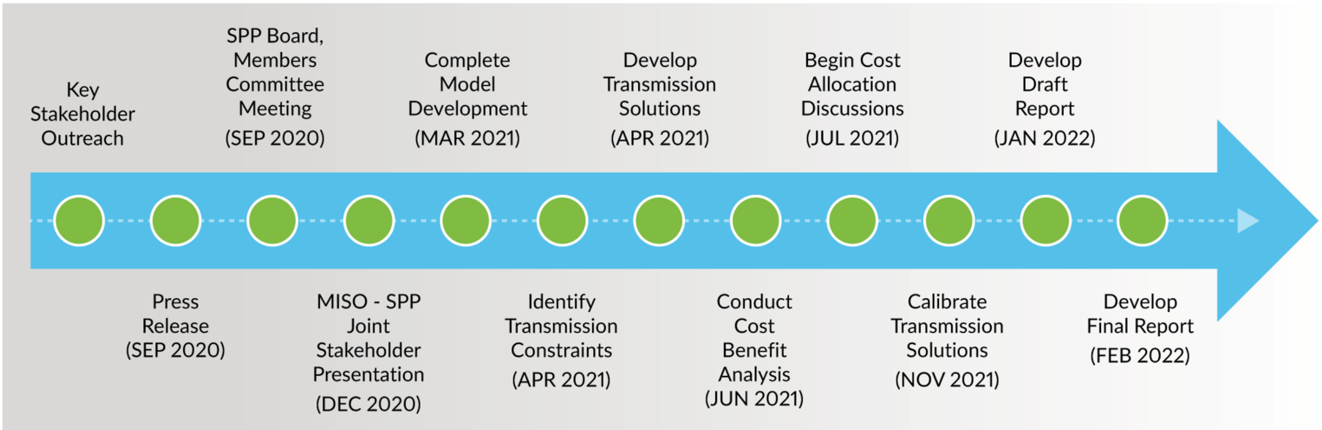
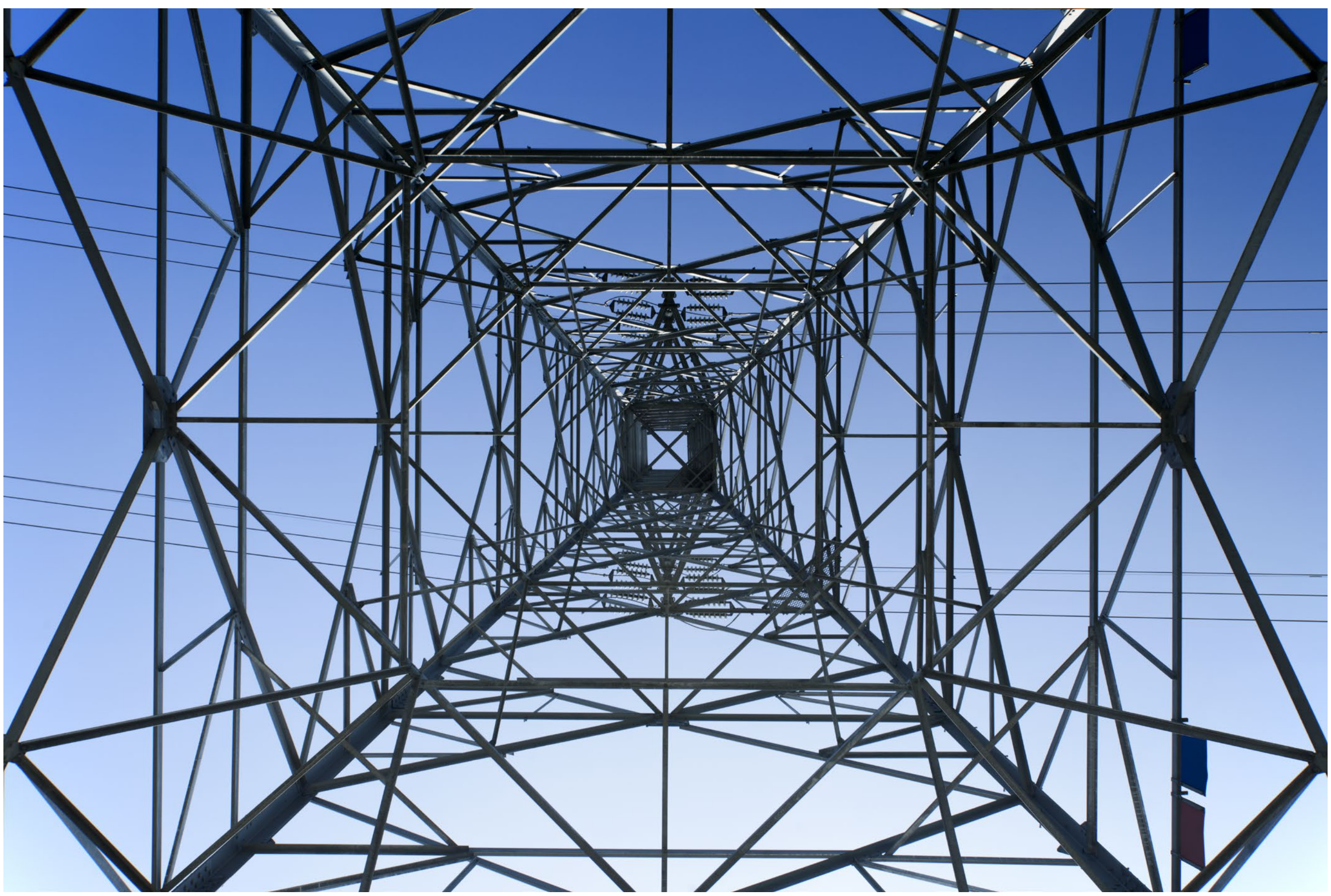


