Appendix E1: MTEP 18 Reliability Planning Methodology

Contents

E1.1 Reliability Planning Methodology Overview

MISO, as Planning Coordinator, performs many types of reliability analyses in its MTEP studies. The reliability assessment tests the existing plan using appropriate North American Electric Reliability Corp. (NERC) standard TPL-001-4 Table I events. If the system, as planned, has the potential to violate Transmission Planning (TPL) standards, MISO will work with its member Transmission Planners to develop a mitigation plan and test this plan to ensure that the desired system performance is achieved. This section describes the study process used to make an assessment of system reliability. MISO Transmission Planning Business Practice Manual (BPM-020 rev 16) references are included. The NERC TPL Standards TPL-001-4 can be found on the NERC website.

E1.2 Baseline Reliability Assessment Methodology

This section describes how the analyses and assessment performed by MISO meet the requirements (in bold italics) of NERC TPL standard TPL-001-4.

R1 ***Each Transmission Planner and Planning Coordinator shall maintain System models within its respective area for performing the studies needed to complete its Planning Assessment. The models shall use data consistent with that provided in accordance with the MOD-010 and MOD-012 standards, supplemented by other sources as needed, including items represented in the Corrective Action Plan, and shall represent projected System conditions. This establishes Category P0 as the normal System condition in Table 1.***

Please refer to the MISO model building document MOD 32 Data Requirements and Report Procedures for model building details. System models will be developed to meet R1 and R2 as described in this document. MISO will also develop models of other system conditions that are not required to meet the TPL standard but will be used for other purposes, such as Winter models to support planning for local area peak conditions.

R1.1 *System models shall represent:*

Umbrella requirement, see sub-requirements.

R1.1.1 *Existing Facilities*

Models used in MTEP Reliability Analyses include existing transmission facilities. The topological starting point of MTEP models is existing facilities.

R1.1.2 *Known outage(s) of generation or Transmission Facility(ies) with a duration of at least six months.*

Outages of six months or more that have been approved in Control Room Operations Window (CROW) will be included in the planning model for the timeframe that they are active.

R1.1.3. *New planned Facilities and changes to existing Facilities*

In addition to changes to existing facilities, planned projects that either have gone through the planning process or are in the MTEP review process are included in the MTEP models. MISO members submit topology changes to Model on Demand (MOD) that will be incorporated in the final models. Please refer to the MISO model building document MOD 32 Data Requirements and Report Procedures for further details.

R1.1.4 *Real and reactive Load forecasts*

Please refer to the MISO model building document MOD 32 Data Requirements and Report Procedures for model building details, including real and reactive load forecasts.

R1.1.5 *Known commitments for Firm Transmission Service and Interchange*

Area interchange will be set to model firm transactions between areas. A transaction table including OASIS data will be utilized to determine Area Interchange. Data needed to model transactions will include the source and sink areas, transaction MW amount, applicable model scenarios, start/end dates and an OASIS reference (Transmission Service Reservation) number or a Grandfathered Agreement (GFA) number. This data is required to be provided by Transmission Owners in collaboration with their Balancing Authority. Transactions need to be confirmed by both transacting parties. Final cases are solved by enabling the PSS/E “ties + loads” interchange function.

R1.1.6 *Resources (supply or demand side) required for load*

MISO member resources required for load will be included in the model and dispatched to serve load as required, as described in the MISO model building manual.

R2 ***Each Transmission Planner and Planning Coordinator shall prepare an annual Planning Assessment of its portion of the Bulk Electric System. This Planning Assessment shall use current or qualified past studies (as indicated in Requirement R2, Part 2.6); document assumptions, and document summarized results of the steady state analyses, short circuit analyses, and stability analyses.***

MISO, as the Planning Coordinator, demonstrates its valid assessment through its MISO Transmission Expansion Plan (MTEP) performed annually with its primary objective to ensure reliability of the Bulk Electric System through a 10-year planning horizon. The annual MTEP Planning Assessment both uses fresh analyses performed both in the present cycle and considers prior analyses performed in recent cycles. MISO has assessed the system performance of the following model years in the last five MTEP planning cycles (Table 1).

Model Year	MTEP Study		
	Year 2	Year 5	Year 10
2015	MTEP13		
2016	MTEP14	MTEP11	
2017	MTEP15	MTEP12	
2018	MTEP16	MTEP13	
2019	MTEP17	MTEP14	
2020	MTEP18	MTEP15	
2021		MTEP16	MTEP11
2022		MTEP17	MTEP12
2023		MTEP18	MTEP13
2024			MTEP14
2025			MTEP15
2026			MTEP16
2027			MTEP17
2028			MTEP18

Table 1: List of Model Years by MTEP Study

Simulations to support assessments of the 10-year planning horizon are based on comprehensive models developed with our membership and external representation from Eastern Interconnection Reliability Assessment Group (ERAG) Multiregional Modeling Working Group (MMWG) cases. The MTEP performs a variety of evaluations of the transmission system with Planned and Proposed transmission system upgrades, as identified in the expansion planning process, to ensure that the transmission system upgrades are sufficient and necessary to meet NERC and Regional planning standards for reliability. This assessment is accomplished through steady-state analysis, dynamic stability simulations, load deliverability analysis, generator deliverability analysis and voltage-stability analysis of the transmission system performed by MISO staff and reviewed in an open stakeholder process.

Detailed results are tabulated in the MTEP report appendices (Table 2).

Appendix	App. Name
D1	Project Justification
D2	Modeling Documentation
D3	Steady State
D4	Voltage Stability
D5	Transient Stability
D6	Generator Deliverability
D7	Contingency Coverage
D8	Nuclear Plant Assessment
D9	Transfer Capability
D10	Short Circuit Analysis

Table 2: List of MTEP results appendices

A list of the planned and proposed mitigations needed is also documented in Appendices A and B. And finally, this Appendix E1 contains detailed documentation of reliability studies performed in each MTEP and how each demonstrates compliance to applicable requirements. Additional details on how the assessment is accomplished are described in the following requirements.

R2.1 *For the Planning Assessment, the Near-Term Transmission Planning Horizon portion of the steady state analysis shall be assessed annually and be supported by current annual studies or qualified past studies as indicated in Requirement R2, Part 2.6. Qualifying studies need to include the following conditions:*

MISO performs an annual assessment and that assessment is documented in each year's MTEP report. MTEP reports have been published annually since 2005.

R2.1.1 *System peak Load for either year one or year two, and for year five.*

The MTEP18 base study models are:

- 2020 Summer Peak with the present wind capacity credit (Year 2)
- 2023 Summer Peak with the present wind capacity credit (Year 5)

Please refer to the MISO Resource Adequacy document for wind capacity credit details, and the MISO MOD 32 Model Data Requirements and Reporting Procedures for generation dispatch details.

