UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

One-Time Informational Reports on	)	
Extreme Weather Vulnerability Assessments	)	Docket Nos. RM22-16-000
Climate Change, Extreme Weather, and	)	AD21-13-000
Electric System Reliability		

ONE-TIME INFORMATIONAL REPORT OF THE MIDCONTINENT INDEPENDENT SYSTEM OPERATOR, INC.

The Midcontinent Independent System Operator, Inc. ("MISO") submits these comments in reply to Order No. 897 that the Federal Energy Regulatory Commission ("FERC" or "Commission") issued in Docket Nos. RM22-16-000 and AD21-13-000 on June 15, 2023.[1] In Order No. 897, the Commission requires transmission providers to submit a one-time informational report on how they establish a scope for their extreme weather vulnerability assessments, develop inputs, identify vulnerabilities and determine exposure to extreme weather hazards, estimate the costs of impacts, and develop mitigation measures to address extreme weather risks. MISO provides the following responses to the report questions provided in Appendix A of Order No. 897.

A. EXECUTIVE SUMMARY

Extreme weather events contribute to a more challenging operating environment in the MISO Region. These weather events in combination with the changing resource mix bring unprecedented uncertainty and challenges for reliably operating the electric grid. MISO has recognized the continuing challenge and the urgency upon which we need to act to address it.

[1] *One-Time Informational Reports on Extreme Weather Vulnerability Assessments Climate Change, Extreme Weather, and Electric System Reliability.* Order No. 897, 183 FERC ¶ 61,192 (2023).

MISO has identified this shared responsibility and termed it the "Reliability Imperative[2]." MISO is looking broadly to address the challenges of the Reliability Imperative and is continuing enhancements to its planning, markets, operations, and systems. This includes positioning MISO to best respond to the rapid industry transition and increasingly unpredictable and volatile weather events. To help guide those efforts, the MISO Roadmap[3] lays out the strategic priorities that support and enable MISO's transition to the grid of the future in order to meet our members' plans and goals and respond to these challenges, including the increasing frequency of extreme weather events.

MISO offers the following information regarding its relationship with Local Balancing Authorities ("LBAs") and the division of responsibilities between LBAs and Regional Transmission Operators:

- MISO was certified by NERC as a Balancing Authority on 1/6/2009, the same date that MISO's Ancillary Services Market became effective;
- Existing Balancing Authorities in the MISO Balancing Authority Area at the time continue to function as Local Balancing Authorities;
- The initial division of responsibilities between MISO and the LBAs was described in R. Harszy's testimony attached to the ASM Tariff filing (see page 12 of Attachment F to the ASM filing) and the Balancing Authority Agreement (Rate Schedule 03).[4]

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2 *See* Docket No. AD21-11-000, Prepared Remarks of Aubrey Johnson on Behalf of the Midcontinent Independent System Operator, Inc. for the Reliability Technical Conference (2021) and Docket No. AD21-13-000, Comments of the Midcontinent System Operator, Inc. in response to the March 15, 2021 Supplemental Notice of Technical Conference Inviting Comments re Climate Change, Extreme Weather, and Electric System Reliability, (2021).

3 MISO Roadmap: https://cdn.misoenergy.org/MISO%20Roadmap619552.pdf.

4 *See* Docket No. ER07-1372-000, Attachment F, p. 12 (2007).

Under this division of responsibilities, MISO became the Balancing Authority for the newly-created Midwest ISO Balancing Authority Area. With the exception of certain essential local supporting tasks retained by the LBAs, MISO assumed the NERC Balancing Authority responsibilities found in NERC Balancing Authority Standards. MISO has full functional control of the Transmission System pursuant to the Tariff.

As a general matter, MISO performs many activities, and current or planned policies and processes that incorporate extreme weather vulnerability assessments. Longer term assessments include the Annual Planning Assessment, Transfer Capability Analysis, Long Range Transmission Planning ("LRTP") Benefits Analysis and Coordinated Seasonal Assessments. These assessments take into account historical Bulk Electric System ("BES") impacts from extreme weather events. MISO's Operations Risk Assessment ("ORA") team includes weather monitoring and potential impact evaluation to BES (generation and transmission risks). This is considered in the days to a few weeks ahead time horizons, as well as real-time alerts to Real-Time Operations. Extreme weather monitoring includes but is not limited to: Hurricane and other Tropical Systems; Severe Weather such as derechos, significant thunderstorms, tornadic activity; Severe Hot and Cold Weather, Ice storms, flooding, drought, wildfire smoke, significant wind events, and other weather events that may affect the operation of the BES. ORA coordinates and communicates with all of the teams described further below for inputs on their processes.

Forward Reliability Assessment Commitment ("FRAC") does up to 6 days forward commitment. These studies take the input from ORA as well as generation availability and expected transmission system constraints and other variables, and incorporate into the FRAC study for this period, looking at expected sufficiency stance.

Operations Planning coordinates with MISO Members and neighboring entities on outage planning and performs Operations Planning horizon studies. These studies may take into account higher risk BES assets as determined by MISO Transmission Owners ("TOs") and Generator Owners ("GOs") as well as the MISO ORA team and Real-Time Operations teams. These studies aid in outage planning as well as providing expected prior-day conditions to the Real Time Operations teams.

Real-Time Operations teams in the control rooms perform day-of/real-time coordination and take actions in real-time to maintain BES reliability. The aforementioned teams and processes lead up to the Real-Time environment setup for the operating day, as well as subsequent days for longer term extreme weather events.

MISO took away key lessons from Winter Storm Uri—each reinforcing our ongoing efforts under the Reliability Imperative[5].

1. Generator performance is essential during emergencies. For the most efficient, reliable delivery of energy, we need sufficient generation to be available at the right times. Extreme weather events can cause negative impacts on generator performance due to issues like weather-related generator outages or fuel delivery challenges. Winterization to protect generation and fuel supplies from extreme weather can mitigate this risk but MISO and its members must assess and establish certain criteria. For instance, to what extreme temperature must generators be prepared to operate, how does MISO ensure consistency amongst similarly-situated generation, and whose role it is to establish and verify such requirements?

[5] *See* Docket No. AD21-11-000, Prepared Remarks of Aubrey Johnson on Behalf of the Midcontinent Independent System Operator, Inc. for the Reliability Technical Conference (2021) and The February Arctic Event, February 14-18, 2021: Event Details, Lessons Learned and Implications for MISO's Reliability Imperative.

2. Resource adequacy planning needs refinement. Historically, tight supply and demand conditions typically only occurred on a few peak days in the summer, but today MISO experiences such conditions with increasing frequency across all seasons. Changing from an annual to a seasonal resource adequacy construct will help address this new reality. Further, fuel availability varies over time, and how and who should ensure fuel availability must be considered in reliability planning. Furthermore, if fuel assurance is required, how do we do so in the most cost-effective manner (e.g., annual firm fuel when the generator may only be needed a few times a year)?

3. Transmission is vital to moving electricity from where it is generated to where it is needed most. The MISO region had adequate supply during the Arctic Event (Winter Storm Uri), but transmission constraints, including overloaded lines and the Regional Dispatch Transfer Limits, hindered the ability to move energy to the specific areas where it was needed. MISO's transmission system also supported our neighbors during the Arctic Event, in particular with substantial power flowing from the east through MISO to support reliable and efficient operations in the Southwest Power Pool. In addition to new transmission capacity, improved interregional operational coordination will bring significant benefits to facilitate reliability and efficiency.

4. Operations of the future will require improved tools and information. Given the rapid shift in resource portfolios, and the increase in challenging weather events, system planners need more detailed and complete data to support event and post-event analyses, planning, and modeling; control room personnel will need more timely, granular, and high-fidelity data to support real-time operation decisions, and operational tools such as parallel flow visualization to improve real-time control room decisions. Automation and advanced analytics techniques will be key in providing insights into upcoming uncertainties and grid status. Such improvements will

help mitigate some of the types of challenges experienced during the Arctic Weather event, such as effectively modeling and managing of the Regional Dispatch Transfer Limits.

5. Finally, many entities, from regulatory bodies, members, market participants to end-use customers, have key roles in accomplishing the work of ensuring reliability. These roles need to be reviewed and adjusted to ensure that we collectively ensure continued reliability. As an example, Regional Transmission Organizations like MISO might not be in the best position to monitor or verify weatherization of the generation fleet. RTOs could, however, help with analysis or provide input into the weatherization requirements needed to further reliability. MISO looks forward to the support and alignment of other entities to ensure the right roles and responsibilities for all involved.

In addition, MISO appreciated the opportunity for discussion and comment at the June 1-2, 2021 Technical Conference and in the Commission's Climate Change, Extreme Weather and Electric System Reliability docket[6], where MISO also identified several items that the Commission could do to improve reliability in the face of increasing extreme weather events and climate change. These included:

1. Robust Transmission Infrastructure – The Commission should continue to support efforts to enable regional and inter-regional transmission planning and development.

2. Support RTO Membership and Deference to Regional Priorities – The Commission can continue to promote the RTO model and incentivize voluntary membership. The Commission should not take action that unnecessarily restricts the ability of an RTO to prioritize regional needs

[6] *See* Docket No. AD21-13-000, Comments of the Midcontinent System Operator, Inc. in response to the March 15, 2021 Supplemental Notice of Technical Conference Inviting Comments re Climate Change, Extreme Weather, and Electric System Reliability, (2021) and Docket No. AD21-13-000 Post- Technical Conference Comments of the Midcontinent Independent System Operator, Inc. (2021).

while leaving non-RTO regions without similar requirements. The Commission should allow RTOs the flexibility to implement changes in a manner and on a time horizon that best reflects the region's needs and priorities.