Figure 4: Study Timeline



5. Cost Allocation

At the time of this report, MISO and SPP, with the assistance of stakeholders of both organizations, are developing a cost allocation methodology to fund the recommended transmission projects. The goal of a cost allocation methodology is to equitably distribute the cost of recommended transmission upgrades to multiple parties that benefit from those upgrades. Efforts thus far have focused on benefits to load and generation interconnection customers. While developing the cost allocation methodology, MISO and SPP intend to investigate additional benefit areas, such as enhancements to BES reliability. The cost allocation methodology will continue development well into 2022.

6. Interconnection Process Alignment progress

MISO and SPP Generator Interconnection teams are actively coordinating to streamline the MISO and SPP interconnection processes. Over the period of the JTIQ Study, MISO and SPP agreed to bring significant changes to the interconnection study methodology and the interaction between MISO and SPP interconnection queue. These changes described in 6.1, 6.2 and 6.3 will be reflected in a filing with FERC to revise the MISO-SPP JOA that is expected to occur in March 2022.

6.1. Relative Queue Priority

MISO and SPP mutually agreed to change the relative queue priority between MISO and SPP interconnection queues from a first-come, first-serve basis to first-ready, first-serve for interconnection study clusters.

The current queue priority for requests in each RTO's interconnection queue is established based on the application deadline for both MISO Definitive Planning Phase (DPP) and SPP Definitive Interconnection System Impact Study (DISIS). The newly proposed queue priority will be established based on the earlier completion date of each RTO's Decision Point 1/I for both DPP and DISIS. This will reduce the need to re-study and will assist in providing cost certainty to interconnection customers.

MISO and SPP have agreed to transition to the new queue priority starting with the DISIS-2018-001 and DPP-2020 cycles.

6.2. SPP Affected System Studies – MISO NRIS Modeling

SPP's new modeling criteria applicable to Network Resource Interconnection Service (NRIS) requests in MISO will reflect the amount of NRIS being requested in MISO's interconnection process. Previously SPP's modeling criteria applicable to NRIS requests in MISO reflected the entire amount of Energy Resource Interconnection Service (ERIS). This change reflects the fact that interconnection requests in MISO could have a lower NRIS amount than ERIS for some projects.

6.3. Tie-line Upgrades

This update incorporates a tie-line upgrade if the limiting element(s) on the tie-line is neither under the control nor ownership of the party that identified the criteria violation. Previously, the party that identified the violation would be responsible for assigning mitigation to upgrades their portion of the tie-line, however the limiting element(s) that are not under the control or ownership of the party that identified the criteria violation may not be upgraded.