R2.1.2 *System Off-Peak Load for one of the five years.*

The MTEP18 off-peak (or "shoulder") study models, defined as an average weekday peak scenario, and typically implemented in the range of 70 percent to 80 percent of Summer Peak load conditions, are:

- 2023 Summer Shoulder with 40 percent (approximate average system wide) wind (Year 5)

R2.1.3. *P1 events in Table 1, with known outages modeled as in Requirement R1, Part 1.1.2, under those System peak or Off-Peak conditions when known outages are scheduled.*

Models will be created in compliance with R1.1.2.

For TPL analysis, MISO continues to support analyzing maintenance events in the planning assessments to assure the system is planned with sufficient flexibility to allow for the future scheduling of outages in the operating horizon.

Maintenance plus forced outage analysis: Beyond TPL analysis, these currently unscheduled and/or shorter-term maintenance events that are less than six months would not be modeled in the base case, but would be addressed in off-peak and/or light load analysis. Pre-contingency system adjustments are allowed, but no load shed will be permitted for these off-peak maintenance planning events.

R2.1.4 *For each of the studies described in Requirement R2, Parts 2.1.1 and 2.1.2, sensitivity case(s) shall be utilized to demonstrate the impact of changes to the basic assumptions used in the model. To accomplish this, the sensitivity analysis in the Planning Assessment must* *vary one or more of the following conditions by a sufficient amount to stress the System within a range of credible conditions that demonstrate a measurable change in System response:*

Sensitivity cases are intended to reflect differences in MISO areas. Steady state models in MTEP18 are based on three sensitivity cases:

- 2020 Light Load, 0 percent wind dispatch (sensitivity to 2020 Summer Peak)
- 2023 Light Load, 80-to-90 percent wind dispatch (sensitivity to 2023 Summer Peak)
- 2023 Summer Shoulder, 80-to-90 percent wind dispatch (sensitivity to 2023 Shoulder)

R2.1.5 *When an entity's spare equipment strategy could result in the unavailability of major Transmission equipment that has a lead time of one year or more (such as a transformer), the impact of this possible unavailability on System performance shall be studied. The studies shall be performed for the P0, P1, and P2 categories identified in Table 1 with the conditions that the System is expected to experience during the possible unavailability of the long lead time equipment.*

Transmission Owners will determine specific equipment with a long lead time where spare equipment is not maintained. It only applies to the transmission equipment that is defined as part of the Bulk Electric System. Any element associated with the generator, such as the Generator Step Up (GSU) or the generator itself, is not included. This will likely be equipment such as transformers, phase shifters and reactive devices where a system spare does not exist. Transmission Owners will provide this data to MISO in accordance with an agreed-upon schedule.

System peak and off-peak cases will be run for relevant P0, P1 and P2 contingencies located near the long-lead equipment with this equipment removed (one equipment item at a time). Analyses will be combined with the maintenance analysis described previously for off-peak cases. The contingencies associated with the long-lead equipment will be reported in R2.1.5 results. Pre-contingency system adjustments will be allowed, but no load shed.

R2.2 *For the Planning Assessment, the Long-Term Transmission Planning Horizon portion of the steady state analysis shall be assessed annually and be supported by the following annual current study, supplemented with qualified past studies as indicated in Requirement R2, Part 2.6:*

MISO performs an annual assessment and that assessment is documented in each year's MTEP report. MTEP reports have been published annually since 2005.

R2.2.1 *A current study assessing expected System peak Load conditions for one of the years in the Long-Term Transmission Planning Horizon and the rationale for why that year was selected.*

Each annual MTEP report assesses the system for the long-term planning horizon by studying expected system conditions in Year 10 in order to book end our long-term analysis and to help identify facilities that cannot be constructed until after Year 5. MTEP11, MTEP12, MTEP13, MTEP14, MTEP15, MTEP16, MTEP17 and MTEP18 assessments all studied expected system conditions in Year 10. These long-term assessments covered the years 2022 through 2028, providing a full coverage of the long-term horizon. Similarly, MTEP18 will study expected system conditions in 2028. These models allow for the development of a long-term planning assessment, which then shapes the comprehensive solution developed in the Year 2 to Year 5 time horizon.

R2.3 *The short circuit analysis portion of the Planning Assessment shall be conducted annually addressing the Near-Term Transmission Planning Horizon and can be supported by current or past studies as qualified in Requirement R2, Part 2.6. The analysis shall be used to determine whether circuit breakers have interrupting capability for Faults that they will be expected to interrupt using the System short circuit model with any planned generation and Transmission Facilities in service which could impact the study area.*

Compliance responsibility for this requirement will be transferred to the Transmission Planner. MISO will incorporate the near-term transmission planning horizon results of Transmission Planners' short circuit analyses into the MTEP report as a separate appendix, per the MTEP report schedule.

R2.4 *For the Planning Assessment, the Near-Term Transmission Planning Horizon portion of the stability analysis shall be assessed annually and be supported by current or past studies as qualified in Requirement R2, Part 2.6. The following studies are required:*

MISO performs an annual assessment and that assessment is documented in each year's MTEP report. MTEP reports have been published annually since 2005.

R2.4.1 *System peak Load for one of the five years. System peak Load levels shall include a Load model which represents the expected dynamic behavior of Loads that could impact the study area, considering the behavior of induction motor Loads. An aggregate System Load model which represents the overall dynamic behavior of the Load is acceptable.*

The dynamic simulation base model to be studied is:

- 2023 Summer Peak (capacity credit wind level)

Year 5 Summer Peak models will be used to assess the dynamic stability performance in the Near-Term Transmission Planning Horizon. Transmission Owners will work with Load-Serving Entities to incorporate substation level aggregate composite load or detailed load models that incorporate estimated induction motor transient behavior, and Transmission Owners will provide that data to MISO by the agreed-upon dynamic model building schedule. Dynamic machine data shall be provided by the GO/GOP in coordination with the Transmission Planners per NERC standard MOD-032. Please see MISO MOD-032 model data requirements and reporting procedures document.

System load models will be built for this planning scenario. Information used to build these models shall come from the Transmission Planners, per the model building schedule outlined by MISO in collaboration with MISO's Transmission Planner members. After NERC standard MOD-032 is active, the Load-Serving Entity will have the obligation to provide the load data.

R2.4.2 *System Off-Peak Load for one of the five years*

Dynamic simulation base model to be studied is:

- 2023 Summer Shoulder (approximate system-wide average wind level at 40 percent)

System load models will be built for this planning scenario. Information used to build these modes shall come from the Transmission Planners, per the model building schedule outlined by MISO in collaboration with its Transmission Planner members.

