



Large Load Additions Workshop

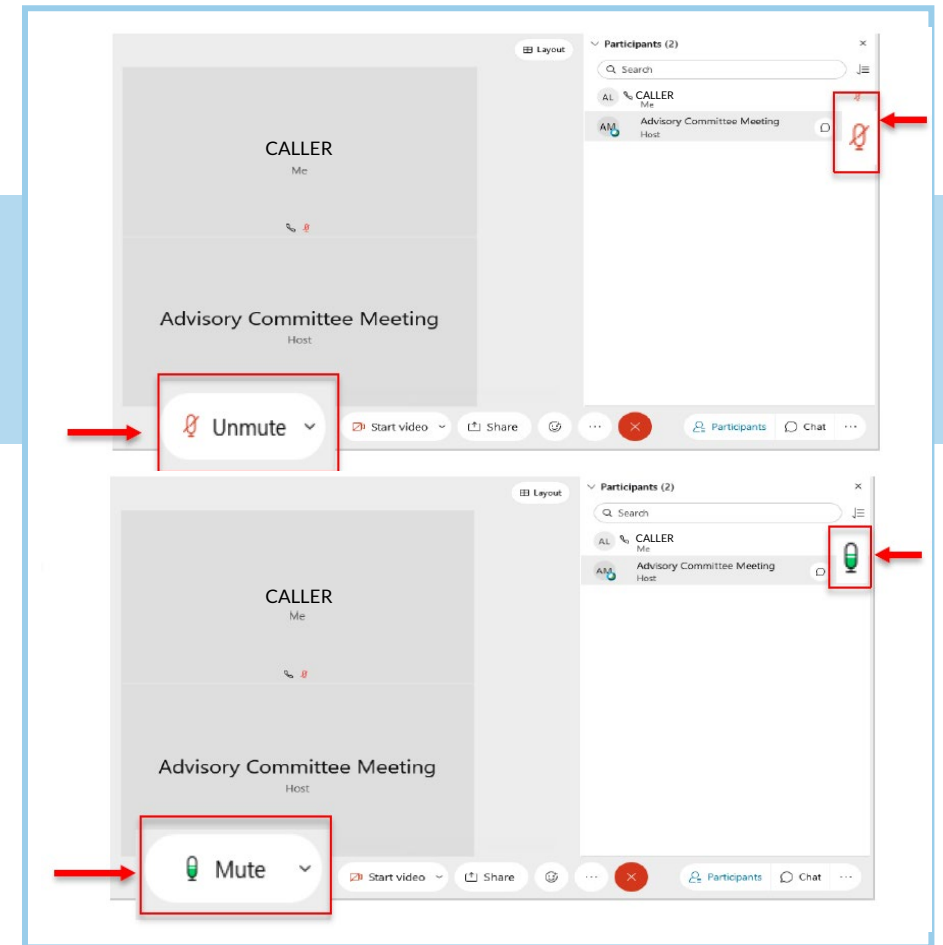
January 30, 2026

10:00 a.m. – 1:00 p.m.

Participation Tips

Please display your first and last name in your Webex login. All audio is muted at the start of the meeting.

- If connected to audio by computer, use “unmute/mute” button
- If connected to audio by phone, use “unmute/mute” button or *6 function on your keypad
- Do not place your call on hold
- The Chair or Presenter will queue for discussion by phone and the “Raise Your Hand” feature
- Announcing your name, organization and sector you represent is required when speaking
- The Webex Chat is not monitored



Please keep your line muted when you are not speaking

Executive Summary

- MISO is experiencing an unprecedented surge in large load interconnection requests — primarily from data centers
- Recognizing urgent needs, MISO established Expedited Resource Addition Study (ERAS) process to accelerate the generator interconnection process and improved MTEP's Expedited Project Review (EPR) process to quickly approve transmission for large loads
- While existing processes effectively integrate new large loads, MISO needs to evolve its approach and develop long-term solutions to maintain reliability while enabling fast-paced load growth
- This workshop will focus on challenges to reliably enabling large loads and actions needed, such as defining reliability requirements, and improving the speed of integration to support member plans and goals while maintaining reliable operations
- MISO is seeking formal feedback on today's discussion by Feb. 23