3. Coordinated Grid Operations – The regional and interregional operational coordination effectively manages system challenges across the footprint and across the RTO seams. The Commission should encourage the use of market-based congestion management tools such as redispatch, seams coordination, and market-to-market processes.

4. Enhanced Transmission Service Availability – The Commission could maximize customer use of the transmission system by enhancing the existing Open Access Transmission Tariff to require availability of cost or market-based congestion redispatch tools.

5. Alignment of Market Incentives with Reliability – The Commission can continue to support market design enhancements that align market incentives with desired reliability outcomes.

6. Continued Gas-electric Coordination – The Commission can continue to assess opportunities to better align the electric and gas scheduling practices.

B. THRESHOLD

1) As a threshold matter, state whether the transmission provider conducts extreme weather vulnerability assessments, and if so, how frequently it conducts those assessments.

MISO Reliability Coordinator:

a. Coordinated Seasonal Assessment ("CSA") Study

The CSA evaluates the performance of MISO's transmission system during anticipated near-term conditions for the Summer and Winter seasons. MISO members

work with MISO engineers and provide feedback through the Operations Planning Users Group ("OPSUG") on the study scope, modeling, and analysis review. The study incorporates projected loads, topology, and generation facilities with signed interconnection agreements that are expected to be operating for that season from the MISO Model on Demand ("MOD") tool. Bidirectional transfer scenarios are studied across the MISO footprint to test for constraints which may materialize in the upcoming operating season. These studies were implemented to test for constraints which have the potential to become binding during expected and unexpected transfers of power across the MISO footprint.

b. Seasonal Risk Assessment

Upon entering winter or summer season, the ORA team performs the Seasonal Risk Assessment utilizing meteorological and advanced data analytics and meets with cross-functional teams at System Operations to discuss readiness plans. The seasonal outlook encompasses: 1) weather risk assessment including above or below normal temperature, hurricanes, cold air outbreak potentials, etc.; 2) how the weather risk drives load, wind and solar generation risks, generation forced outage or derates and fuel risks, and aggregated risks; 3) technology risks and neighboring conditions; and 4) Operations tool, process and plans for the seasonal readiness.

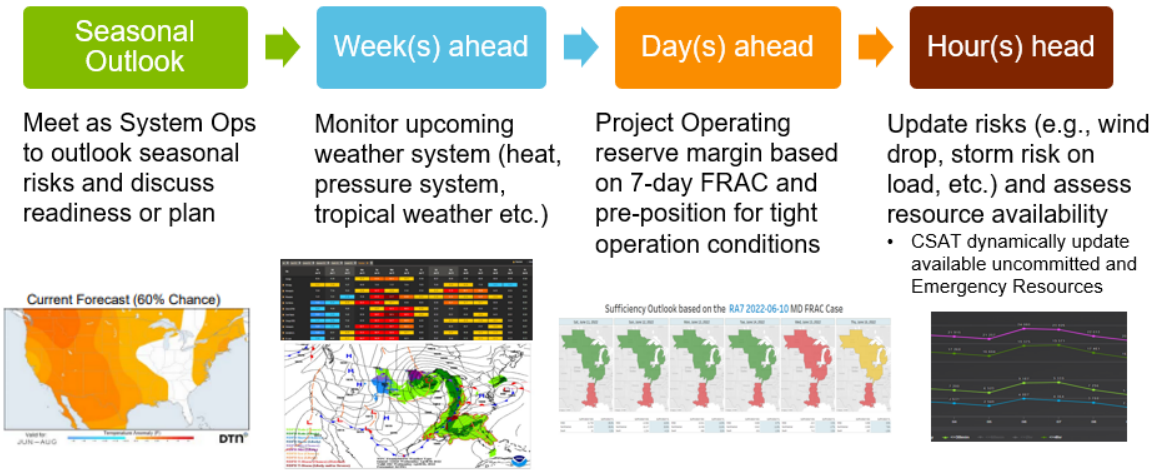
c. Weeks to Days Ahead Weather Risk Assessment

Coming into up to two weeks ahead window, as weather forecasts' accuracy improves, the ORA team closely monitors the upcoming weather system and provides updates to the control room if any heat dome, tropical weather, extreme coldness, etc. is observed in the horizon. The team continues to track the weather system closely as it

evolves and updates the control room on the changes. Within the one-week ahead window, when load, wind, solar forecasts become available, the team will perform in-depth risk assessments and translate weather risks into operating conditions risk to support Operations Planning, Unit Commitment and any declarations. The in-depth risk assessment is performed all the way leading into Real-Time with assistance from weather and risk analytical tools.

d. Control Room Real Time Monitoring and Analysis and Week Ahead Review

In real-time, the control room operators coordinate with the ORA, Operations Planning, and FRAC teams to access the current conditions and forecasted future conditions. Depending on the projected risk and analysis of many other factors, the Shift Manager ("SM") can/will make any declarations needed for current or future conditions in coordination with ORA, Operations Planning and FRAC. This can include, but is not limited to, severe weather declarations.



MISO Planning Coordinator:

a. Annual Planning Assessment

Per NERC Reliability Standard, TPL-001-5.1, Transmission System Planning Performance Requirements, MISO performs an annual Planning Assessment each year during the MISO Transmission Expansion Planning ("MTEP") process. This Planning Assessment includes evaluating the transmission system against all TPL contingency definitions including extreme events. Within those extreme events, MISO includes extreme events for severe weather (i.e., EE-3.a.iv). MISO requests such events from our Transmission Planning members who are subject matter experts for weather patterns in their respective transmission systems.

b. Transfer Capability ("TC") Analysis

MISO also considers extreme weather events while performing Transfer Capability analysis ("TC Analysis"). The Transfer Capability analysis team considers both linear and voltage stability transfer scenarios based on the conditions that we are trying to stress the system for a given interface. MISO performs some type of TC Analysis for each MTEP cycle, again based on Stakeholder feedback and biannual meetings that MISO Planning Coordinator ("PC) meets with MISO Reliability Coordinator ("RC") internally to discuss potential system conditions that warrant special attention from planning. Transfer scenarios can be selected based on a number of things: historic trends, Stakeholder Collaboration, or reliability assessment results. Transfer scenarios can be either inter-regional or intra-regional, depending on the specific scenario.

C. SCOPE

2) A description of the types of extreme weather events for which the transmission provider conducts, or plans to conduct, extreme weather vulnerability assessments, if any. For transmission providers that conduct, or plan to conduct, such assessments, a description of how the transmission

provider determined which extreme weather hazards to include in the assessment (e.g., extreme storms such as hurricanes and the associated flooding and high winds, wildfires, extreme prolonged heat or cold, or drought conditions);

MISO Reliability Coordinator:

In the ORA team, MISO's meteorologists provide forecast risk assessments for several severe weather events including:

1. Hurricanes and Tropical Storms

a. Hurricanes and tropical storms present multiple threats to transmission operations, unit commitment, and load/renewable forecast accuracy. Copious amounts of rainfall, strong continuous winds/extreme wind gusts, storm surge, and embedded tornadoes upon landfall are all threats. These threats can compromise/destroy transmission and power generation unit infrastructure. Additionally, the threats compromise/destroy distribution level infrastructure leading to load forecast difficulties as load levels drop rapidly. The threats can also compromise/destroy renewable energy infrastructure.

2. Severe Thunderstorms

a. Severe thunderstorms present multiple threats to transmission operations, unit commitment, and load/renewable forecast accuracy. Tornadoes, large hail, strong winds/wind gusts, and heavy rainfall are all threats. These threats can compromise/destroy transmission and power generation unit infrastructure. Additionally, the threats compromise/destroy distribution level infrastructure and present multi-day to intra-day weather forecasting challenges leading to load forecast accuracy degradation as load levels can drop rapidly. The threats can also

compromise/destroy renewable unit infrastructure and present forecast challenges with sudden wind bursts and cloud cover structure/extent.

3. Extreme Cold Waves

a. Extreme cold waves present multiple threats to transmission operations, unit commitment, and load/renewable forecast accuracy. Extended periods of anomalously cold temperatures, extreme wind chills, and ample frozen precipitation are all threats. These threats can compromise transmission and power generation unit infrastructure leading to outages. Additionally, the threats compromise/destroy distribution level infrastructure and present multi-day to intra-day weather forecasting challenges leading to load forecast accuracy degradation as load levels can fluctuate up and down. The threats can also compromise/destroy renewable unit infrastructure and present forecast challenges with iced turbines and snow-covered solar panels.

4. Extreme Heat Waves

a. Extreme heat waves present multiple threats to transmission operations, unit commitment, and load/renewable forecast accuracy. Extended periods of anomalously hot temperatures and extreme heat index temperatures driven by elevated humidity are the main threats. These threats can compromise transmission and power generation unit infrastructure leading to outages because of heat stress. Additionally, the threats compromise distribution level infrastructure and present multi-day to intra-day weather forecasting challenges leading to load forecast accuracy degradation as load levels can fluctuate up and down. The threats can also compromise renewable unit infrastructure and present forecast challenges with hot weather turbine shutdowns and reduced solar panel efficiency.