R2.4.3 *For each of the studies described in Requirement R2, Parts 2.4.1 and 2.4.2, sensitivity case(s) shall be utilized to demonstrate the impact of changes to the basic assumptions used in the model. To accomplish this, the sensitivity analysis in the Planning Assessment must vary one or more of the following conditions by a sufficient amount to stress the System within a range of credible conditions that demonstrate a measurable change in performance:*

Sensitivities to base dynamic models include:

- 2023 Light Load, 80 to 90 percent wind dispatch (high wind)
- 2023 Summer Shoulder, 80 to 90 percent wind dispatch (high wind)

R2.5 *For the Planning Assessment, the Long-Term Transmission Planning Horizon portion of the Stability analysis shall be assessed to address the impact of proposed material generation additions or changes in that timeframe and be supported by current or past studies as qualified in Requirement R2, Part 2.6 and shall include documentation to support the technical rationale for determining material changes.*

MISO will determine the impact of proposed material generation or additional changes in the Long-Term Transmission Planning Horizon and develop documentation to support the technical rationale for determining material changes.

MISO will perform the Long-Term Transmission Planning Horizon portion of the stability analysis unless there is documentation to support the technical rational for determining material changes and demonstrate there are no proposed material generation additions or changes in that timeframe applying the technical rational.

R2.6 *Past studies may be used to support the Planning Assessment if they meet the following requirements*

Umbrella requirement, see sub-requirements.

R2.6.1 *For steady state, short circuit, or stability analysis: the study shall be five calendar years old or less, unless a technical rationale can be provided to demonstrate that the results of an older study are still valid.*

Any prior study used by MISO shall be five calendar years old or less.

R2.6.2 *For steady state, short circuit, or stability analysis: no material changes have occurred to the System represented in the study. Documentation to support the technical rationale for determining material changes shall be included.*

For any valid past study to be used, MISO will show that there have been no material changes between the planning year being studied and the planning year of the study to be used, per the guidelines noted in R2.5. Transmission Owners will determine if there are material changes to short circuit studies.

R2.7 *For planning events shown in Table 1, when the analysis indicates an inability of the System to meet the performance requirements in Table 1, the Planning Assessment shall include*

Corrective Action Plan(s) addressing how the performance requirements will be met. Revisions to the Corrective Action Plan(s) are allowed in subsequent Planning Assessments but the planned System shall continue to meet the performance requirements in Table 1. Corrective Action Plan(s) do not need to be developed solely to meet the performance requirements for a single sensitivity case analyzed in accordance with Requirements R2, Parts 2.1.4 and 2.4.3. The Corrective Action Plan(s) shall:

Corrective Action Plans will be developed collaboratively by MISO and Transmission Planners. MISO documentation of Corrective Action Plans that meet the performance requirements of Table 1 can be found within the MTEP report appendices. Corrective Action Plans are not required for sensitivity case analyses that reveal Table 1 violations for a single sensitivity scenario.

R2.7.1 *List System deficiencies and the associated actions needed to achieve required System performance.*

MISO provides a written summary through MTEP Appendices A and B, which have expected in-service dates for each project facility as determined through reliability analysis. Additionally, MISO points to MTEP Appendix D1 to provide a written summary of plans necessary to achieve required system performance.

R2.7.2 *Include actions to resolve performance deficiencies identified in multiple sensitivity studies or provide a rationale for why actions were not necessary.*

Corrective Action Plans will be developed collaboratively by MISO and Transmission Planners for performance deficiencies identified in multiple MISO sensitivities. If a Corrective Action Plan was not developed, MISO will provide rationale in Appendix D3 of the MTEP report. The Transmission Planner will identify performance deficiencies that present in multiple MISO and/or Transmission Owner sensitivities.

R2.7.3 *If situations arise that are beyond the control of the Transmission Planner or Planning Coordinator that prevent the implementation of a Corrective Action Plan in the required timeframe, then the Transmission Planner or Planning Coordinator is permitted to utilize Non-Consequential Load Loss and curtailment of Firm Transmission Service to correct the situation that would normally not be permitted in Table 1, provided that the Transmission Planner or Planning Coordinator documents that they are taking actions to resolve the situation. The Transmission Planner or Planning Coordinator shall document the situation causing the problem, alternatives evaluated, and the use of Non-Consequential Load Loss or curtailment of Firm Transmission Service.*

Should the temporary use of Non-Consequential Load Loss and curtailment of Firm Transmission Service outside of the guidelines in Table 1 be necessary to meet performance requirements, MISO will work with the Transmission Planner to follow the guidance outlined in R2.7.3.

R2.7.4 *Be reviewed in subsequent annual Planning Assessments for continued validity and implementation status of identified System Facilities and Operating Procedures.*

MISO will review the regional Corrective Action Plan and Operating Procedures for continued sufficiency and implementation status as part of the annual MTEP assessment. This will include coordination with the Transmission Owners to track the implementation status of the identified system facilities through quarterly MTEP status reports. Transmission Owners will, at a minimum of once annually, check the validity and communicate the continued need for new planned projects through the MTEP Appendix A Quarterly Status Report.

R2.8 *For short circuit analysis, if the short circuit current interrupting duty on circuit breakers determined in Requirement R2, Part 2.3 exceeds their Equipment Rating, the Planning Assessment shall include a Corrective Action Plan to address the Equipment Rating violations. The Corrective Action Plan shall:*

MISO will transfer compliance responsibility for short circuit studies and any actions necessary to meet the performance requirements outlined with R2.8 and its sub-requirements to the Transmission Planners. Transmission Planners will provide corrective actions for the breakers where the maximum fault current that the breaker must interrupt exceeds the short circuit current interrupting capability of the breaker.

R3 ***For the steady state portion of the Planning Assessment, each Transmission Planner and Planning Coordinator shall perform studies for the Near-Term and Long-Term Transmission Planning Horizons in Requirement R2, Parts 2.1, and 2.2. The studies shall be based on computer simulation models using data provided in Requirement R1.***

MISO develops planning models as outlined within the TPL-001-4, R1 with required modeling data.

MISO performs studies using models within the appropriate computer simulation tools.

R3.1 *Studies shall be performed for planning events to determine whether the BES meets the performance requirements in Table 1 based on the Contingency list created in Requirement R3, Part 3.4.*

MISO will simulate the events outlined in Table 1 to evaluate the Bulk Electric System's ability to meet the necessary performance requirements. Details on what events will be simulated, and how those events to be simulated will be determined, can be found under R3.4.

R3.2 *Studies shall be performed to assess the impact of the extreme events which are identified by the list created in Requirement R3, Part 3.5.*

MISO will simulate the events outlined in Table 1 to evaluate the Bulk Electric System's ability to meet the necessary performance requirements. Details on what events will be simulated, and how those events are chosen, can be found under R3.5.

R3.3 *Contingency analyses for Requirement R3, Parts 3.1 and 3.2 shall:*

Lead in requirement, see sub-requirements.