Large Load Stakeholder Workshop

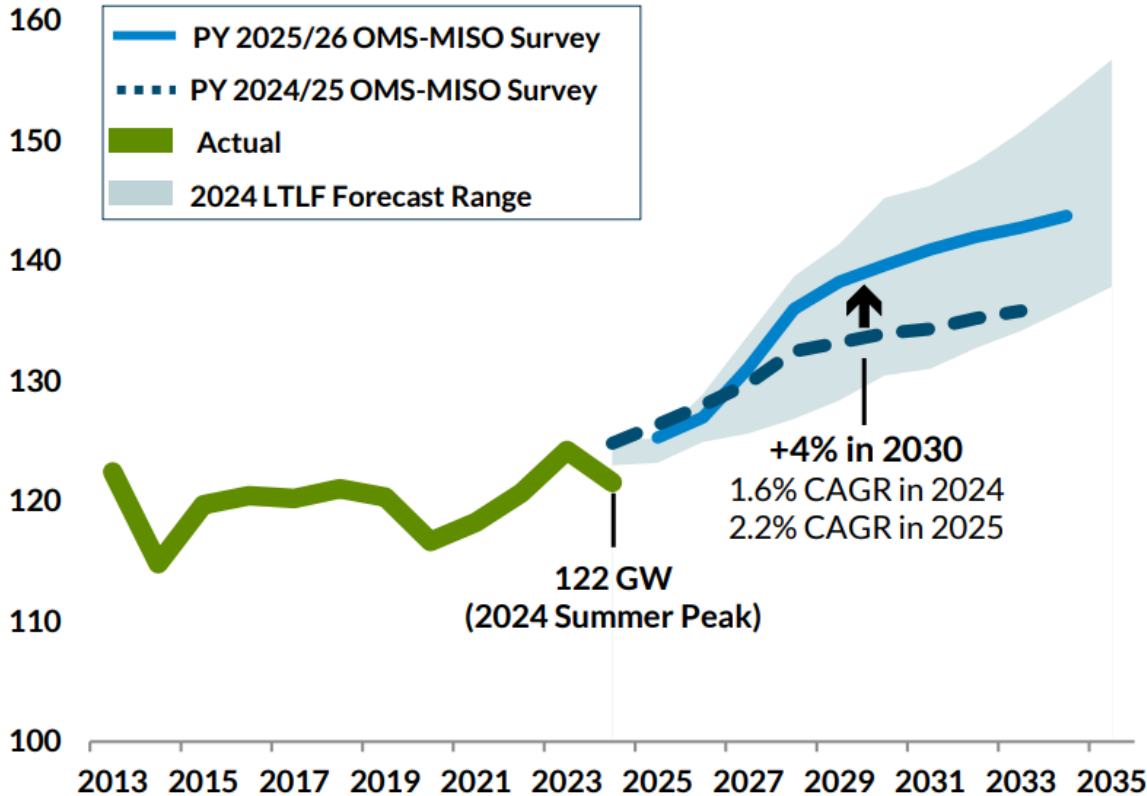
January 30, 2026

Topic	Time
Introduction and Overview	10:00
Topic 1: Considerations and Desired Outcomes	10:30
Topic 2: Interconnection Reliability Requirements and Guidelines	11:00
<i>Break</i>	11:25
Topic 3: Speed to Reliable Power	11:40
Topic 4: Reliable Operation	12:05
Next Steps	12:15
Additional Q&A	12:20
Adjourn	1:00

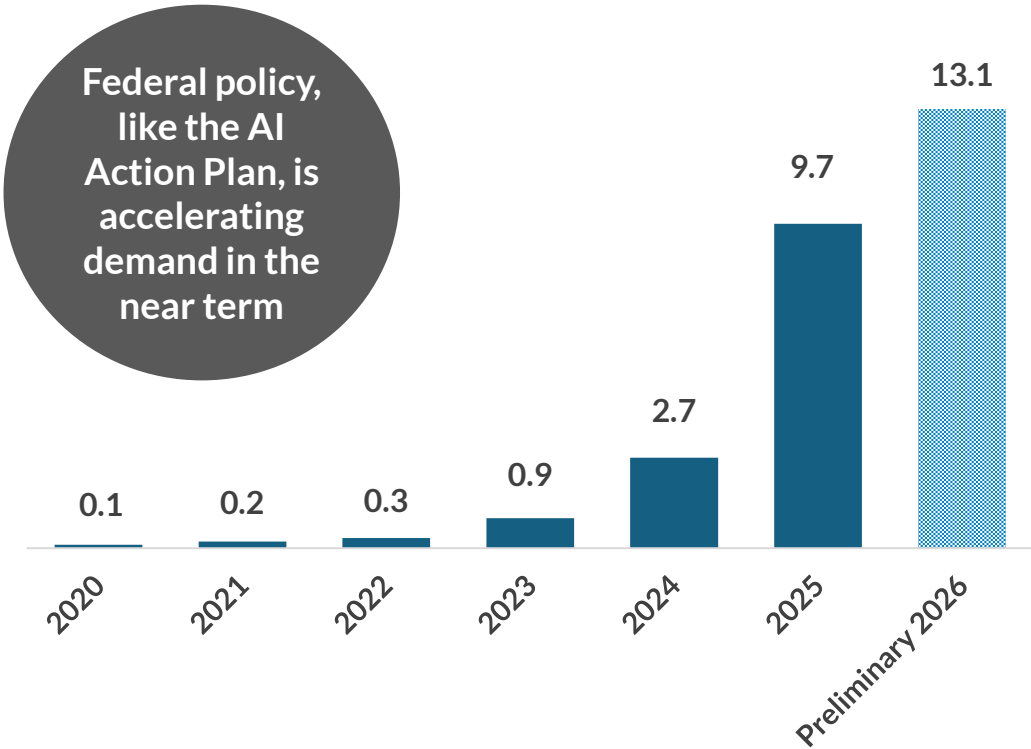
Introduction and Overview

MISO's long-term forecasts and projects submitted through MTEP's EPR process project accelerating requests for large load additions

2024 Long-Term Load Forecast (GW)
Based on OMS-MISO Survey Submissions



Large Load Additions (GW)
Based on MTEP's Expedited Review Projects (EPRs)



* Preliminary MTEP data based on MISO member submissions and prior to studies and approvals.