5. Flooding, Extreme Drought, Wildfire Smoke

a. These events are considered extreme if they occur on the high ends of the climatological distribution as determined by MISO meteorologists and if Operations employees have reliability concerns because of said events.

6. New Work: Extreme and Anomalous Wind Generation Pattern Analysis

a. As of the summer 2023, MISO's meteorologists have begun to build a catalog of the weather patterns that produce different levels of wind generation at MISO. By clustering days of historical hourly wind generation together, date groups of unique daily wind shapes were obtained. These date groups are being plotted across multiple weather variables including Hub-Height Wind and Mean Sea Level Pressure, so that MISO can understand the average of, standard deviation of, and unique weather patterns that produce different levels of wind generation in the MISO footprint.

b. The impetus for this project is the fact that traditional meteorology education and practice does not focus much on variables that drive renewable energy generation: Hub-Height Wind (80-100 m winds) and solar irradiance (W/m^2). Thus, energy meteorologists must expand their operational forecast knowledge to add value in the forecast risk assessment of renewables.

c. Future work: MISO meteorologists plan to apply this catalog methodology to solar energy.

MISO Planning Coordinator:

MISO annually performs extreme weather events in accordance with Table 1 of NERC TPL-001. Extreme weather events (i.e., 3.a.iv) are solicited by MISO to all Transmission Planners each year and we simulate all extreme events that are provided to MISO during each annual MTEP

cycle. During our TC Analysis, MISO tries to stress the system in order to duplicate recent extreme weather events. To study an extreme weather event with TC Analysis, MISO determines system conditions that mimic an extreme weather event. Then MISO develops source and sink subsystems (e.g., Winter Storm Uri) to attempt to recreate similar system conditions that were observed from past historical weather events. In some cases, the conditions during the actual extreme weather event are beyond TPL-001 extreme event conditions (i.e., winter storm Uri was an N-40+ event). These type of real-world conditions makes it difficult for powerflow models to be created and a valid solution achieved.

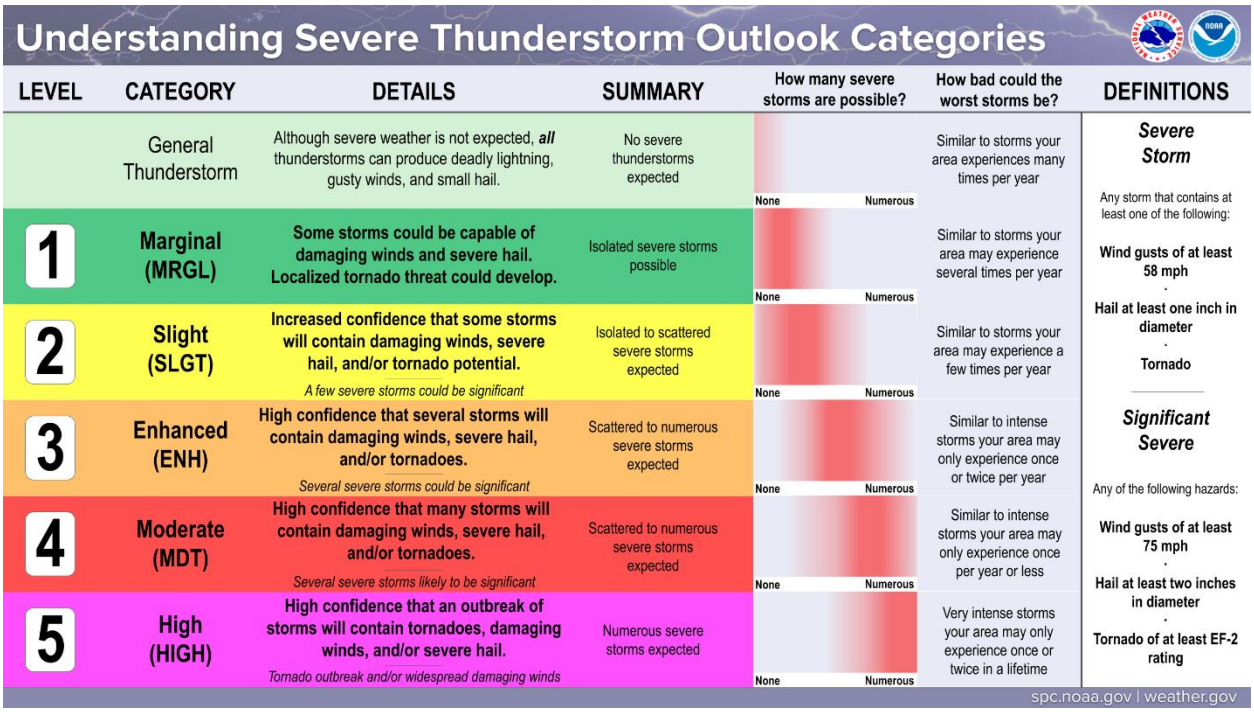
MISO has included evaluation of extreme winter weather impacts in assessing benefits of the LRTP regional transmission investments in the long-term planning horizon. This analysis examined future scenarios with high renewable penetration where generation deficiency resulting from correlated outages of renewable and gas-fired generation resources during extreme winter conditions poses a significant risk of load loss. The winter event scenarios were conditions that were similar to those experienced in recent winter storms to identify the benefits from the avoided risk of load loss that is provided by transmission investment.

3) A description of how the transmission provider defines an extreme weather event for the purposes of its extreme weather vulnerability assessment, including what thresholds it uses relative to historical measurements or probabilities of occurrence, if applicable;

MISO Reliability Coordinator:

1. Any hurricane or tropical storm that is expected to impact the MISO footprint, especially a storm that will make landfall in MISO territory from extreme eastern Texas, Louisiana, and Mississippi, will be treated as an extreme event and given the utmost preparation with risk assessments.

2. Severe Thunderstorms are considered extreme by MISO Operations Assessment warranting a forecast risk assessment when the Storm Prediction Center ("SPC") deems a given area within MISO's footprint over the course of one day (24 hours) has an enhanced risk (3/5 on their scale) or higher. The scale categories are as follows:



Understanding Severe Thunderstorm Outlook Categories

LEVEL	CATEGORY	DETAILS	SUMMARY	How many severe storms are possible?	How bad could the worst storms be?
	General Thunderstorm	Although severe weather is not expected, ***all*** thunderstorms can produce deadly lightning, gusty winds, and small hail.	No severe thunderstorms expected	None – Numerous	Similar to storms your area experiences many times per year
1	**Marginal (MRGL)**	**Some storms could be capable of damaging winds and severe hail. Localized tornado threat could develop.**	Isolated severe storms possible	None – Numerous	Similar to storms your area may experience several times per year
2	**Slight (SLGT)**	**Increased confidence that some storms will contain damaging winds, severe hail, and/or tornado potential.** *A few severe storms could be significant*	Isolated to scattered severe storms expected	None – Numerous	Similar to storms your area may experience a few times per year
3	**Enhanced (ENH)**	**High confidence that several storms will contain damaging winds, severe hail, and/or tornadoes.** *Several severe storms could be significant*	Scattered to numerous severe storms expected	None – Numerous	Similar to intense storms your area may only experience once or twice per year
4	**Moderate (MDT)**	**High confidence that many storms will contain damaging winds, severe hail, and/or tornadoes.** *Several severe storms likely to be significant*	Scattered to numerous severe storms expected	None – Numerous	Similar to intense storms your area may only experience once per year or less
5	**High (HIGH)**	**High confidence that an outbreak of storms will contain tornadoes, damaging winds, and/or severe hail.** *Tornado outbreak and/or widespread damaging winds*	Numerous severe storms expected	None – Numerous	Very intense storms your area may only experience once or twice in a lifetime

DEFINITIONS

Severe Storm

Any storm that contains at least one of the following:

Wind gusts of at least 58 mph

Hail at least one inch in diameter

Tornado

Significant Severe

Any of the following hazards:

Wind gusts of at least 75 mph

Hail at least two inches in diameter

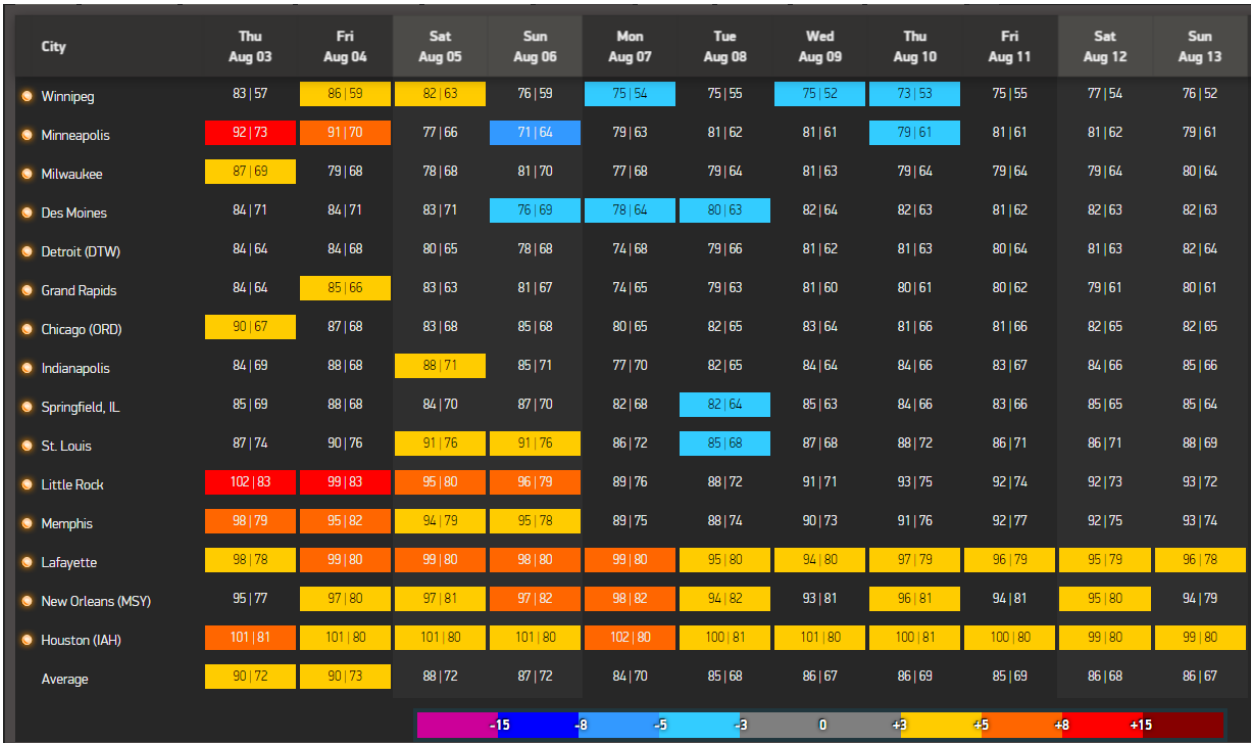
Tornado of at least EF-2 rating

spc.noaa.gov | weather.gov

The specific reasoning in the "how bad could the worst storms be?" column articulates MISO's reasoning well as the storms will likely be some of the strongest of the year for a given area. Thus, reliability risk is highly elevated. Additionally, the SPC does not capture the severity of every storm or capture the risk outlook for upcoming storms, thus MISO meteorologists pay close attention to the latest forecast information to inform Operations when necessary. MISO does not exclusively rely on the SPC for severe weather notifications and outlooks.

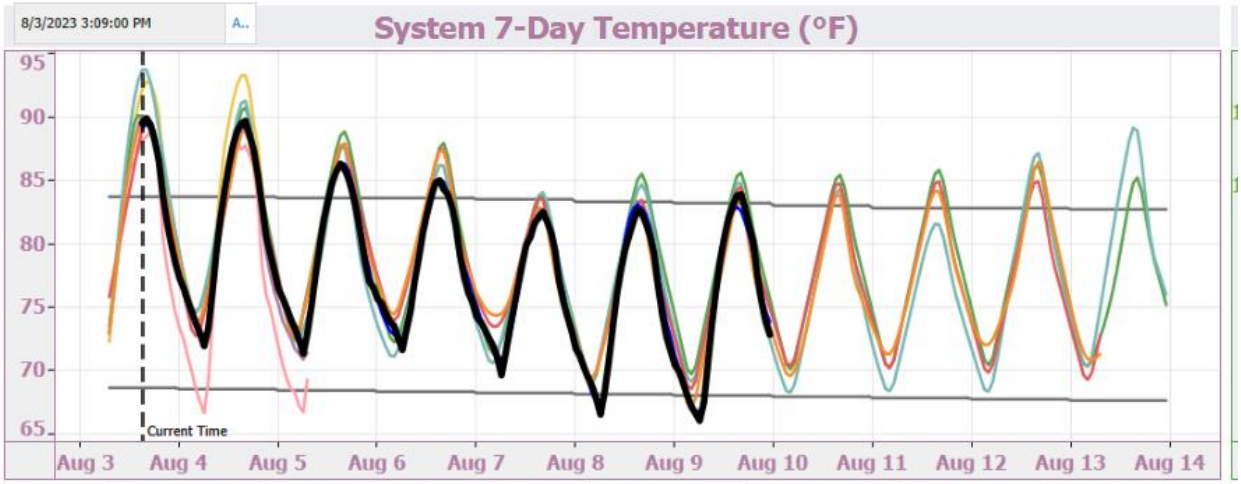
3. For extreme heat and cold waves, MISO defines said events as extreme by utilizing the latest weather forecast and comparing it both to the 30-year normal and 10-year normal.

That is, for a given city/MISO region or Systemwide, the high and low temperature forecast on a given date are compared to both the daily max/min 30-year and 10-year normal. No specific anomaly thresholds are deemed "extreme" by MISO, but both forecast temperatures and temperature anomalies are evaluated daily by the ORA team by utilizing a tool provided by a weather vendor MISO subscribes to and internal dashboards developed by ORA. The images below are examples:



City	Thu Aug 03	Fri Aug 04	Sat Aug 05	Sun Aug 06	Mon Aug 07	Tue Aug 08	Wed Aug 09	Thu Aug 10	Fri Aug 11	Sat Aug 12	Sun Aug 13
Winnipeg	83 | 57	86 | 59	82 | 63	76 | 59	75 | 54	75 | 55	75 | 52	73 | 53	75 | 55	77 | 54	76 | 52
Minneapolis	92 | 73	91 | 70	77 | 66	71 | 64	79 | 63	81 | 62	81 | 61	79 | 61	81 | 61	81 | 62	79 | 61
Milwaukee	87 | 69	79 | 68	78 | 68	81 | 70	77 | 68	79 | 64	81 | 63	79 | 64	79 | 64	79 | 64	80 | 64
Des Moines	84 | 71	84 | 71	83 | 71	76 | 69	78 | 64	80 | 63	82 | 64	82 | 63	81 | 62	82 | 63	82 | 63
Detroit (DTW)	84 | 64	84 | 68	80 | 65	78 | 68	74 | 68	79 | 66	81 | 62	81 | 63	80 | 64	81 | 63	82 | 64
Grand Rapids	84 | 64	85 | 66	83 | 63	81 | 67	74 | 65	79 | 63	81 | 60	80 | 61	80 | 62	79 | 61	80 | 61
Chicago (ORD)	90 | 67	87 | 68	83 | 68	85 | 68	80 | 65	82 | 65	83 | 64	81 | 66	81 | 66	82 | 65	82 | 65
Indianapolis	84 | 69	88 | 68	88 | 71	85 | 71	77 | 70	82 | 65	84 | 64	84 | 66	83 | 67	84 | 66	85 | 66
Springfield, IL	85 | 69	88 | 68	84 | 70	87 | 70	82 | 68	82 | 64	85 | 63	84 | 66	83 | 66	85 | 65	85 | 64
St. Louis	87 | 74	90 | 76	91 | 76	91 | 76	86 | 72	85 | 68	87 | 68	88 | 72	86 | 71	86 | 71	88 | 69
Little Rock	102 | 83	99 | 83	95 | 80	96 | 79	89 | 76	88 | 72	91 | 71	93 | 75	92 | 74	92 | 73	93 | 72
Memphis	98 | 79	95 | 82	94 | 79	95 | 78	89 | 75	88 | 74	90 | 73	91 | 76	92 | 77	92 | 75	93 | 74
Lafayette	98 | 78	99 | 80	99 | 80	98 | 80	99 | 80	95 | 80	94 | 80	97 | 79	96 | 79	95 | 79	96 | 78
New Orleans (MSY)	95 | 77	97 | 80	97 | 81	97 | 82	98 | 82	94 | 82	93 | 81	96 | 81	94 | 81	95 | 80	94 | 79
Houston (IAH)	101 | 81	101 | 80	101 | 80	101 | 80	102 | 80	100 | 81	101 | 80	100 | 81	100 | 80	99 | 80	99 | 80
Average	90 | 72	90 | 73	88 | 72	87 | 72	84 | 70	85 | 68	86 | 67	86 | 69	85 | 69	86 | 68	86 | 67

-15 -8 -5 -3 0 +3 +5 +8 +15



	Thu, Aug 3	Fri, Aug 4	Sat, Aug 5	Sun, Aug 6	Mon, Aug 7	Tue, Aug 8	Wed, Aug 9
MISO High	89.9	89.7	86.3	85.0	82.5	82.7	83.9
MISO Low	78.5	71.9	71.3	71.6	69.6	66.5	66.0

4. Flooding is rarely evaluated at MISO, but when it is a threat to grid reliability, soil moisture, expected additional rainfall/snowmelt, and river levels are all evaluated closely in coordination with the threat. Drought levels are monitored weekly via the Climate Prediction Center and University of Nebraska Lincoln and extreme drought levels (level 4 and 5 out of 5) are considered in temperature forecast risk, river level if thermal generation units are at risk of not being able to bring in water for cooling.

The above weather risk assessment is further translated into Operations risk including impacts to BES generation and transmission assets. The ORA team coordinates with Shift Managers in determining extreme weather events taking into consideration of the above weather thresholds as well as the potential impacts to BES assets (generation and transmission).

MISO Planning Coordinator:

In practice, MISO defines an extreme weather event as a system condition that could negatively impact the Bulk Electric System. These extreme weather events can vary based on the planning region of MISO's current PC footprint. For example, in the MISO South region a

common extreme weather event would be a hurricane where in the MISO North region a polar vortex may be more probable of occurring. Again, under the current TPL-001 standard, MISO relies on Stakeholders expertise of their geographic region to provide the extreme weather events that are more probable of occurring in their areas.