R3.3.1 *Simulate the removal of all elements that the Protection System and other automatic controls are expected to disconnect for each Contingency without operator intervention. The analyses shall include the impact of subsequent:*

MISO will analyze contingent event definitions submitted by the Transmission Planner to simulate the automatic response to disturbances including tripping, reclosing, and other automatic adjustments anticipated for those events for P1 through P7 contingency events. MISO may analyze events in addition to those submitted by Transmission Planner.

R3.3.1.1 *Tripping of generators where simulations show generator bus voltages or high side of the generation step up (GSU) voltages are less than known or assumed minimum generator steady state or ride through voltage limitations. Include in the assessment any assumptions made.*

MISO will use values obtained from the Generator Owners (GO) when available. If not available, the voltage ride-through curve from Attachment 2 of PRC-024 will be used as the criteria. GOs must comply with this standard and will trip (either manually or automatically within the applicable software) if the generator cannot ride through the disturbance based on the above-referenced voltage ride-through curve. MISO reserves the right to contact the GOs in specific cases to get actual ride-through curves if the generator cannot ride through the disturbance based on the above PRC-024 ride-through curve prior to identifying a need for a Corrective Action Plan. Submitted generator voltage thresholds will be used.

R3.3.1.2 *Tripping of Transmission elements where relay loadability limits are exceeded.*

MISO will use Transmission Planner tripping proxy values for this analysis if they are provided. Otherwise, MISO will use 115 percent of the emergency rating as the tripping proxy. Note that the emergency ratings of some Transmission Owners are equal to their normal ratings. Therefore, if the magnitude of the complex powerflow (real and reactive powerflow) at the line terminal exceeds the proxy value for the relay loadability limits of the line, MISO will simulate tripping of that line terminal. The proxy value threshold aligns with PRC-023-3. If relay load encroachment options are used or all tripping schemes (including backup protection) require pickup of non-load-responsive relays (e.g., differential relays, phase comparison relays, etc.), then MISO believes that modeling tripping is not necessary. MISO will contact the Transmission Owners when the proxy limit is exceeded to get actual relay settings and determine if a Corrective Action Plan is required.

R3.3.2 *Simulate the expected automatic operation of existing and planned devices designed to provide steady state control of electrical system quantities when such devices impact the study area. These devices may include equipment such as phase-shifting transformers, load tap changing transformers, and switched capacitors and inductors.*

The powerflow models used in the MTEP analysis contain existing and planned control devices, such as Load Tap Changing (LTC) transformers, phase angle regulating transformer controls, generator voltage controls, Direct Current line controls and switched shunts controls. These controls are enabled as part of powerflow simulation solution parameters.

R3.4 *Those planning events in Table 1, that are expected to produce more severe System impacts on its portion of the BES, shall be identified and a list of those Contingencies to be evaluated for System performance in Requirement R3, Part 3.1 created. The rationale for those Contingencies selected for evaluation shall be available as supporting information.*

MISO and the Transmission Planners will simulate contingencies that could result in severe system impacts. Transmission Owners may provide a complete set of severe events meeting Table 1 requirements to MISO. Transmission Owners shall provide severe P4 and P5 events to MISO as these events require detailed knowledge of protection system operation and timing. Transmission Owners shall provide P7 events to MISO. All provided contingencies shall have a contingency label that starts with NERC contingency type (P11, P12, P21, P22 and P7). Refer to the [MISO Contingency Naming Guideline](). Contingencies and rationale document shall be provided to MISO per an agreed-upon schedule.

MISO will evaluate the following steady-state events:

- Simulate select P1, P2, P4, P5 and P7 events that have the most significant impact on the transmission system
- Simulate select P3 and P6 events
  - Simulate same control area and adjacent control area events for P3 and P6, in order to find those combinations most likely to have an impact when simulated together

R3.4.1 *The Planning Coordinator and Transmission Planner shall coordinate with adjacent Planning Coordinators and Transmission Planners to ensure that Contingencies on adjacent Systems which may impact their Systems are included in the Contingency list.*

MISO and Transmission Planners will identify contingencies files that may affect adjacent Planning Coordinators and Transmission Planners. MISO will send identified contingencies to neighboring Planning Coordinators and Transmission Planners and copy MISO Transmission Planners. MISO will ask adjacent Planning Coordinators and Transmission Planners to provide contingencies that may impact MISO. MISO will coordinate with its own Transmission Planners, as well as adjacent Planning Coordinators and Transmission Planners, to ensure that all appropriate contingencies will be included on the list.

R3.5 *Those extreme events in Table 1 that are expected to produce more severe System impacts shall be identified and a list created of those events to be evaluated in Requirement R3, Part 3.2. The rationale for those Contingencies selected for evaluation shall be available as supporting information. If the analysis concludes there is Cascading caused by the occurrence of extreme events, an evaluation of possible actions designed to reduce the likelihood or mitigate the consequences and adverse impacts of the event(s) shall be conducted.*

MISO and the Transmission Planner will collaborate to develop a list of extreme events expected to produce more severe results to be simulated.

For those extreme events that could result in cascading, MISO and the Transmission Planner will evaluate possible actions to reduce the likelihood or mitigate the consequences and adverse impacts of those extreme events.

R4 ***For the Stability portion of the Planning Assessment, as described in Requirement R2, Parts 2.4 and 2.5, each Transmission Planner and Planning Coordinator shall perform the Contingency analyses listed in Table 1. The studies shall be based on computer simulation models using data provided in Requirement R1.***

MISO develops planning models as outlined within the TPL-001-4, R1 with necessary data.

MISO performs studies using the models within the appropriate computer simulation tools.

R4.1 *Studies shall be performed for planning events to determine whether the BES meets the performance requirements in Table 1 based on the Contingency list created in Requirement R4, Part 4.4.*

MISO will simulate the events outlined in Table 1 to evaluate the Bulk Electric System's ability to meet the necessary performance requirements. Details on what events will be simulated, including the event selection process, can be found under R4.4.

R4.1.1 *For planning event P1: No generating unit shall pull out of synchronism. A generator being disconnected from the System by fault clearing action or by a Special Protection System is not considered pulling out of synchronism.*

MISO will employ default scanning options provided by dynamic simulation tools, or Transmission Planner scanning options or criteria if they are provided. MISO and the associated Transmission Planner will validate the post-simulation results prior to developing a Corrective Action Plan. A Corrective Action Plan will be developed for valid P1 events where a generating unit pulls out of synchronism.

R4.1.2 *For planning events P2 through P7: When a generator pulls out of synchronism in the simulations, the resulting apparent impedance swings shall not result in the tripping of any Transmission system elements other than the generating unit and its directly connected Facilities.*

A Corrective Action Plan will be developed for any valid event (P2 through P7) where a generator pulls out of synchronism and trips any transmission system elements outside of the generator and its directly connected facilities.

Facilities directly connected are facilities that otherwise would not carry any network flow if the subject generator did not exist. These may include, but are not limited to: the associated GSU transformer; all facilities on the low side of the GSU transformer (such as auxiliaries, other generators, shunt devices, etc.); and the generator lead line between the high side of the GSU transformer and the point of interconnection to the transmission network.