Large loads have disproportionate impact on system reliability due to their size and unique characteristics; various definitions of “large” have recently come into focus across the industry

	Scale / Load Size	Unique Characteristics
Draft NERC Guidelines	<ul style="list-style-type: none"> Has not adopted a uniform definition, but administered a survey suggesting a 50 or 75 MW threshold 	<ul style="list-style-type: none"> Pointed to characteristics such as interconnection voltage, size relative to local interconnection, and local system strength that affect reliability impacts
Large Load ANOPR	<ul style="list-style-type: none"> 20 MW threshold 	<ul style="list-style-type: none"> MW size appears to be the sole determinant
PJM	<ul style="list-style-type: none"> 50 MW threshold in load forecast adjustment process and proposed by board of directors in their decisional letter 	<ul style="list-style-type: none"> MW size appears to be the sole determinant
SPP	<ul style="list-style-type: none"> Differentiates by voltage level: ≥ 10 MW at distribution or ≥ 50 MW at transmission level, with accelerated study tracks 	<ul style="list-style-type: none"> Lower MW threshold at lower voltage reflects difference in system impact at different voltage levels and is consistent with a NERC survey
ERCOT	<ul style="list-style-type: none"> 75 MW threshold, supported by detailed modeling and telemetry protocols 	<ul style="list-style-type: none"> MW size appears to be the sole determinant, though large loads are subsequently studied to identify facility upgrades or operational limits needed to avoid violations of operating standards

The scale, pace and characteristics of data center-driven load growth are presenting significant operational and planning challenges for states, utilities and MISO



States and Utilities

Make resource decisions – additions and retirements



MISO

Enable Member plans; ensures timely grid connections and efficient regional transmission

Planning challenges

- New large load can often be online in 1.5 – 3 years
- Adding generation can take 4 years
- New transmission takes 7-10 years

Operational challenges

- Data centers are energy-intensive, requiring hundreds of megawatts
- MISO reserve margins are already tight with limited available capacity
- Flexibility to manage demand spikes is declining, especially during seasonal peaks

MISO has already responded to the urgent need, but more action is needed

GENERATION INTERCONNECTION

Expediting processes to get generation online faster

ERAS

Targeted process for generation serving new load

JTIQ

Facilitates interconnection of large amounts of new generations more efficiently and cost effectively

Interconnection Queue

Numerous enhancements create efficiencies in standard processes, driving to a 373-day cycle

CROSS FUNCTIONAL

Providing continuity across resource and transmission planning

GI Options

Standard, provisional, surplus, replacement, and ERAS generation interconnection requests provide options to customers

Load Forecasting

Improved load forecast capabilities support proactive transmission and resource planning

New Tools

Automation enhances transparency and provides improved tools for study across processes, enabling more transparent and efficient results delivery

TRANSMISSION PLANNING

Evaluating the transmission system to meet near- and long-term system needs

MTEP

Transparently review near term needs and evaluate alternatives

EPR

Quickly analyze emerging needs, such as large loads, to reliably enable speed to power

LRTP

Provide a backbone to enable energy and lower total transmission costs on the system

Developing an approach requires strong stakeholder engagement; workshops and stakeholder committee meetings will help ensure MISO appropriately addresses the scale, pace and unique characteristics of large loads



Stakeholder Workshops

- Discuss broader topics
- Ensure cross-functional alignment
- Review status updates from stakeholder committees

Stakeholder Committees

- Handle specific work regarding requirements, solutions and policy work
- Help determine potential filings

External Engagement

- Participate in regulatory forums (i.e., NERC technical conferences)
- Communicate and share information with regulators, industry, RTOs, etc.