This change will assist in making complete upgrades to tie-lines and enhance the rating of the tie-line even if the limiting element is not under the control/ownership of the party that identified the criteria violation.

7. Next Steps

The engineering analysis and collaboration has developed a proposed portfolio with a study-level cost estimate of approximately $1.65 billion of investment. As discussed in stakeholder meetings, a next step to enable the construction of the JTIQ Portfolio is the development of an equitable cost allocation mechanism between interconnection customers and load in MISO and SPP. Key to this is the determination of a framework for allocating costs in alignment with benefits from projects.

Over the course of 2021, the JTIQ public stakeholder process began to explore potential methodologies. At the outset, simplicity and flexibility for use in the future were key attributes identified for the potential methodology- with three primary sources of funding considered:

1. The MISO region load contribution
2. The SPP region load contribution
3. GI customer contribution

One potential methodology proposed to stakeholders was a scoring system which would include multiple weighted factors and benefits, with costs split between generators and load based on benefits. The framework for each GI customers' cost obligation is under development but would likely be calculated as each interconnection request is studied in the MISO DPP or SPP DISIS process.

Refinements will continue to the cost allocation framework with stakeholders until the final cost allocation methodology is completed and sent to FERC for approval. The JTIQ Portfolio will be considered by each RTO's Board of Directors following FERC approval of a cost allocation methodology. Continued stakeholder engagement through future cost allocation workshops are planned for Spring 2022.

8. Appendices

8.1. MISO Study Scope

8.1.1. MISO Reliability Study

8.1.1.1. Study Models

Studies were performed using the following power flow models:

- The near-term starting models from the MISO MTEP20_2025 case
  - 2025 Summer Shoulder MTEP20_2025_SH40_TA
  - 2025 Summer Peak MTEP20_2025_SUM_TA
- The out-term starting models from the MISO MTEP20_2030 case
  - 2030 Summer Shoulder MTEP20_2030_SH40_TA
  - 2030 Summer Peak MTEP20_2030_SUM_TA

MISO performed one group study for all MISO and SPP regions (Table 11).

For each model, two scenarios were created to represent Future I changes, such as renewable energy growth, generator retirements, and load growth, both before and after.

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

Table 11: Study Models

8.1.1.2. Generation, Transmission and Dispatch Assumptions

Generation Assumptions

- MISO Deactivations
  - MISO-approved Attachment Y (Retirement/Suspension) generation were modelled offline
  - MISO age-based retirements as per Future I were modelled offline
  - Complete list is in Appendix section 8.7
- SPP Deactivations
  - SPP Generation deactivations provided by SPP were modelled offline
  - Complete list is in Appendix section 8.8

New Interconnection Generation

- MISO will add Future I generation in the MISO footprint
  - Distributed Generation was excluded
  - Complete list is in Appendix section 8.7
- SPP Future generation information was provided by SPP
  - Distributed Generation was excluded
  - Details in Appendix section 8.8

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 provided modeling information for major transmission upgrades in its footprint by year 2030 along with in-service dates. This was added to applicable MISO MTEP20 2025 or/and 2030 models.

Dispatch Assumptions

Dispatch assumptions consistent with MISO Generator Interconnection DPP studies were used.

The study units added to the starting case were dispatched at their expected output level as per fuel type (Table 12) such that the study units in MISO North (Classic) were sunk into MISO North (Classic) and generators in MISO South were sunk into MISO South. The existing generation/deactivations was scaled down by the amount of MW study units added.

The same fuel type methodology was used for SPP Futures generation. SPP Futures generation was sunk into SPP control areas and the existing generation/deactivations is scaled down by the amount of MW SPP Futures generation added.

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[4]	100%	0%
Steam - Coal	100%	100%
Oil	100%	0%
Waste Heat	100%	100%
Wind	15.6%	100%
Solar	100%	0%

Table 12: MISO Fuel Type Dispatch for Study Units

8.1.1.3. Monitoring and Contingencies

Monitor

All control areas in MISO's and SPP's footprint were monitored. Monitor files built for MTEP2020 study were used to monitor MISO control areas for this study. SPP provided SPP's monitor file.