Tripping of transmission system elements other than the generating unit and its directly connected facilities due to proper operation of an SPS for purposes other than apparent impedance swings shall not require a corrective action plan.

In order to perform these simulations, relaying details will need to be modeled (line relays, power swing blocking relays and out-of-step tripping relays per R4.3.1.3). The relaying details will be provided by the Transmission Planner.

R4.1.3 *For planning events P1 through P7: Power oscillations shall exhibit acceptable damping as established by the Planning Coordinator and Transmission Planner.*

For simulations of contingent events P1 through P7, power oscillations shall meet the damping criterion established by the Transmission Planner or Regional Reliability Organization. If the Transmission Planner or Regional Reliability Organization has not established criterion, power oscillations shall meet the damping criterion specified for R.6. Failure to meet the applied damping criterion would require a Corrective Action Plan.

R4.2 *Studies shall be performed to assess the impact of the extreme events which are identified by the list created in Requirement R4, Part 4.5.*

MISO will simulate the events outlined in Table 1 to evaluate the Bulk Electric System's ability to meet the necessary performance requirements. Details on what events will be simulated, and how those events will be determined, can be found under R4.5.

R4.3 *Contingency analyses for Requirement R4, Parts 4.1 and 4.2 shall:*

Lead-in requirement, see sub-requirements.

R4.3.1 *Simulate the removal of all elements that the Protection System and other automatic controls are expected to disconnect for each Contingency without operator intervention. The analyses shall include the impact of subsequent:*

MISO will analyze contingent event definitions submitted by the Transmission Planner to simulate the automatic response to disturbances including tripping, reclosing, and other automatic adjustments anticipated for those events for P1 through P7 contingency events. MISO will analyze events developed in collaboration with the Transmission Planner per R4.4.

R4.3.1.1 *Successful high speed (less than one second) reclosing and unsuccessful high speed reclosing into a Fault where high speed reclosing is utilized.*

MISO will analyze angular stability considering high-speed reclosing into a faulted transmission circuit after the initial trip. The contingency definitions will include reclosing times and the conditions required to enable high speed reclosing.

R4.3.1.2 *Tripping of generators where simulations show generator bus voltages or high side of the GSU voltages are less than known or assumed generator low voltage ride through capability. Include in the assessment any assumptions made.*

MISO will use values obtained from the GOs when available. If not available, the voltage ride-through curve from Attachment 2 of PRC-024 will be used as the criteria, since GOs must comply with this standard and will simulate tripping (either manually or automatically within the applicable software) if the generator cannot ride through the disturbance based on the established voltage ride-through curve. MISO reserves the right to contact the GOs in specific cases to get actual ride-through curves if the generator cannot ride through the disturbance based on the PRC-024 ride-through curve prior to identifying a need for a Corrective Action Plan. Submitted generator voltage thresholds will be used.

R4.3.1.3. *Tripping of Transmission lines and transformers where transient swings cause Protection System operation based on generic or actual relay models.*

MISO will analyze the tripping of transmission lines and transformers where transient swings cause Protection System tripping based on generic or actual relay models. When generic models are used, the Transmission Planner will verify any simulated line or transformer tripping by modeling the actual relay settings. If the Transmission Planner does not provide generic or actual relay settings, then MISO will use the following options:

- If power swing blocking is utilized on a specific line terminal, this requirement is automatically satisfied with no further analysis required.
- If power swing blocking is not utilized, use generic relay models provided in the simulation tools.

The Transmission Owners of the applicable relays will need to provide actual loadability tripping settings, if they are to be used in the models. MISO will check whether any transmission elements are loaded above their relay loadability limits and then will simulate the tripping of the elements.

In the future, when the MOD-032 standard becomes effective, the relay setting data will be provided by the associated Transmission Owners if needed. When PRC-026-1 is approved, a screening method can be used to simplify this process, such as evaluating relays only when a power swing causes an angular displacement between the equivalent sending-end and receiving-end voltages of 120 degrees or more.

R4.3.2 *Simulate the expected automatic operation of existing and planned devices designed to provide dynamic control of electrical system quantities when such devices impact the study area. These devices may include equipment such as generation exciter control and power system stabilizers, static var compensators, power flow controllers, and DC transmission controllers.*

Any equipment expected to respond within the 20-second response time window should be incorporated into the dynamic models. This information will be provided by the Transmission Planner.

R4.4 *Those planning events in Table 1 that are expected to produce more severe System impacts on its portion of the BES, shall be identified, and a list created of those Contingencies to be evaluated in Requirement R4, Part 4.1. The rationale for those Contingencies selected for evaluation shall be available as supporting information.*

MISO and Transmission Planners will collaborate to develop the list of severe contingencies that will be simulated. MISO and the Transmission Planner will document rationale for contingencies selected. In the example of relay failures and stuck breaker failures, the worst would be selected, recognizing that clearing times and number of facilities tripped may be different between those events (P4 versus P5).

R4.4.1 *Each Planning Coordinator and Transmission Planner shall coordinate with adjacent Planning Coordinators and Transmission Planners to ensure that Contingencies on adjacent Systems which may impact their Systems are included in the Contingency list.*

MISO and Transmission Planners will prepare a list of contingencies (and files that contain them) that may impact neighboring systems. MISO will send identified contingencies to neighboring Planning Coordinators and Transmission Planners and copy the MISO

Transmission Planner. MISO will coordinate with MISO Transmission Planners, adjacent Planning Coordinators and adjacent Transmission Planners to ensure that contingencies on adjacent systems, which may impact MISO systems, are included in the Contingency list. MISO will ask adjacent Planning Coordinators and Transmission Planners to provide adjacent Planning Coordinator and Transmission Planner contingencies that may impact MISO.

R4.5 *Those extreme events in Table 1 that are expected to produce more severe System impacts shall be identified and a list created of those events to be evaluated in Requirement R4, Part 4.2. The rationale for those Contingencies selected for evaluation shall be available as supporting information. If the analysis concludes there is Cascading caused by the occurrence of extreme events, an evaluation of possible actions designed to reduce the likelihood or mitigate the consequences of the event(s) shall be conducted.*

MISO and the Transmission Planner will collaborate to develop the list of the extreme events. MISO will simulate the extreme events with the greatest potential for severe results.

For extreme events that could result in cascading, MISO and the Transmission Planners will evaluate possible actions that will either mitigate or reduce the adverse impact of those extreme events on the reliable operation of the transmission system.