In the Long-Range Transmission Planning benefits analysis, the extreme weather events were limited to winter weather conditions characterized by the combination of low temperatures, frozen precipitation and low wind over a large portion of the footprint. Thresholds were not specifically quantified but the events were representative of large-scale weather impacts reflected in the historical record of winter related NOAA data on billion-dollar disasters[7].

4) A description of how the transmission provider selects, or plans to select, the set of assets and operations that will be examined;

MISO Reliability Coordinator:

All assets including transmission lines (=> 165 kV), renewable and thermal generating units, and geographic locations of higher load are examined during extreme event analysis. These assets present the largest risk to reliability if they are compromised and or experiencing extreme weather conditions as listed above.

If a severe weather is forecasted in an area, stressed outage analysis may be performed considering potentials for multi-facility contingencies or tower contingencies. In all scenarios, MISO declaration of severe weather alerts or conservative operation dictates final approval/implementation of outages that may challenge resource adequacy or system reliability.

MISO Planning Coordinator:

[7] https://www.ncei.noaa.gov/access/billions/.

MISO evaluates the BES to assess system conditions in accordance with NERC TPL-001 Reliability Standard. MISO also assesses the transmission system at lower voltages where impacts to the BES have been historically observed. MISO also includes 69 kV facilities which have been designated as transmission according to the FERC 7-factor test MISO monitors the entire 69 kV system as a whole.

The LRTP benefits analysis applied transfer capability analysis to examine thermal limits of the BES under scenarios where high regional transfers between portions of the MISO footprint would be needed to replace a supply deficiency caused by extreme winter events.

5) A description of how the transmission provider determines, or plans to determine, the geographic or regional scope of the analysis;

MISO Reliability Coordinator:

ORA and MISO Operations utilize multiple dashboards both internally developed and provided by vendors. These dashboards give us geographic perspectives on the magnitude and extent of forecast extreme conditions. The granularity included are (from smallest largest): Unit level (thermal and renewable), LBA level, MISO sub-Regional Level, MISO System level.

MISO meteorologists utilize a vendor procured professional Numerical Weather Prediction ("NWP" i.e. weather models) website where multiple NWP models and their forecast information is displayed in geographical map, tabular, and chart formats. MISO meteorologists can approximate how many assets each NWP model, model averages, and our weather vendor's forecast fall within extreme conditions forecast location.

MISO Planning Coordinator:

MISO assesses each of our four (4) planning regions (i.e., North, East, Central and South) as well as assessing MISO's Tier-1 neighbors against MISO's TPL contingencies. When MISO

is performing TC Analysis, MISO will monitor areas outside of MISO that may be negatively impacted on the results.

The LRTP event scenarios were created to reflect large scale generation loss within a single Local Resource Zone ("LRZ") for events of lesser magnitude and while larger events included resources within multiple LRZs to evaluate different levels of supply deficiency.

6) A description of whether and to what extent the transmission provider considers, or plans to consider, external interdependencies, such as interconnected utilities, other critical infrastructure sectors (e.g., water, telecommunications) and supply chain-related vulnerabilities, in the assessment;

MISO Reliability Coordinator:

Every weekday, the MISO Gas & Electric Coordinator reviews public gas pipeline electronic bulletin board postings for critical notices that may impact gas generation in the MISO footprint. This information is then summarized in an internal Microsoft Teams chat and at a morning operations meeting.

For coal and fuel oil units there is the "Weekly Fuel and Consumables Data Request." This data request, which gathers data every week during high fuel risk winter season and gathers data every three weeks during modest fuel risk seasons, asks generators to provide current and projected fuel and non-fuel consumable (typically emission control reagents/chemicals) inventory levels. It also asks for any local, state or federally imposed environmental requirements that could limit the operation of the unit.

This data is analyzed, mapped to generation asset risks, and visualized via dashboards for operations and management personnel to provide situational awareness in assessing risk associated with whether at the system or individual unit level.

MISO Planning Coordinator:

In the LRTP analysis, the impact of weather on external systems was represented by heavy imports rather than a more detailed generation resource model. The level of interchange was defined to be consistent with historical observations under similar extreme weather conditions.

7) A description of whether and to what extent the transmission provider coordinates, or plans to coordinate, with neighboring utilities and/or entities in other sectors that could potentially be relevant to the assessment;

MISO Reliability Coordinator:

In preparation for extreme weather events, ORA uses data from Annual Generator Winterization Survey, Fuel and Consumable survey and critical notices posted by the natural gas pipelines to assess risk that can impact MISO from other sectors.

Coordination with other sectors

As part of daily base business, MISO constantly tracks critical notices posted by the gas pipelines to understand the impact to MISO generators. This includes data on Operational Flow Orders ("OFO"), instances of Force Majeure, possible constraints, outages, weather alerts, maintenance work, and other operational events that might pose challenges to fuel procurement for MISO resources.

Coordination with members

For generators dependent on gas as their primary fuel, data is procured, including the specific pipelines or Local Distribution Companies ("LDCs") they rely on for fuel. Understanding the nature of their contracts, be it firm, interruptible, or a combination of both. Generator Owners also provide the duration in a 24-Hour Period that they can depend on their firm contract.

Additionally, the Generator Owners provide whether the generator has subscribed to storage services, no-notice services, or non-rateables service.

For coal-dependent generators, Generators answer questions on a weekly basis during winter on their current fuel and consumable inventory, expected next delivery date and any constraints going forward. For example, if Coal Generators expressed concerns whether the expected delivery dates would be met during the Rail Strike, this places more risk on generators with low inventory supply. By analyzing their current inventory, MISO can determine the number of hours they can operate at their maximum power. Furthermore, based on anticipated deliveries, MISO can get a good idea on additional operational hours. Any environmental constraints that might hinder operation are also taken into consideration.

ORA developed internal Gas and Coal dashboards to merge all this data in one place. These dashboards facilitate a rapid assessment of the gathered data, allowing MISO to identify MISO generators potentially at risk. By utilizing this data-driven approach, ORA can identify, quantify, and address capacity risks that can come from other sectors.

Coordination with neighboring RTOs

Neighboring RTO conditions have significant impact to MISO's interchange transactions and transmission flows. The ORA team established analytics and visualization of neighboring conditions leveraging neighboring RTO's publicly available data to assess risks. ORA also maintains contact with its counter parties of neighboring RTOs to proactively exchange its risk assessments and coordinate on the operating plans.

Control Room Real Time Monitoring and Analysis and Week Ahead Review

The control room operators work with the ORA team and other control room positions to access the current conditions and forecasted future conditions. Depending on the projected risk

and analysis of many other factors, the SM can/will make any declarations needed for current or future conditions. This can include but is not limited to severe weather declarations. The SM conducts a daily Reliability Coordination Conference Call with Transmission Operators ("TOPs"), Balancing Authorities ("BAs"), LBAs, and neighboring RCs and BAs to review system conditions and discuss Reliability issues for the Operating Day and future Operating Days. Each Reliability Coordinator provides a report that includes a review of pertinent events from the previous day, a weather report, peak hour and Load, Actual Operating Reserves, Required Operating Reserves, significant Generation outages, significant Transmission Outages, current Transmission Loading Relief ("TLRs") and/or Energy Emergency Alert ("EEAs") in effect at the time of the call, and any other significant information.

Additional calls can/are made when needed to have further discussions and gather information for planning purposes. The type of information could include, expected availability to provide emergency energy, confidence in projected conditions, any possible factors that are not being counted, possible impacts to Regional Dispatch Transfer, any expected or potential declarations including levels and duration. This information is shared with the operators and operations support teams to better plan for any conditions needed.

Biweekly meetings with TOPs and weekly Joint Operating Agreement ("JOA") meeting with neighboring RCs' Operation Planning teams among other activities provide a forum for discussing impacts of potential severe weather. Essential JOA processes and guides previously designed to mitigate constraints affecting MISO and neighboring RCs or RTOs are utilized as needed.

MISO Planning Coordinator:

MISO coordinates with neighboring entities by exchanging contingencies in accordance with NERC Reliability Standard TPL-001-5.1, R3.4.1. MISO also coordinates on study results where MISO sees negative impacts of their BES based on internal studies that we have simulated. When MISO performs TC Analysis, MISO monitors both internal and external entities which may be impacted by system condition stressors for a given transfer scenario. When a Non-MISO facility is identified as limiting, MISO coordinates with that impacted entity to the extent of what MISO analysis show, but at the end of the day, MISO is obligated to protect those facilities that are under MISO's functional control when reported in TC Analysis. MISO also participates in regional studies with the Regional Entities and collaborates as necessary when results are impacting facilities outside of the MISO BES. The focus of LRTP assessment of extreme weather focused on the identification of benefits associated with transmission investment already proposed for the MISO system. The identification of additional transmission solutions external to MISO that could address interregional transfer limitations were outside the scope of the current study.

8) A description of whether and to what extent the transmission provider engages, or plans to engage, with stakeholders in the scoping phase of the assessment, including the processes used to identify and engage relevant stakeholder groups and incorporate stakeholder feedback into the extreme weather vulnerability assessment, including all affected communities.