Considerations and Desired Outcomes

MISO has developed 12 considerations to help think about the specific challenges of large load integration for the purpose of soliciting stakeholder feedback to focus MISO's work on the right areas



Process Complexity

- Member desire for rapid interconnection drives a need to adapt existing processes or create new processes to serve load faster, which increases administrative complexity

Market participation of flexible demand

- Desire for large load customers to directly participate in MISO markets is uncertain; no-market or emergency-only participation (not curtailed in pre-emergency conditions) may make it more difficult to operate the system

Cost Efficiency

- The rapid increase of large loads adds to cost pressures on the system

Jurisdictional and regulatory

- There are potential jurisdictional overlaps when it comes to establishing reliability requirements and rules leading to questions about which mechanisms MISO should pursue to ensure system reliability
-

Operating time-frame reserves

- MISO operating time-frame reserve requirements aim to reflect uncertainty in generation, load, and imports. With large load growth, load forecast uncertainty may increase in a way that isn't captured by our current processes

Modeling

- Models (steady-state, dynamic, and/or EMT) used to represent the behavior of large loads may not accurately represent the actual equipment installed at the BPS-interconnected facility

Information and data coordination

- Current MISO processes, communication channels and cross-functional coordination need to adapt to accommodate the nature and complexity of large loads and their evolving commissioning processes and operational requirements

Stability Management

- Large loads have unique disturbance behaviors (frequency sensitivity, low fault current, oscillations, harmonics), unknown and varied ride-through performance, and complex protection schemes that complicate stability assessments in the operating time frame

Considerations

Visibility & Control

- Lack of telemetry, metering, and control limits situational awareness and operator ability to manage loads in real time. Insufficient real-time tools and communication channels further limit operators' ability to monitor and manage large load behavior

Forecasting

- Uncertainty in timing, scale, and operational information (e.g., forecasts, outages) of large loads can result in inefficient unit commitment, higher congestion costs and elevated reliability risks

Generation & Transmission Development

- If large load demand growth somehow out-paces resource additions or transmission upgrades, risks to the grid will increase

Security & Resilience

- Large loads are critical infrastructure with potential cyber/physical vulnerabilities and poorly defined restoration roles
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MISO is working towards three desired outcomes that warrant stakeholder consideration



Interconnection reliability requirements

A set of guidelines and requirements needed to support reliability are defined for large load at the time of interconnection.



Speed to reliable power

Large load can secure service quickly and without compromising reliability, accounting for the unique characteristics and commitments of the facility.



Reliable operations

The grid is operated reliably and efficiently with substantial levels of large load.

In recent orders and an ANOPR, FERC provided direction aligned with these outcomes

	PJM Co-Location Order	SPP HILL/HILLGA Order and CHILL Filing	FERC ANOPR
Interconnection reliability requirements	<ul style="list-style-type: none"> • FERC directed parties to identify requirements needed for reliability in a paper hearing 	<ul style="list-style-type: none"> • FERC-approved High Impact Large Load (HILL) study process and large load requirements, consistent with NERC draft guidelines 	<ul style="list-style-type: none"> • Utilities serving large loads should meet applicable NERC reliability standards and NERC should review these standards
Speed-to-reliable-power	<ul style="list-style-type: none"> • FERC directed PJM to develop several types of transmission service to serve load co-located with generation 	<ul style="list-style-type: none"> • FERC-approved High Impact Large Load Generation Assessment (HILLGA) for co-located generation and load • SPP-filed Conditional High Impact Large Load (CHILL) for non-firm load 	<ul style="list-style-type: none"> • Signals support for mechanisms that reduce delays for firm capacity additions tied to reliability needs and encourages flexible load and supply configurations that reduce system stress
Reliable operations	<ul style="list-style-type: none"> • Non-firm co-located load can be curtailed during emergencies at PJM’s direction 	<ul style="list-style-type: none"> • CHILLs must curtail per SPP instruction (not approved) 	<ul style="list-style-type: none"> • Considers limited operations and curtailment options

Defining Interconnection Guidelines and Reliability Requirements

Interconnection Reliability Requirements



A set of guidelines and requirements needed to support reliability are defined for large load at the time of interconnection

Until NERC sets standards governing large loads, MISO distilled the requirements down to five themes, informed by the reliability universe