Contingencies

The following contingencies in the study region (all control areas in MISO and SPP) were utilized in the steady state analysis:

- NERC Category P0 (system intact; no contingencies)
  - NERC Category P1 contingencies
- Single element outages, at buses with a nominal voltage of 68 kV and above
  - Multiple element NERC Category P1 contingencies
  - NERC Category P2, P4, P5 and P7 contingencies
- 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

8.1.1.4. Study Performance Criteria

Under NERC category P0 conditions (system intact) branches were monitored for loading above the normal rating (PSSE Rating A). NERC category P1-P7 conditions branches were monitored for emergency rating (PSSE Rating B).

[4] Only Battery Discharge scenario was studied. Battery Charging additional Scenarios were not created.

Voltage limits for system intact and contingent conditions are as per the applicable Transmission Owner Planning Criteria.

Study cases were compared with bench cases to see if the new interconnection projects were responsible for causing criteria violations.

To further filter down constraints and to focus on the transmission constraints in the MISO-SPP seams region, MISO used this criterion:

- 5 percent DFAX of at least one study region in one RTO and 3 percent DFAX of at least one study unit in other RTO

8.2. MISO Economic Study

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

Solutions were tested for Adjusted Production Cost (APC) savings, or "benefit," to quantify the economic value of each of the proposed solutions or solutions sets. Benefit was 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 utilized Future I as defined in the MTEP21 MTEP PROMOD models. This Future's assumptions are heavily driven by MISO's stakeholders, members and state commissions mandates and goals. MISO can run four model years: 5, 10, 15 and 20 years out. MISO will use the 5-, 10- and 15-year models to get a closer study timeline with SPP's economic models. MISO created 5- and 10-year Summer Powerflow models that are used for the PROMOD models.

Approved Generation Interconnection projects were added to the model as of October 2020, and active queue generation Point of Interconnection information is used in the futures siting process. Real Time (RT) and Day Ahead (DA) market-identified flowgates are added annually to MISO's event file. Additionally, when the futures were added to the model, MISO conducted Contingency Analysis using Power Analytics Software Tool (PAT) to identify any additional flowgates or events to monitor based on our future assumptions or updated Bulk Electric System parameters.

Key future assumptions were generation additions and retirements, the MISO total numbers are shown in Table 13 and Table14 for Future 1. Additional metrics are demand and energy forecasts and the natural gas forecast (MISO is using Gas Market Simulation System (GPCM) Base forecast with MISO customized pipeline market points).

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

Table 13: Futures I MISO Interconnections 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

Table14: Futures I MISO Retirements Summary

8.3. SPP Study Scope

8.3.1. SPP Reliability Study

8.3.1.1. Study Models

The Generation Interconnection (GI) study utilized the following 2021 Integrated Transmission Plan power flow models:

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

The GI study included a High Variable Energy Resource (HVER) and Low Variable Energy Resource (LVER) dispatch scenario (Table 15 and Table 16). For each dispatch scenario, a base (BC) and transfer (TC) case were created per season, which represent the before and after future changes.

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 15: HVER Study 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

Table 16: LVER Models

Only one set of models were developed to evaluate the current study interconnection requests in the GI analysis. That is, there is no "in-group" or "out-group" dispatch. This "model reduction" is meant to highlight potential constraints that 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 that 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 8.7 and 8.8.

Current study interconnection requests that are already modeled in the 2021 ITP will be left as-is. That is, the project will 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 were used to determine the capacity of the unit.

Current study interconnection requests which are not modeled in the 2021 ITP were added to the model as "out of service" at the POI. The Pmax of each project was modeled consistently with the requested summer and winter capacity amounts requested in the host RTO's public queue.

8.3.1.2. Generation, Transmission and Dispatch Assumptions

Generation Assumptions

Retirements/Deactivations

- SPP
  - SPP Generation deactivations were modelled offline
  - Complete list in Appendix section 8.8
- MISO
  - MISO-approved Attachment Y (Retirement/Suspension) generation were modelled offline
  - MISO age-based retirements as per Futures I were modelled offline
  - Complete list is in Appendix section 8.7

New Generation

- SPP
  - SPP added Future II generation in SPP footprint
  - Details in Appendix section 8.8
  - Distributed Generation was excluded
- MISO
  - MISO added Future I generation in MISO footprint
  - Details in Appendix section 8.7
  - Distributed Generation was excluded

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.