MISO Reliability Coordinator:

MISO assesses operating conditions continuously and different risks present with different types of extreme weather. Communication and outreach will differ based on the risk presented and operating horizon in which the risk was identified. MISO issues mass communication to stakeholders that includes targeted information for stakeholders in the

impacted region or sub-region. An example of a targeted communication is MISO may ask a stakeholder to update their offers or come off outage. Examples of mass communication are the Annual Generator Winterization Survey and hot weather, hurricane, or seasonal risk assessments for high outage scenarios. Leadership between MISO and affected entities meet frequently during a weather event. MISO's External Affairs team may reach out to Organization of MISO States and/or MISO regulators. MISO's Strategic Communications and Policy Coordination team makes a posting on one or more of its digital communications platforms (i.e. website and/or social media) depending on the circumstances.

MISO Planning Coordinator:

MISO utilizes as series of annual public stakeholder meetings (i.e., Planning Subcommittee ("PSC") and Subregional Planning Meetings ("SPMs") to scope out the types of assessments MISO should consider with each new MTEP cycle. MISO will take the preliminary scope to the PSC for Stakeholder review before finalizing the scope prior to the beginning of each new MTEP cycle. MISO will also go to the PSC for scope review of both Linear and Voltage Transfer Capability Analysis to give our Stakeholders an opportunity to provide input and feedback into these analyses.

MISO then utilizes a series of SPMs to share detailed results of our annual project review for each of the planning regions. In some instances, MISO will host non-public Technical Studies Task Force ("TSTF") meetings where technical CEII-level details of MTEP studies are discussed. These TSTFs and the number of them can vary from planning region to planning region each MTEP cycle.

Specific to Extreme Event study collaboration with Stakeholders, MISO utilizes the PSC as the forum to discuss scope, results and feedback with our Stakeholder community.

MISO conducted numerous public stakeholder discussions to define scope of study for identification of the projects required to meet the LRTP objectives. The extreme event analysis that was incorporated in evaluation of benefits was included in these stakeholder discussions to seek feedback on the application and methods for identifying benefits delivered to MISO customers responsible for the transmission costs.

D. INPUT

9) A description of methods and processes the transmission provider uses, or plans to use, to determine the meteorological data needed for its assessment. In particular, how the transmission provider determines whether it can rely on existing extreme weather projections, and if so, whether such projections are adequately robust;

MISO Reliability Coordinator:

MISO meteorologists utilize a wide array of tools to assess risk from extreme weather. Firstly, both vendor and in-house generated dashboards are utilized. These dashboards display our vendor's deterministic mean (accuracy weighted average) forecasts as both meteorological variables like dry bulb temperature, windspeed, and precipitation along with load forecast values, and wind/solar generation values. Because vendor deterministic forecasts are not always accurate enough-especially during extreme events, other tools are utilized to check the feasibility of our vendor's forecast solutions.

The procured professional NWP website (as mentioned in Question 5) allows full access to all NWP models. Additional to the NWP models, temperature and precipitation bias maps by forecast period for the NWP models most frequently used are provided. This bias data helps determine the legitimacy of a forecast by weather model. MISO meteorologists use this bias data to adjust the forecast and or communicate risk to Operations if warranted.

Access to multiple NWP models allows for a robust, yet timely comparison of forecasts for a given potential extreme event/time of interest. This allows for determining if the depiction by one NWP model agrees with other models, or if that solution is an outlier and should be weighted lower in the risk assessment.

MISO Planning Coordinator:

MISO has meteorologists on staff working with our Real-Time Operations team. Biannually, MISO prepares both summer and winter readiness data to review with Stakeholders ahead of each approaching peak season. Meteorologists' forecasts are taken into consideration during the preparation of these readiness workshops. When MISO PC meets with MISO RC biannually, weather forecasts are sometimes discussed as MISO planners are determining specific conditions to consider for evaluation in each MTEP cycle.

The extreme event scenarios used in LRTP benefits analysis were focused on a high-level evaluation of risks and were associated with a limited set of conditions based on historical record of winter events in the Midwest. The use of long-term trends observed in the dataset was adequate to support scope of this long-term planning assessment.

10) A description of how the transmission provider determines whether to use scenario analysis, and if so, whether to do so with multiple scenarios;

MISO Reliability Coordinator:

Currently, MISO performs scenario analysis when elevated risks are identified in its Multi-Day ("MD") FRAC process and its intra-day Capacity Sufficiency Analysis Tool ("CSAT"). Both the process and the tool allow the capability to evaluate different scenarios of load forecasts, wind forecasts, net scheduled interchanges, stranded MW, etc. in addition to the

base scenario, so that operations are pre-positioned with adequate Operating Reserve Margin or resource flexibility to manage not only projected load obligation but also uncertainties.

MISO has a contractual Regional Dispatch Transfer ("RDT") limit between its Classic and South region. Upon risk from the joint parties to reduce RDT limit or depending on the project Operating Reserve Margin for a sub-Region or the RDT flow uncertainty, MISO often performs analysis of multiple RDT scenarios to ensure adequate margin not only on a systemwide basis but also for a sub-Regional basis.

Looking forward, MISO is building an Operations Risk Platform. The risk platform will digest the under-construction probabilistic forecasts and enable probabilistic Operations planning and Unit Commitment in an automatic and market-based manner through dynamic requirements of market product.

MISO Planning Coordinator:

MISO considers specific scenarios to evaluate with each new MTEP cycle; moreover, the US Manitoba Interface is often a North flowing scenario for our winter models because there is a high probability of that scenario occurring each winter peak period. In MISO's East Region, there are a variety of scenarios that we consider each year which are uniquely modeled just for the East Region planning team.

From a TC Analysis point of view, MISO is always looking for new scenarios that may have a negative impact on the BES and when MISO hears of such new scenarios, MISO immediately investigates and collaborates internally to determine the level of analysis MISO needs to approach the scenario.

The extreme event analysis used in the LRTP benefits evaluation incorporated scenarios that reflected different levels of impacts on resource availability based on the geographic scope of

the weather event. Scenarios represented region-wide weather events and zonal weather events within smaller geographic areas corresponding to the various states in the MISO Midwest subregion.

11) The extent to which it reviews neighboring transmission providers' extreme weather vulnerability assessments, if available, to evaluate the consistency of extreme weather projections between transmission providers. Further, for RTOs/ISOs, a description of how it accounts for differences between transmission owner members' extreme weather vulnerability assessment assumptions and results;

MISO Reliability Coordinator:

Neighboring transmission providers' extreme weather vulnerability assessments are not fully available for comparison or evaluation of consistency, especially during those fast-evolving events when time is critical and limited to manage the extreme weather events. Neighboring TO's publicly available website load and renewable generation forecasts along with some of the aforementioned dashboards and the NWP weather model page are utilized in MISO Operation's risk assessment discussions to determining generation import and export risk. Some dashboards and the NWP model page provide the same meteorological information as they do for the MISO footprint, thus a brief assessment can be made by MISO for our neighboring TO's.

Additionally, the coordination among RTOs as commented in Question 7 has been beneficial in preparing for extreme weather events. With the increasing frequency and intensity of extreme weather events, MISO expects the collaboration among RTOs will continue to improve especially with the Commission's support.

The SM conducts a daily Reliability Coordination Conference Call with TOPs, Balancing Authorities ("BAs"), LBAs, and neighboring RCs and BAs to review system conditions and

discuss Reliability issues for the Operating Day and future Operating Days. Each Reliability Coordinator provides a report that includes a review of pertinent events from the previous day, a weather report, peak hour and Load, Actual Operating Reserves, Required Operating Reserves, significant Generation outages, significant Transmission Outages, current TLRs and/or EEAs in effect at the time of the call, and any other significant information. Additional information is sometimes exchanged when there is a current or expected impact from weather. Further, MISO Operations personnel discuss system conditions, risks, and weather conditions with our neighboring entities and membership before making declarations, such as System Status Level Events (0, 1, 2, or 3), Conservative Operations, Capacity Advisory, Transmission System Emergency, Local Transmission Emergency, Transmission System Emergency, Max Gen Alert/Warning/Event, Hot/Severe/Cold Weather Alerts, Firm Load Shed (Capacity/Transmission), and EEA Levels.

Additional calls can/are made when needed to have further discussions and gather information for planning purposes. The type of information could include, expected availability to provide emergency energy, confidence in projected conditions, any possible factors that are not being counted, possible impacts to Regional Dispatch Transfer, any expected or potential declarations including levels and duration. This information is shared with the operators and operations support teams to better plan for any conditions needed.

MISO Planning Coordinator:

MISO meets with the neighboring PCs and shares a variety of study results. During TC Analysis, MISO sometimes identifies limits from neighboring entities. If a limit is identified, MISO collaborates with that entity to 1) let them know about the limit MISO identified and 2) confirm if it is a valid limiting element/contingency pair.

The scope of the LRTP extreme event analysis was limited to evaluation of benefits to MISO Midwest customers and did not include assessment of impacts on neighboring systems.

12) The timeframe(s) and discount rate(s) selected for the extreme weather vulnerability assessment;

MISO Reliability Coordinator:

None.

MISO Planning Coordinator:

To align benefits of LRTP portfolio with the cost of transmission investment, MISO uses a 20-40 year timeframe for determining the value of the avoided risk of load shedding benefit. The discount rate of 6.9% based on the Transmission Owners weighted average cost of capacity ("WACC") was used to evaluate benefits for the purpose of determining eligibility for regional cost sharing. For information purposes a discount rate of 3% is also used in benefit calculations to provide an expected upper range of value.