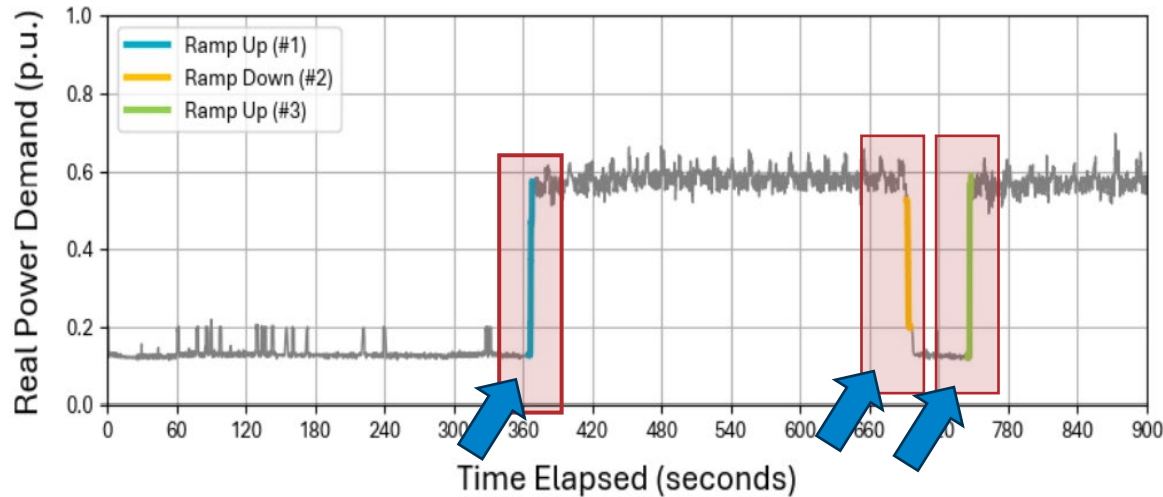


Themes	Examples
<p>Performance & Ride-through</p> <p>Ensure large loads remain connected and operate reliably during system disturbances</p>	<p><i>Voltage ride-through</i></p> <p><i>Frequency ride-through</i></p> <p><i>Reactive power & voltage control</i></p>
<p>Flexibility & Reliability Limits</p> <p>Prevent sudden large changes that could destabilize the system</p>	<p><i>Ramp limit</i></p> <p><i>Block load limit</i></p> <p><i>Controlled energization and load pickup</i></p>
<p>Operational Readiness</p> <p>Ensure large loads provide real-time data and coordination for forecasting, outage planning, and system protection</p>	<p><i>Telemetry & metering standards</i></p> <p><i>Forecasting (short-term and long-term)</i></p> <p><i>Outage Coordination Protocols</i></p>
<p>System Stability</p> <p>Avoid adverse impacts on system dynamics and maintain system strength</p>	<p><i>Control Interaction & Controller Stability</i></p> <p><i>Oscillation Sensitivity</i></p> <p><i>Voltage Stability</i></p>
<p>Resilience & Security</p> <p>Ensure large loads withstand disruptions and maintain secure operations</p>	<p><i>Cyber & Physical Security Compliance</i></p> <p><i>Restoration Coordination</i></p> <p><i>Block Loading for Recovery</i></p>

Data centers can draw extremely large amounts of electricity almost instantly, creating reliability concerns; standards can manage how quickly these loads can ramp up

Industry Examples

AI Training Data Center (50 MW)*
Demand Curve



entsoe**

Large load proposes a ramp rate cap for increasing demand. The system operator reviews the proposal, approves or adjusts it based on reliability studies, or applies a default standard ramp rate if needed.

ercot

Once each large load is built, the system operator approves ramp rate based on individual study results for that large load.

SPP***

Large loads must limit ramping to no more than 20 MW per minute (unless otherwise directed) and coordinate changes with the transmission operator to maintain system reliability.

*An AI Training Data Center Begins a Training Run (EdgeTunePower)

**Characteristics and Risks of Emerging Large Loads published by NERC Large Loads Task Force in July 2025, pg 6. Implementation guideline for Network Code "Demand Connection

***20260114_Order-Revisions to Add the High Impact Large Load Process and Generation Assessment_ER26-247-000

Large loads can distort grid models and forecasts; accurate telemetry and metering are essential to predict and manage their impact

Telemetry is needed for:

- Grid reliability and stability
- Operational control
- Modeling and planning

Industry Examples



Large loads must provide live data to keep the grid stable, and ensure the energy measurements conform to national standards



Large loads must confirm accurate modeling and telemetry data before connecting to the grid



Large loads must supply Real-time telemetry with PMU installment for High Impact Large Load

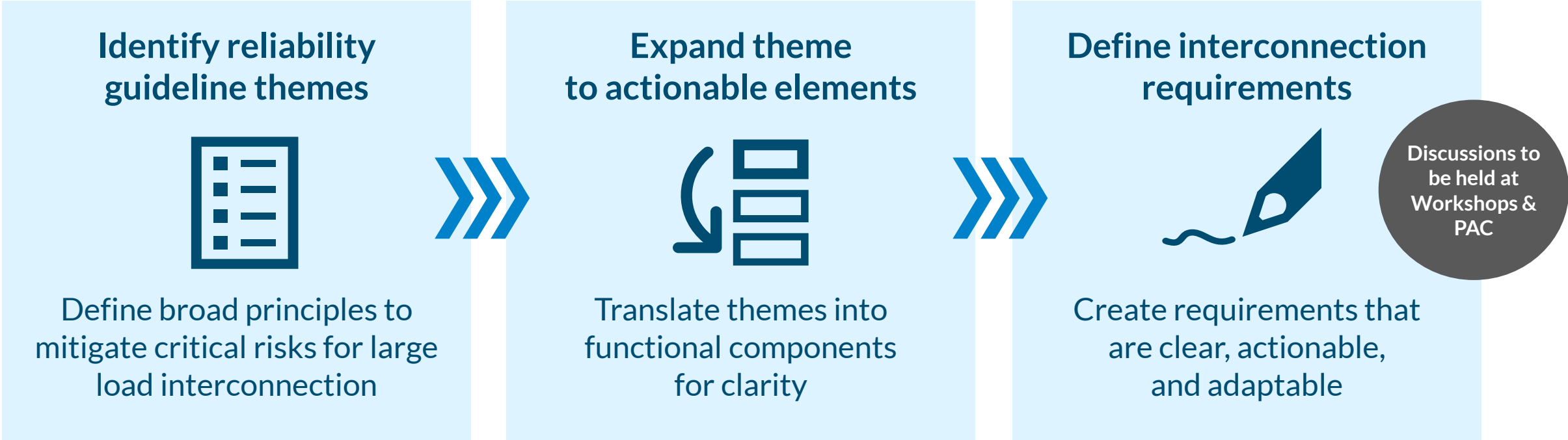
*Implementation guideline for Network Code "Demand Connection