R5 ***Each Transmission Planner and Planning Coordinator shall have criteria for acceptable System steady state voltage limits, post-Contingency voltage deviations, and the transient voltage response for its System. For transient voltage response, the criteria shall at a minimum, specify a low voltage level and a maximum length of time that transient voltages may remain below that level.***

MISO will apply the Transmission Planner criteria for acceptable system steady-state voltage limits, post-contingency voltage deviations, and the transient voltage response. MISO will use the following MISO criteria in the absence of Transmission Planner criteria:

- Steady-State Normal Voltage Limits: 0.95 to 1.05 per unit
- Steady-State Emergency Voltage Limits: 0.90 to 1.10 per unit
- Steady-State Post Contingency Voltage Deviation shall not exceed 0.20 per unit
- Generator Transient Bus Voltages Limits shall adhere to PRC-024 standard. Default voltage criteria, using both the high voltage curve and the low voltage curve, are shown in PRC-024 Attachment 2 Voltage Ride-Through Time Duration curve unless there is a demonstrated exemption.
- Load Transient Bus Voltage Recovery Limits: transient low voltage may be less than 0.70 per unit voltage from 0 to 2 seconds after fault clearing. Voltage shall remain above 0.7 per unit from 2 to 20 seconds after fault clearing. Voltage shall recover to 0.9 per unit 20 seconds after fault clearing.

R6 ***Each Transmission Planner and Planning Coordinator shall define and document, within their Planning Assessment, the criteria or methodology used in the analysis to identify System instability for conditions such as Cascading, voltage instability, or uncontrolled islanding.***

MISO will apply the Transmission Planner criteria or methodology used to identify system instability for conditions such as cascading, voltage instability or uncontrolled islanding, if the

TP's planning criteria is provided. Otherwise MISO will use the following default criteria and its cascading analysis methodology including:

- Damping Criterion: $\zeta = -\frac{\alpha}{\sqrt{\alpha^2+\gamma^2}} \geq 0.03$
- PV Margin Limit: 90 percent of voltage collapse transfer level (10 percent back from nose of PV curve)
- Clearing Time Safety Margin: MISO recommends adding a 1.0 cycle safety margin to actual fault clearing time. Transmission Planner-provided dynamic disturbances should include their criteria or methodology's clearing time safety margin. MISO will not add clearing time safety margin to Transmission Planner-provided disturbance files.

In the absence of the Transmission Planner criteria for cascading in steady-state analysis, MISO will use the following default definition and criteria:

- **Cascading**: A cascading outage has occurred and must be mitigated if one or more of the following conditions result during planning event simulations (P1 through P7):
  - Four or more elements trip due to excessive loading, power swings, or abnormal system voltages in planning simulations of a P1, P2, P3, P4, P5, P6 or P7 event. Elements tripping to clear faults, either as primary or backup protection, or elements tripping in response to the expected operation of a Special Protection System, do not count.
  - One or more elements trip due to excessive loading, power swings or abnormal system voltages in planning simulations of a P1, P2, P3, P4, P5, P6 or P7 event *and the load loss due to tripping of these elements exceeds 1,000 MW*. This does not include consequential load loss due to elements that trip to clear the fault, either as primary or backup protection, load lost due to expected operation of a Special Protection System, or firm load shed performed in accordance with the TPL standards.

Elements are defined as transmission lines, transformers, and generators. All elements within a protective zone would be considered a single element (i.e., a three-terminal line is considered a single element). Elements do not include shunt devices. Tripping is assumed to occur at load levels of 115 percent or higher of the highest emergency rating, depending upon the Transmission Owner provided facility load duration rating.

R7. ***Each Planning Coordinator, in conjunction with each of its Transmission Planners, shall determine and identify each entity's individual and joint responsibilities for performing the required studies for the Planning Assessment.***

MISO and each Transmission Planner will execute a Coordinated Functional Registration (CFR), a Delegation Agreement, or Coordination Agreement to identify each entity's individual and joint responsibilities for performing the required studies.

R8. ***Each Planning Coordinator and Transmission Planner shall distribute its Planning Assessment results to adjacent Planning Coordinators and adjacent Transmission Planners within 90 calendar days of completing its Planning Assessment, and to any functional entity that has a reliability related need and submits a written request for the information within 30 days of such a request.***

MISO will send, via email, a link and directions on how to access the MTEP study results, including appendices, to adjacent Planning Coordinators and Transmission Planners.

R8.1 *If a recipient of the Planning Assessment results provides documented comments on the results, the respective Planning Coordinator or Transmission Planner shall provide a documented response to that recipient within 90 calendar days of receipt of those comments.*

MISO will respond to any comments received by adjacent Planning Coordinators and Transmission Planners within the timeframe allotted per the TPL-001-4 standard, R8.1.

E1.3 Discussion of TPL-001-4 Table 1 Requirements

E1.3.1 New Contingencies

The following new planning event contingencies should be added to the contingency files:

- Loss of Shunt Device (P1-4)
- Opening a line section without a fault (P2-1)
- Protection system failures (P5)[1]

The following new extreme event contingencies should be added to the contingency files:

- Two simultaneous contingencies with insufficient time for system adjustments in between
- Loss of two generating plants (not units) due to specified conditions

E1.3.2 Contingencies with Increased System Performance Requirements

The following contingencies should be modified in the model or evaluation process:

- Firm load shedding and interruption of firm service are not allowed for the following:
    - Extra-High Voltage (EHV) bus section faults
    - EHV internal breaker faults (non-bus tie)
    - For HV and EHV, two non-simultaneous contingencies when one or more contingent elements is a generator
    - Stuck breaker when the fault is on the EHV system (stuck breaker may or may not be on the EHV system)
    - Relay failure when the fault is on the EHV system

E1.3.3 Applicable Ratings and Facility Rating Time Duration Requirements

Background Materials

- Current TPL 003-0b Column Header, Footnote a, and Footnote c:

[1] Technically, P5 contingencies are not new contingencies based on the interpretation of the current TPL standards as part of Order 754 compliance that indicated the most severe contingency between a stuck breaker and relay failure must be evaluated. However, in the new standard, it requires looking at both stuck breakers (P4) and relay failures (P5).

System Stable and both Thermal and Voltage Limits within Applicable Rating

a) Applicable rating refers to the applicable Normal and Emergency facility thermal Rating or system voltage limit as determined and consistently applied by the system or facility owner. Applicable Ratings may include Emergency Ratings applicable for short durations as required to permit operating steps necessary to maintain system control. All Ratings must be established consistent with applicable NERC Reliability Standards addressing Facility Ratings.

c) Depending on system design and expected system impacts, the controlled interruption of electric supply to customers (load shedding), the planned removal from service of certain generators, and/or the curtailment of contracted Firm (non-recallable reserved) electric power transfers may be necessary to maintain the overall reliability of the interconnected transmission systems.

- New TPL 001-4 Header Note e and f:

  e. Planned System adjustments such as Transmission configuration changes and re-dispatch of generation are allowed if such adjustments are executable within the time duration applicable to the Facility Ratings.

  f. Applicable Facility Ratings shall not be exceeded.