Dispatch Assumptions

In an attempt to reconcile dispatch discrepancies between MISO West and SPP, SPP groups 9, 13, 15, 16, 17 and 18 were combined into what will be referred to as "SPP North" which aligns with the MISO West region and includes the area of interest (Figure 5). SPP groups 1, 2, 3, 4, 6, 7, 8 10, 12, and 14 were considered "SPP South."

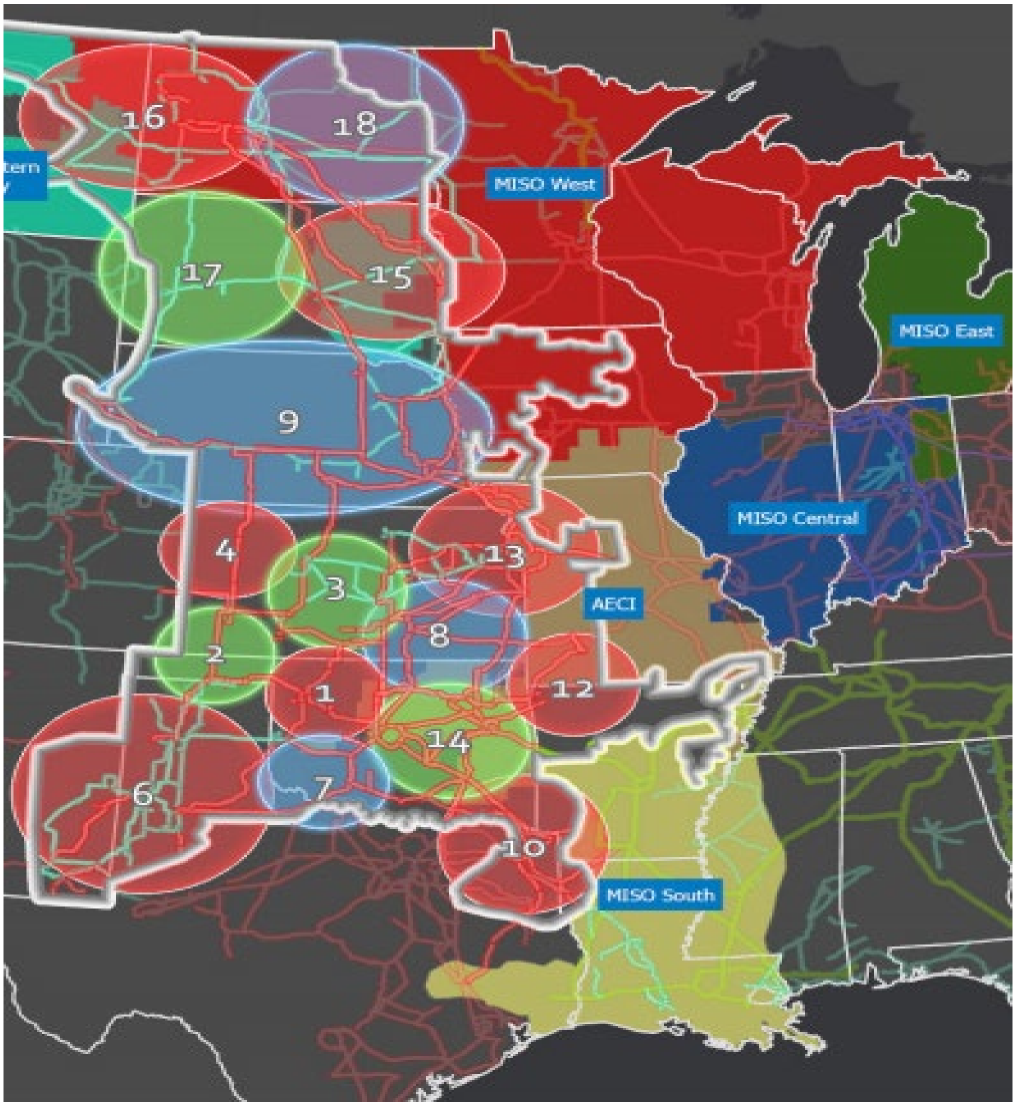


Figure 5: SPP Groups

As MISO evaluated Network Resource Interconnection Service (NRIS) for SPP, the SPP GI study did not evaluate NRIS for MISO. MISO and SPP interconnection requests were evaluated for ERIS only. As such, SPP developed HVER and LVER dispatch scenarios (Table 17).