**20260114_Order-Revisions to Add the High Impact Large Load Process and Generation Assessment_ER26-247-000

These questions aim to ensure interconnection guidelines for large loads are practical, effective and support reliability without creating barriers; input will help focus on the right elements and prevent late-stage rework

Context Setting	<ul style="list-style-type: none">• How do you see interconnection guidelines impacting your ability to design and plan large loads like data centers?• What would make these guidelines most useful and practical for you?• From your perspective, what risks do we need to address upfront to avoid late-stage surprises?• Do these five requirement themes reflect the challenges you face?
Ramp-Related Guideline	<ul style="list-style-type: none">• How do you currently manage ramp-up behavior for large loads?• What would an effective ramp-related guideline look like at the time of interconnection?• What concerns do you have about implementing ramp-related limits at the time of interconnection?
Telemetry & Metering Guideline	<ul style="list-style-type: none">• What telemetry data should be required at the time of interconnection to ensure system reliability?• What challenges do you foresee in meeting telemetry and metering requirements at the point of interconnection?• What lessons from generation interconnection telemetry requirements should we apply to large load interconnection?

MISO will collaborate with stakeholders to apply best practices that address complexity and maintain priorities in reliability risk management



Speed to Reliable Power

Speed to Reliable Power



Large load can secure service quickly and without compromising reliability, accounting for the unique characteristics and commitments of the facility.

The time-to-build mismatch between large load facilities, transmission, and generation drive a need to adapt or create processes to expedite large load interconnection while maintaining reliability