13) A description of the methods and processes the transmission provider uses, or plans to use, to create an inventory of potentially vulnerable assets and operations.

MISO Reliability Coordinator:

MISO gathers a variety of data and methods to help identify which generation assets are at risk of not performing as expected. Every weekday the MISO Gas & Electric Coordinator reviews public gas pipeline electronic bulletin board postings for critical notices that may impact gas generation in the MISO footprint. This is information is then summarized in an internal Microsoft Teams chat and at a morning operations meeting.

For coal and fuel oil units there is the "Weekly Fuel and Consumables Data Request." This data request, which currently gathers data every three weeks due to reduced risk, asks

generators to provide current and projected fuel and non-fuel consumable (typically emission control reagents/chemicals) inventory levels. It also asks for any local, state or federally imposed environmental requirements that could limit the operation of the unit.

For units of all fuel types, MISO contacts an Annual Generator Winterization Survey to gather data on generators cold weather operating and start-up temperatures in addition to questions designed to assess the unit's general preparedness for winter operations.

This data is assembled into dashboards for operations and management personnel to provide situational awareness in assessing risk associated with whether at the system or individual unit level.

MISO Planning Coordinator:

While not truly a list of vulnerable BES facilities, MISO currently stores the Planning Assessment results within maintained databases.

In the LRTP benefits analysis, scenarios were created to reflect impacts of weather on generation resources within geographical areas. The scenarios defined weather-related outages of future generation resources modeled within those areas based on the type of resource.

E. VULNERABILITIES AND EXPOSURE TO EXTREME WEATHER HAZARDS

14) A description of how the transmission provider identifies the transmission assets or operations vulnerable to the extreme weather events for which it conducts assessments;

MISO Reliability Coordinator:

ORA utilizes several resources to identify and prepare for extreme weather risk and the operational impacts that may follow. Operational impacts can typically be broken down into two categories: *conventional* generation risk and *renewable* generation risk.

For conventional generation risk, MISO Operations gathers the input of stakeholders through a generator annual winter survey as sanctioned by NERC (IRO-010 and TOP-003). Data gathered includes a unit's minimum design temperature, historical operating temperature, or current cold weather performance temperature determined by an engineering analysis. This information is used for situational awareness and coincides well with a vendor procured interactive map display. The vendor tool has map layers including transmission lines and different weather variables, including the latest Storm Prediction Center risk polygons to provide visibility to transmission risk during severe weather. Additionally, by utilizing asset locations, MISO meteorologists can approximately understand what and how many assets are under extreme weather risk by the NWP model forecasts via the aforementioned NWP model page.

For renewable generation risk, MISO requires Market Participants to submit all unit static information as part of the registration process. This includes cold weather cutoff temperatures °F, hot weather cutoff temperatures °F, high wind speed cut off threshold (m/s), etc. The static information is sent to MISO's renewable vendors and used as part of the forecasting process to account for the renewable forecast risks arising from extreme cold or hot temperature. In addition to using the provided static/real time data in the forecasting process, our renewable vendors leverage NWP data heavily to incorporate forecast risk for the static data listed above and additionally, turbine icing. The wind forecasts include a most likely icing impact forecast scenario and a worst case icing forecast scenario. The ORA team utilizes this data as well as additional meteorological icing analysis to assess the icing risk.

MISO Planning Coordinator:

MISO simulates NERC Reliability Standard TPL-001 extreme event contingencies and monitors the MISO planning coordination BES footprint as well as neighboring entity assets.

MISO also monitors 69 kV facilities across our entire footprint where some portions of our PC footprint MISO has functional control over the 69 kV system for that Transmission Owning member. MISO is obligated to identify operational vulnerabilities on the assets within these areas.

The LRTP assessment of extreme events was designed to examine loss of generation due to extreme weather and included all wind, solar and gas fired resources in the affected areas defined by the study scenario. This analysis did not include any weather impacts related to availability of transmission facilities (outages).

15) A description of how the transmission provider uses, or plans to use, screening analyses to test for potential vulnerabilities, as well as how the transmission provider examines, or plans to examine, the sensitivities of the transmission assets and operations being studied to types and magnitudes of extreme weather events.

MISO Reliability Coordinator:

MISO does perform screening analysis in the dynamic simulation analysis where a fast fault screening is performed in order to reduce the total number of faults to study each year. As soon as the potential for extreme weather (such as wide area icing on transmission lines) are communicated to MISO, planned outages may be postponed based on over-all MISO declaration of conservative operation or severe weather alerts. MISO's ORA team evaluates the weather model output and determines how much icing may occur in an area; specifically, how much will fall as freezing rain vs. sleet. This evaluation gives the ORA team a rough sense of how much ice may accumulate on transmission lines. The ORA team uses freely available diagrams and analysis to determine which icing accumulation amounts are the largest concern for transmission lines.

MISO Planning Coordinator:

The LRTP assessment of extreme events included in the benefits evaluation examined weather impacts on resource availability and did not include weather impacts on transmission availability.

F. COSTS OF IMPACTS

16) A description of the methodology or process, if any, the transmission provider uses, or plans to use, to estimate the potential costs of extreme weather impacts on identified vulnerable assets and operations;

MISO Planning Coordinator:

The assessment of LRTP benefits applied a value of lost load ("VOLL") of $3,500/MWh that is currently used in market pricing. This value reflects a willingness to pay to avoid load curtailment and was calculated based on prior analyses of customer classes. MISO also calculated the benefit using a VOLL of $23,000/MWh based on the recommendations of the Independent Market Monitor ("IMM") to provide the upper range of value for additional information.

17) If the transmission provider estimates such potential costs, a description of the types of: (a) direct costs, such as replacements or repair costs, restoration costs, associated labor costs, or opportunity costs of lost sales, and (b) indirect costs, such as costs associated with loss of service to electric customers and other utilities that purchase power from the transmission provider, including equipment damage, spoilage, and health and safety effects, in calculating the costs of extreme weather impacts.

MISO Planning Coordinator:

VOLL used in the LRTP benefits analysis was developed for use in market pricing. The value was developed considering a number of factors including costs associated with inconvenience, lost opportunity, spoilage, damage, health/safety and business interruption.[8]

G. RISK MITIGATION

18) A description of how the transmission provider uses, or plans to use, the results of its assessment to develop measures to mitigate extreme weather risks, including:

i. How the transmission provider determines which risks should be mitigated and the appropriate time horizon for mitigation;

MISO Reliability Coordinator:

MISO's risk assessment includes understanding of individual risks (weather, load, wind, solar, generation availability and fuel, interchange transactions, transmission congestion and/or stranded MW) and the quantification of aggregated risks. The risk analysis combined with MISO operating procedures and processes determine which risks to mitigate and how as elaborated below. The appropriate timing is a balance of resource or mitigation measure availability versus the data accuracy including forecasts and Market Participant offers and outage schedules. Typically, the closer to the operating day/hour, the more accurate are the forecasts and offers. However, due to operating constraints such as startup and notification times, a long lead unit will not be available to mitigate risks if waited for too long. In addition, advanced notification or situational awareness enable Market Participants proactive preparation actions. MISO strikes the best balance to provide the most accurate and timely declarations.

[8] https://cdn.misoenergy.org/20200806%20MSC%20Item%2005c%20Value%20of%20Lost%20Load%20(VOLL)%20(IR071)464468.pdf.

The control room operators will leverage MISO any applicable operating procedures including the Market Capacity Emergency and Conservative Operations procedures that outline thresholds for several different declarations. In addition to this, real time operating tools will also be used for more detailed analysis of conditions. These tools include EMS, CSAT, weather and load forecasts, generation and transmission plans. Collaboration with other operating positions and support teams is also common practice.

Generally, a conservative approach is taken if some variables are unknown or have a low confidence in the accuracy. Advanced notice of system conditions is shared with other RTO's and members when appropriate. This could be through phone calls, MISO Communications System ("MCS") messaging, RCIS (Reliability Coordinator Information System) posting, email, or other forms of communication.

MISO Ops Planning follows the official system awareness protocol to defer planned outages to help in ensuring system reliability. Where possible, after coordinating and collaborating with TOPs and GOPs, return dates of outages may be shortened.

MISO Planning Coordinator:

The extreme events analysis incorporated in the LRTP benefits assessment was developed to support the business case for regional transmission investment. This analysis demonstrates the value of pursuing transmission expansion necessary to achieve future shift in generation resources with greater reliance on renewables and lower carbon emitting resources. The LRTP transmission portfolio delivers multiple streams of value, one of which is the avoided risk of load loss from extreme weather events. The cost-benefits analysis examine the total benefits to determine if the portfolio of projects has sufficient value to justify the cost.

ii. How the transmission provider determines appropriate extreme weather risk mitigation measures, including any analyses used to determine the lowest-cost or most impactful portfolio of measures;

MISO Reliability Coordinator:

MISO's market-based approach uses tools and systems designed to look for a reliable solution in the most economical way possible. If the market tools and system's solution is insufficient, then MISO's Operations personnel take manual actions according to documented processes, procedures, and operating guides. During an emergency, cost is not considered and maintaining reliability is the first and only consideration. Based upon documented processes, procedures and systems, economics will be considered when reliability has been restored.