MISO Application

The new standard clarifies that system adjustments must be made within the time duration applicable to facility ratings. Therefore, the following practice should be codified in the Transmission Planning BPM:

- Since footnote f indicates applicable Facility Ratings shall not be exceeded, system adjustments, non-consequential firm load shed and curtailment of firm transmission services cannot be used to avoid exceeding the highest Facility Rating for simultaneous event contingencies (all contingencies except P3 and P6). Furthermore, non-consequential load shed is not allowed for P3 contingencies.
- If an emergency rating within the planning models that was provided by a Transmission Owner is exceeded following a simultaneous event contingency, then MISO will check whether the Transmission Owner wants to provide MISO with a higher short-term rating (although not included in the planning models) and certify that applicable system adjustments, load shed and/or curtailment of firm transmission service can be made within the duration associated with the higher short-term emergency rating. Otherwise, if an additional higher rating is not available, or system adjustments cannot be made within the duration of the higher emergency rating, a Corrective Action Plan will need to be developed.
- For non-simultaneous event contingencies (P3 and P6), system adjustments can be made between the events. Non-consequential firm load shed and curtailment of firm transmission service are allowed only for P6 contingencies, and must be performed prior to the second contingencies. It must also be achievable within the allowable system adjustment period, for example, 30 minutes for an Interconnection Reliability Operating Limit (IROL) and the applicable emergency rating duration for a System Operating Limit (SOL).

E1.3.4 Footnote 12

Footnote 12 in the new standard replaces footnote b in the existing standard. Footnote 12 allows load shed for certain contingencies (P1, P2-1 and P3) if the load shed is less than 75 MW, applicable facility ratings are not exceeded, and a stakeholder process as defined in Attachment 1 is followed. MISO assumes Transmission Owners would not use Footnote 12 under normal circumstances. If an exception should apply, the Transmission Owners will notify MISO of the exception.

E1.4 MTEP Models Developed

MTEP powerflow models were developed to represent various system conditions in the planning horizon as described in Table 3. MISO coordinated with external seam regions (TVA, SPP and PJM) to reflect the corresponding regions latest topology within the MTEP models. For all other areas, modeling data of corresponding year or closer match from Eastern Interconnection Regional Reliability Organization (ERAG) 2017 series model were applied.

Model Year	Base case	Sensitivity
Year 2	2020 Summer Peak with wind at 15.6% (TPL requirement R2.1.1)	2020 Light Load (minimum load level) wind at 0% (TPL requirement R2.1.4)
Year 5	2023 Summer Peak with wind at 15.6% (TPL requirement R2.1.1)	2023 Summer Shoulder (70-80% peak) with wind at 90% (TPL requirement R2.1.4)
Year 5	2023 Summer Shoulder (70-80% peak) with wind at 40% (TPL requirement R2.1.2)	2023 Light Load (minimum load level) with wind up to 90% (TPL requirement R2.1.4)
Year 5	2023-2024 Winter Peak with wind at 40%	
Year 10	2028 Summer Peak with wind at 15.6% (TPL requirement R2.2.1)	

Table 3: MTEP Model Developed

E1.5 Contingencies Examined

Regional contingency files will be developed by MISO staff collaboratively with Transmission Owner and Regional Study Group input. NERC TPL-001-4 Category P1 through P7 contingency events on the transmission system under MISO functional control shall be analyzed. In general, contingencies on the MISO members' transmission system at 100 kV and above will be analyzed in MTEP18, although some 69 kV transmission events may also be analyzed.

E1.5.1 Steady-State Analysis

AC Contingency Analysis will be performed on the 2020 Summer Peak, 2023 Summer Peak and Shoulder cases, and 2028 Summer Peak case with and without the proposed MTEP18 Appendix A projects models. The following contingencies will be simulated:

1.) Steady-state contingency analysis – Studies shall be performed for planning events to determine whether the Bulk Electric System meets the performance requirements in Table 1 of the TPL-001-4 standard, based on the standard requirements:
    a. R2.1.3 – Simulate P1 events for all models with known outages modeled per R1 during those conditions where expected
    b. R3.4 – Simulate those events that are expected to produce more severe system impacts
        i. Rationale for selecting those events shall be documented

   ii. Planning Coordinators and Transmission Planners shall also coordinate with adjacent Planning Coordinators and Transmission Planners to ensure that contingencies in adjacent systems that could impact the MISO system are simulated

c. R3.5 – Simulate those extreme events from Table 1 expected to produce the most severe system impacts
   i. Rationale for selecting those events shall be documented
   ii. Should cascading occur, an evaluation of possible actions to reduce the likelihood or mitigate the consequences shall be conducted
   iii. Planning Coordinators and Transmission Planners shall also coordinate with adjacent Planning Coordinators and Transmission Planners to ensure that contingencies on adjacent systems that could impact the MISO system are simulated
d. Simulate contingent events provided by adjacent Planning Coordinators, which could have an impact on the MISO System
e. R2.1.5 – Assess the impact of the unavailability of major transmission equipment with a lead time of one year or more. P0, P1 and P2 categories should be simulated for the expected system conditions

E1.5.2 Dynamics Stability Analysis

Contingency analyses listed in Table 1 of TPL-001-4 shall be performed for the stability portion of the Planning Assessment, as described in Requirement 2, parts 2.4 and 2.5 of the standard, and Requirement 4:

- R4.4 – Simulate those events that are expected to produce more severe system impacts
  - Rationale for selecting those events shall be documented (R3.4)
  - Planning Coordinators and Transmission Planner shall also coordinate with adjacent Planning Coordinators and Transmission Planners, to include contingencies on adjacent Systems that could impact the MISO system
- R4.5 – Simulate those extreme events from Table 1 expected to produce the most severe system impacts
  - Rationale for selecting those events shall be documented
  - Should cascading occur, an evaluation of possible actions to reduce the likelihood or mitigate the consequences shall be conducted
  - Planning Coordinators and Transmission Planner shall also coordinate with adjacent Planning Coordinators and Transmission Planners, to include contingencies on adjacent systems that could impact the MISO system
- Simulate contingent events provided by adjacent Planning Coordinators, which could have an impact on the MISO System
- Stability analysis System performance requirements
  - P1 events: no generating unit shall pull out of synchronism
  - P2 through P7 events: when a generator pulls out of synchronism, resulting apparent impedance swings shall not result in tripping of any transmission system elements other than the generator and its directly connected facilities
  - P1 through P7 events: power oscillations shall exhibit acceptable damping as established by the Planning Coordinators and Transmission Planner

- Simulation of the removal of all elements that the protection system or other automatic controls are expected to disconnect for each contingency without operator intervention, including:
    - Successful high-speed reclosing and unsuccessful high-speed reclosing into a fault where high-speed reclosing is utilized
    - Tripping of generators where generator bus voltages or high side of the GSU are less than generator low-voltage ride-through capability
    - Tripping of transmission lines and transformers where transient swings cause protection system operation

MTEP AC analysis non-converged steady-state contingencies, which cannot be made to solve in individual powerflow analysis, will be tested in dynamic stability simulations.