Transmission



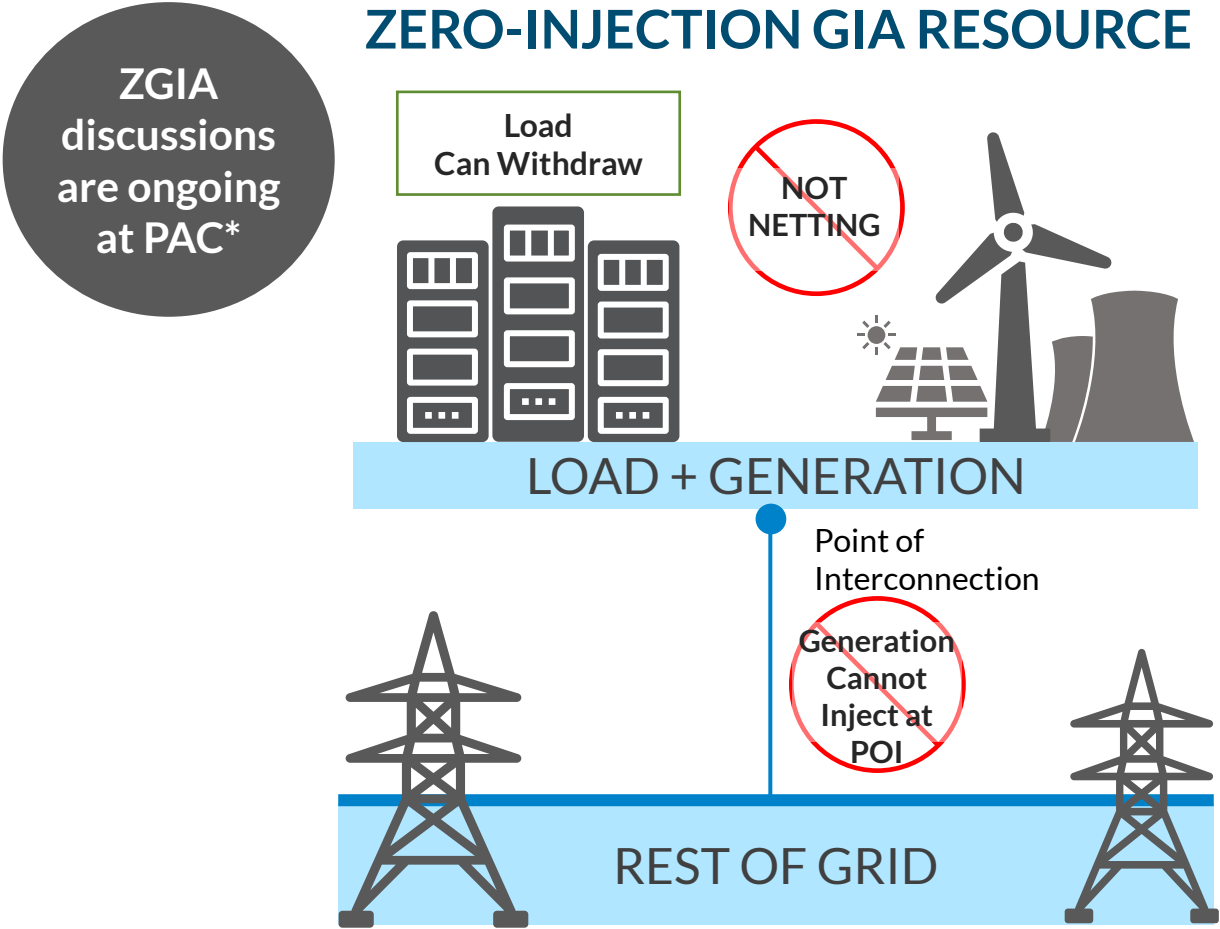
Generation



Load

YEARS TO BUILD	7-10	4	1.5-3
LEVERS	<ul style="list-style-type: none"> • Build what is necessary through current or enhanced MISO processes • Potential incremental transmission capacity above firm level 	<ul style="list-style-type: none"> • Build more through current or enhanced MISO processes • Co-located with load • Behind the meter 	<ul style="list-style-type: none"> • Scale with available generation and transmission • Curtailable load, demand response

Solution example: Zero-Injection GIAs (ZGIA) may help address the timing mismatch by creating a faster interconnection path while often reducing network upgrade requirements



STUDY PROCESS

- 1. ZGIA study of the generation (stability and interconnection studies are completed in ~90 days; project doesn't go through DPP)
- 2. MTEP study of the load, which accounts for the signed GIA