MISO Planning Coordinator:

See above.

19) A description of how the transmission provider informs, or plans to inform, relevant stakeholders—such as neighboring transmission providers, RTOs/ISOs of which the transmission provider is a member, electric customers, all affected communities, emergency management agencies, local and state administrations, and state utility regulators—of identified extreme weather risks and selected mitigation measures;

MISO Reliability Coordinator

Internal and external operating entities are communicated with via normal communication paths, including MISO communication tools (MISO Communications System and Operator Interface) for internal and MISO members, as well as NERC RCIS and MISO website and app for external notification. For non-operating entities, Strategic Communications department communicates applicable information to the external parties**.**

MISO assesses operating conditions continuously and different risks present with different types of extreme weather. Communication and outreach will differ based on the risk presented and operating horizon in which the risk was identified. MISO issues mass communication to stakeholders that includes targeted information for stakeholders in the impacted region or sub-region. An example of a targeted communication is MISO may ask a stakeholder to update their offers or come off outage. Examples of mass communication are the Annual Generator Winterization Survey and hot weather, hurricane, or seasonal risk assessments for high outage scenarios. Leadership between MISO and affected entities meet frequently during a weather event. During extreme weather events, MISO leadership has standard calls with neighboring entities or key customers in regard to system conditions and expectations. This high-level information sharing across leadership helps to ensure a common operating picture expectation across the systems. MISO's External Affairs team may reach out to the Organization of MISO States and/or MISO regulators. MISO's Strategic Communications and Policy Coordination team makes a posting on one or more of its digital communications platforms (i.e., website and/or social media) depending on the circumstances.

MISO Shift Manager:

The SM conducts a daily Reliability Coordination Conference Call with Transmission Operators ("TOPs"), Balancing Authorities ("BAs"), LBAs, and neighboring RCs and BAs to review system conditions and discuss Reliability issues for the Operating Day and future Operating Days. Each Reliability Coordinator provides a report that includes a review of pertinent events from the previous day, a weather report, peak hour and Load, Actual Operating Reserves, Required Operating Reserves, significant Generation outages, significant Transmission Outages, current

Transmission Loading Relief ("TLRs") and/or Energy Emergency Alert ("EEAs") in effect at the time of the call, and any other significant information.

Additional calls can/are made when needed to have further discussions and gather information for planning purposes. The type of information could include, expected availability to provide emergency energy, confidence in projected conditions, any possible factors that are not being counted, possible impacts to Regional Dispatch Transfer, any expected or potential declarations including levels and duration. This information is shared with the operators and operations support teams to better plan for any conditions needed.

Biweekly meetings with TOPs and weekly Joint Operating Agreement ("JOA") meeting with neighboring RCs' Operation Planning teams among other activities provide a forum for discussing impacts of potential severe weather. Essential JOA processes and guides previously designed to mitigate constraints affecting MISO and neighboring RCs or RTOs are utilized as needed.

Seasonal Risk Assessment:

Biannually, MISO prepares both summer and winter readiness data to review with Stakeholders ahead of each approaching peak season. Upon entering winter or summer season, the ORA team performs the Seasonal Risk Assessment utilizing meteorological and advanced data analytics and meets with cross-functional teams at System Operations to discuss readiness plans. The seasonal outlook encompasses: 1) weather risk assessment including above or below normal temperature, hurricanes, cold air outbreak potentials, etc.; 2) how the weather risk drives load, wind and solar generation risks, generation forced outage or derates and fuel risks, and aggregated risks; 3) technology risks and neighboring conditions; and 4) Operations tool, process and plans for the seasonal readiness. Advanced notice of system conditions is shared with other RTO's and

members when appropriate. This could be through phone calls, MCS messaging, RCIS posting, email, or other forms of communication.

Seasonal Readiness Workshops/Forums:

In the spring and fall of each year, prior to the summer and winter seasons, MISO hosts Summer and Winter Readiness Workshops/Forums. These workshops include a variety of topics from MISO staff and external guest speakers. MISO staff will present generation and transmission assessments and seasonal weather forecasts. Other topics from MISO can include lessons learned from prior seasons, process and procedure improvements and other relevant topics for the upcoming season. Guest speakers are similarly identified for timely topics. For example, the winter 2022 workshop included the Executive Director of the National Coal Transportation Association due to the potential at the time for a nationwide railroad strike. Presentations and recordings of prior workshops can be found here: https://www.misoenergy.org/stakeholder-engagement/committees/seasonal-readiness/.

MISO Technical Training:

MISO's Technical Development team hosts yearly drills for MISO and Member Operators focused on abnormal and emergency conditions. These drills include Hurricane Drills in the spring, Market Capacity Emergency Drills in the spring, and Restoration Drills in the fall. Each of these drills allow for discussions regarding potential risk and risk mitigation, simulated problem solving and critical thinking, as well as a review of recent events and procedures to manage potential future events. MISO also implemented a new Cold Weather Drill for MISO Operators in 2022 and has plans to invite members in the coming years.

MISO Stakeholder Meetings:

MISO has multiple reliability related stakeholder groups that meet at a regular cadence, such as the Reliability Subcommittee, Reliable Operations Working Group - Closed, and Operations Training Users Group. There is often communication with stakeholders in these groups about lessons learned from weather related events, changes to processes or tools as a result of events or getting feedback from members after a major storm or event has occurred.

MISO Planning Coordinator:

The purpose of the extreme weather analysis included in the LRTP benefits assessment is to document one of the benefits of the transmission investment rather the identification of vulnerability. It does not seek to identify mitigation measures but demonstrates how proposed transmission expansion can deliver value in the form of avoided risk of load loss.

20) A description of the extent to which the transmission provider incorporates, or plans to incorporate, identified extreme weather risks and mitigation measures into local and regional transmission planning processes;

MISO Reliability Coordinator:

Not applicable to the RC time frame.

MISO Planning Coordinator:

The evaluation of extreme weather impacts in the LRTP benefits analysis examines value of transmission in supporting future reliability needs. This evaluation is designed to support the need for pursuing transmission investment in future scenarios where resource mix shifts include higher levels of renewable and lower carbon resources. The analysis does include a detailed examination of all the risks associated with extreme weather and does not look to identify further solutions to mitigate risks.

21) A description of how the transmission provider measures, or plans to measure, the progress and success of extreme weather risk mitigation measures (e.g., through reduced outages) and how it incorporates these observations into ongoing and future extreme weather risk mitigation actions.

MISO Reliability Coordinator:

MISO, as a Transmission Provider, constantly balances reliability and economics through continuous communication with stakeholders, neighboring ISOs/RTOs and regulators. The communication increases in frequency during extreme weather events. One communication method to measure the progress or success of extreme weather risk measures is the review of the extreme weather events in stakeholder forums via the Markets Subcommittee, Reliability Subcommittee, Reliable Operations Working Group (Closed) and the Markets Committee of the MISO Board of Directors meetings. Additionally, the Markets & Operations Analytics team produces the Monthly Market and Operations Report containing MISO markets and operations performance metrics and information. The Monthly Market and Operations Report also includes detail regarding operating conditions during the prior month, such as declarations made for Hot/Cold/Severe Weather. The Report is posted to the MISO public website monthly and included in Board Meeting materials each quarter.

Another method MISO measures the progress and success of implementation of risk mitigation measures is the through the quarterly State of the Market reports developed by MISO's IMM. These quarterly IMM reports typically include assessment of MISO Market and Operations performance during any extreme conditions that occurred, and any recommendations that MISO should consider. These quarterly IMM reports are publicly available on MISO's website. MISO Operations personnel also meet with the IMM weekly for an Operational Review.

MISO's Operations Services team conducts an event analysis process which in part, measures the success and progress of risk mitigation measures. The Operations Services team supports Operations personnel to evaluate how well the documented process or procedure was followed, develops lessons learned and corresponding action items, tracks action item progress, revises procedure documentation, and works with the Technical Development team to provide event-related training.

MISO ORA continues to work towards better weather, load, and renewable generation forecast accuracy during extreme events. While it is not always possible to get good accuracy during extreme events, part of the team's function and goals is to provide Operations with risk assessment where communicating quantitative directional risk adds value to Control Room decision making.

MISO Operations Planning continues to better utilize the weather forecast dashboard for awareness and improve decision making in proactive collaboration, outage planning and reschedules to ensure system reliability.

MISO Planning Coordinator:

The LRTP transmission portfolio is periodically re-evaluated to assess the delivered financial benefits of the approved portfolio of projects. Each future iteration of LRTP will re-examine all the benefit metrics including the avoided risk from extreme weather impacts and determine which benefits are appropriate for that specific portfolio of transmission.

H. CONCLUSION

WHEREFORE, the Midcontinent Independent System Operator, Inc. respectfully provides this response to the Commission's one-time informational report questions in the above-captioned docket.

Respectfully Submitted,

/s/ Steven Clay
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Attorney for Midcontinent Independent System Operator, Inc.

Dated: October 25, 2023

CERTIFICATE OF SERVICE

I hereby certify that I have this day e-served a copy of this document upon all parties listed on the official service list compiled by the Secretary in the above-captioned proceeding, in accordance with the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure (18 C.F.R. § 385.2010).

Dated this 25th day of October, 2023 in Carmel, Indiana.

/s/ Cortney Sanders

Cortney Sanders
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