Dispatch assumptions consistent with SPP Generator Interconnection DISIS studies were 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 17. 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.

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

Table 17: Fuel-Type Dispatch for Current Study Interconnection Requests

8.3.1.3. 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:

- NERC Category P0 (system intact; no contingencies)
- NERC Category P1 contingencies
    - Single element outages, at buses with a nominal voltage of 68 kV and above
    - Multiple element NERC Category P1 contingencies
- NERC Category P2, P4, P5 and P7 contingencies
- 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.

8.3.1.4. Study Performance Criteria

Under NERC category P0 conditions (system intact) branches were monitored for loading above the normal rating (PSSE Rating A), and for NERC category P1-P7 conditions branches were monitored for emergency rating (PSSE

Rating B). Voltage limits for system intact and contingent conditions are as per applicable Transmission Owner Planning Criteria.

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

To further filter down constraints and to focus on the transmission constraints in the MISO-SPP seams region, MISO used the following criterion:

- 3 percent DFAX of at least one study region in SPP and 5 percent DFAX of at least one study unit in MISO.

8.3.2. SPP Economic Study

Study Models

Economic models were 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 were 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 18 details the assumptions included in the 2021 ITP assessment models.

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

Table 18: 2021 ITP Assessment Assumptions

The following models from the 2021 ITP assessment were utilized:

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

To appropriately constrain the economic model during Security Constrained Unit Commitment/Security Constrained Economic Dispatch (SCUC/SCED) simulations, the event file developed for the 2021 ITP assessment was 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 generally follows the requirements outlined in section 2.2.3 of the ITP Manual, "Constraint Assessment".

SPP Economic Analysis

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

Solutions were tested for Adjusted Production Cost (APC) savings, or "benefit" to quantify the economic value of each of the proposed solutions or solutions sets. Benefits were 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).

8.4. Interconnection Process Alignment — Scope

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).

8.5. JTIQ Reliability Performance Matrix

JTIQ Reliability Performance Matrix.xl

8.6. JTIQ Economic Results

JTIQ Economic Results.xlsx

8.7. MISO Generation and Retirement Assumptions

MISO JTIQ SOW (Gen & Retirements)

8.8. SPP Generation and Retirement Assumptions

SPP JTIQ SOW (Gen & Retirements) r3.xl

8.9. MW Enablement Analysis Details

For this analysis, SPP and MISO utilized selected constraints and examined the loading on each element for the base case and study case. Two scenarios were accounted for: enablement by alleviating constraints and enablement by utilizing new capacity. The bench and study cases used for each are:

- *By alleviating constraints: Bench = Pre dispatch, Study = Post-dispatch and **pre** portfolio*

Generation Enabled by Addressing Constraints = (Study loading % - 100) / (Study loading % - Bench loading %)

For each generator maximum generation restriction removed by JTIQ projects in utilized.

- *By utilizing new capacity: Bench =Pre-Dispatch, Study = Post-dispatch **post** portfolio*

Generation Enabled by utilizing new capacity = (100 – Study Loading %) / (Study Loading % - Bench loading %)

Minimum additional generation (linearly increasing futures generation on the existing sites) before violating any new line or existing constraint is used (first contingency).

The final numbers from these two scenario calculations were summed and are mentioned in Section 2.3.

JTIQ

JOINT TARGETED INTERCONNECTION QUEUE STUDY

This report was jointly created and developed by the Midcontinent Independent System Operator, Inc. (MISO), and Southwest Power Pool, Inc. (SPP).

A MISO - SPP COLLABORATION

MISO

SPP Southwest Power Pool