E1.5.3 Voltage Stability Analysis

Voltage stability analysis is performed in order to identify voltage stability limits and power margins. Voltage stability analysis is used to identify reactive resource constrained areas and margin-to-voltage collapse under different system conditions. The appropriate system conditions and areas to study are selected based on the stakeholder and system operator input solicited at the beginning of the planning cycle.

In addition to the identified contingencies by the stakeholders and system operators, MISO will supplement with contingencies that were analyzed in the steady-state contingency analysis within that study area.

E1.6 Load Deliverability Analysis

In 2017 MISO will complete its eighth annual LOLE study under accepted tariff provisions, designed to meet MISO's Resource Adequacy construct as well as NERC standard BAL-502-RFC-02. A detailed compliance conformance table will be available in the 2017 LOLE Study Report.

E1.7 Generator Deliverability Analysis

The Generator Deliverability analysis determines the ability of groups of generators in an area to operate at their maximum capability without being limited by transmission constraints, that is, without being bottled-up. This test is performed as part of the generator interconnection study process for new generators before granting Network Resource status. The generator is required to fix transmission constraints limiting deliverability up to the requested Network Resource Interconnection Service amount, in order to be treated as a Network Resource. A generator that is certified deliverable can be designated by any Load-Serving Entity within the MISO Energy Market Footprint to satisfy its Resource Adequacy requirement as specified in Module E of the MISO Energy Market Tariff.

The deliverability levels of already granted Network Resources may deteriorate over time as a result of load growth and other changes to the transmission system. A Baseline Generator Deliverability Study is performed in order to identify and address any new transmission constraints to ensure ongoing deliverability of Network Resources. Baseline generator deliverability upgrades represent a reliability need to ensure the continued ability to count on Network Resources nominated to meet reserve requirements.

E1.8 Mitigation Plan Development

MISO staff works collaboratively with Transmission Owners and stakeholders to review and develop mitigation plans. MISO staff presented the MTEP projects to stakeholders at the first round of Subregional Planning Meetings in December 2017. Proposed plans were then reviewed again in additional detail at the second round of Subregional Planning Meetings, after MISO staff had reviewed and performed preliminary analysis of the project proposals, submitted at the beginning of the planning cycle. Feedback from stakeholders was incorporated into the project review process. The third and final round of Subregional Planning Meetings for each of the four planning regions presents the final list and details of projects moving forward for MISO Board of Directors approval in 2018.

The MISO transmission system is divided into four planning regions – West, Central, East and South - to facilitate the MTEP study and Subregional Planning Meetings. MISO staff members are assigned Transmission Owners in each planning region. MISO transmission-owning members and other interested stakeholders participated in the MTEP study and development of mitigation plans.

During the MTEP planning cycle, the Planning Subcommittee stakeholder group reviews MTEP analysis, project recommendations, and the MTEP report. Review of cost allocation of projects recommended for the MISO Board of Director approval, via the MTEP study, is done by the Planning Subcommittee and a specific stakeholder meeting for the purpose of reviewing the projects eligible for regional cost allocation. The last step in development of the mitigation plan is presentation of the final plan to the MISO Board of Directors for their review and approval.

E1.9 Transfer Capability Assessment

The Transfer Capability Assessment (FAC-013-2) standard requires the annual assessment of the transfer capability of the transmission system in order to identify weaknesses and limiting facilities that could impact the Bulk Electric System's ability to reliably transfer energy in the Near-Term Transmission Planning Horizon.

MISO will conduct its near-term (years one through five) planning assessment based on powerflow simulations representative of various system conditions in five-year-out MTEP models. System conditions modeled are normal base transfers that are representative of network projected customer demands and projected Firm Transmission Services at the forecasted system demands and is consistent with applicable NERC Transmission Planning standards. By using these base MTEP models to conduct Transfer Capability analyses, MISO will establish incremental Transfer Capability above these base transfer levels.

E1.10 Nuclear Plant Assessments

The Nuclear Plant Interface Coordination (NUC-001-2) standard requires coordination between the Nuclear Plant Generator Operators and Transmission Entities for the purpose of ensuring nuclear plant safe operation and shutdown. This section describes how the analyses and assessment performed by MISO planning to meet the requirements of the NERC NUC-001-2 standard, as applicable to MISO in its role as Planning Coordinator.

MISO has developed 12 Nuclear Plant Operating Agreements (NPOAs) for the 12 nuclear plants in the MISO footprint. Each NPOA contains the mutually agreed to Nuclear Plant Interface Requirements (NPIRs) and documents how the Nuclear Plant Generator Operator, the Transmission Owner and MISO will address and implement issues in the long-term planning horizon.

Compliance Requirements and Assessment

R3 Per the agreements developed in accordance with this standard, the applicable Transmission Entities shall incorporate the NPIRs into their planning analyses of the electric system and shall communicate the results of these analyses to the Nuclear Plant Generator Operator.

MISO incorporates the NPIRs into its regional planning analyses of the electric system. This includes incorporating the applicable NPIRs and Nuclear Plant Operating Agreement requirements in the MTEP Steady State (Appendix D3) and Transient Stability Analyses (Appendix D5), consistent with all NPOAs. Voltage Limits will be set in Steady State Analyses and voltages outside of these limits will be identified as constraints and addressed through mitigations.

In all cases, when a constraint is identified, the MTEP report contains appropriate and necessary mitigation plans to ensure that the voltage limits identified in the NPIRs and Nuclear Power Plant Operating Requirements are respected. These studies will be conducted in a manner consistent with the NERC TPL reliability standard requirements, and the limits provided in the NPIRs document will be respected during the MISO analysis.

MISO will communicate the results to the nuclear plant staff and the Transmission Planner, as appropriate, through posting of the annual study results to the MTEP ftp site along with notifying all MISO Planning Stakeholders[2] of the posting. Also, MISO will review and incorporate the long-term results from the Transmission Planner's planning analyses of the electric system's ability to meet the NPIRs into the annual MTEP report.

R8 Per the agreements developed in accordance with this standard, the applicable Transmission Entities shall inform the Nuclear Plant Generator Operator of actual or proposed changes to electric system design, configuration, operations, limits, protection systems, or capabilities that may impact the ability of the electric system to meet the NPIRs.

Per the NPOA, MISO will incorporate the NPIRs into the regional MTEP planning analysis. In addition to this, MISO will review and incorporate the long-term results from the Transmission Planners' long-term planning analyses of the electric system's ability to meet the NPIRs into the annual MTEP report, as required under the NPOAs.

[2] Note that only stakeholders with MISO NDA will be able to access this information since it is CEII.