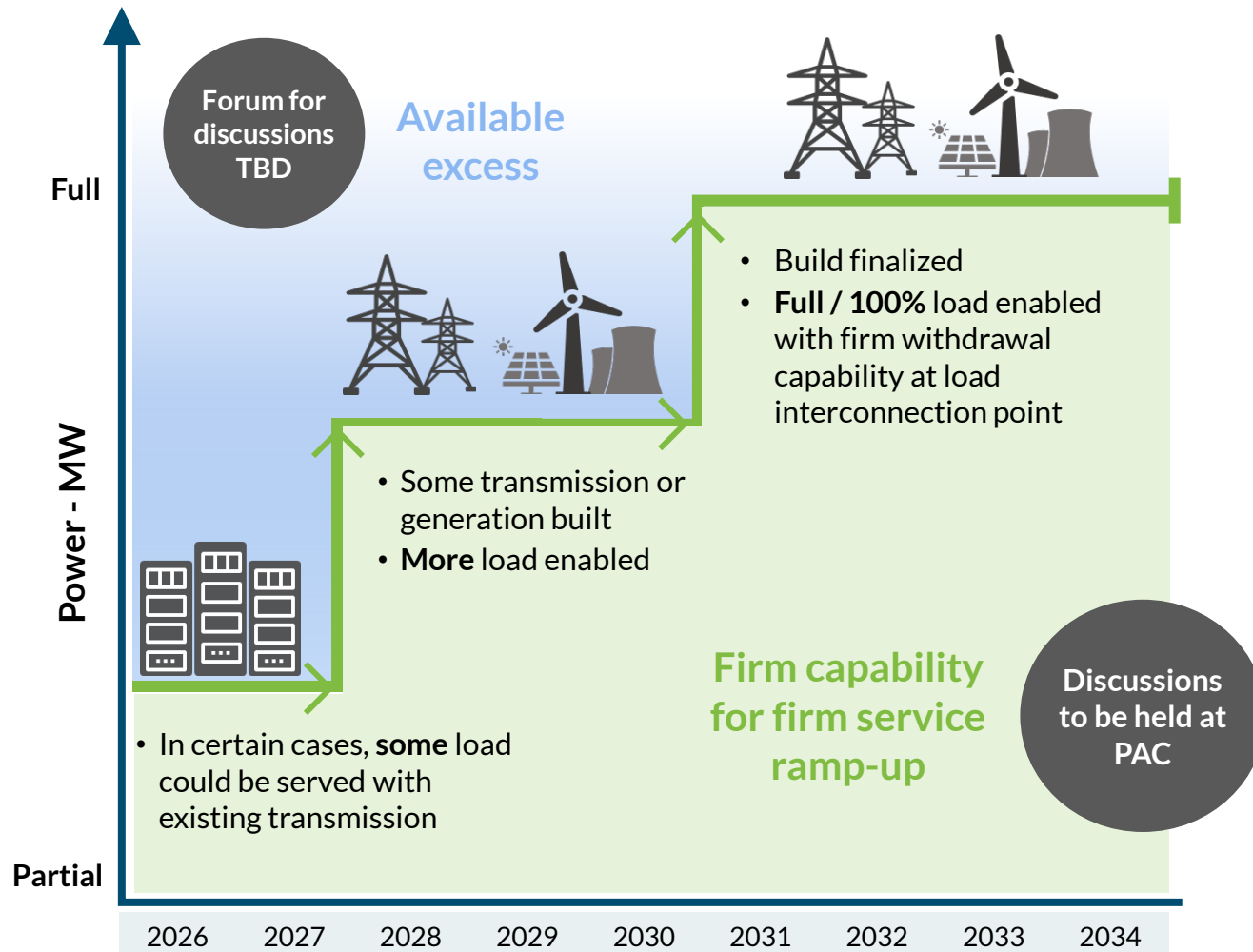


OUTCOME

MTEP study results in a set of potentially reduced network upgrades, reflective of the presence of the accompanying generator

ZGIA: Zero-Injection Generator Interconnection Agreement
*ZGIA discussion is ongoing at PAC Market Participation and Registration of Co-Located Load and Generation (PAC-2024-4)

Solution example: Speed to Partial Power helps address the challenges of using the system that is available and manage service as conditions change



Options

- Clarify **firm** capability as transmission or generation come into service
- Consider how to access and use **available excess** transmission capacity
- Consider implications for each option:
 - Resource adequacy requirements
 - Demand response participation models
 - Co-located or behind-the-meter generation

Enabling large loads to secure service quickly and reliably will require coordination across MISO's service lines

Planning

- How should MISO and stakeholders coordinate generation and transmission solutions to effectively serve large loads?
- How should changes in transmission and generation in-service dates impact service or withdrawal capability?

Markets

- How should load and generation be represented in resource adequacy, network and commercial modeling and market participation for the demand and supply side when enabling load to be served quickly and reliably?
- What interest exists with respect to additional transmission service, curtailment or price-sensitive load instruments?

Operations

- What requirements should exist around telemetry, direct metering, forecasting when enabling load to be served quickly and reliably?
- What additional requirements and monitoring are needed in the operational horizon when enabling load to be served quickly and reliably?

Reliable Operations

Reliable Operations



The grid is operated reliably and efficiently with substantial levels of large load.

Large loads introduce new operational behavior, and solutions will need to be proportional to the volume of uncertainty that is expected

Real-time steady-state visibility

- Real-time measurements such as power flows and voltage data for load and co-located generators are critical for reliability analysis.

Short-term forecast visibility

- Large loads would be considered non-conforming load, and currently there are no requirements for non-conforming load forecast in the operations horizon. Accurate load forecasting is important for reliable and efficient unit commitment in the day-ahead and real-time markets.

Reserve procurement

- Large loads have fast ramping and unconventional behavior, further complicated by their size, their ability to quickly increase or decrease demand, potential sudden loss of co-located generation, and forecasting errors. Existing operating reserve products don't account for these new risks and need to be reviewed and enhanced.

Dynamic models and processes

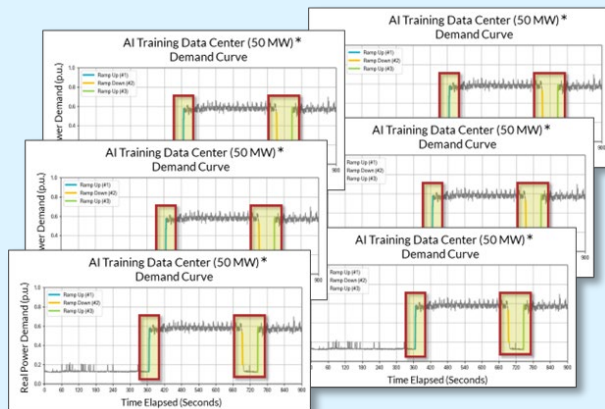
- Accurate dynamic modeling information enables assessment of transmission system stability strength. New processes may need to be created to assess stability in the operations horizon.
-

Example: MISO has various reserve products to manage uncertainties across different time frames, and enhancements may help address large load-specific challenges

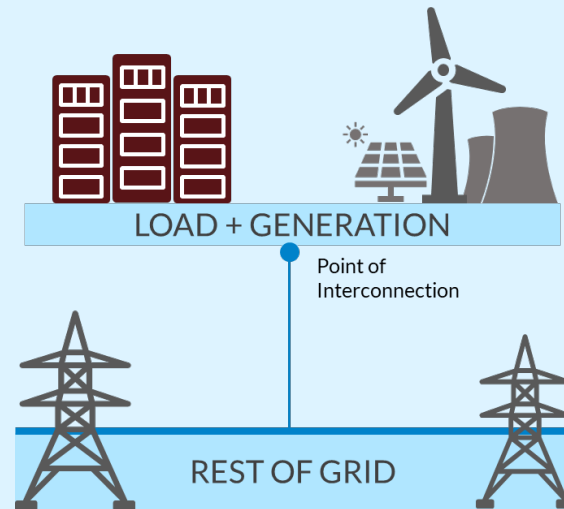
Discussions
to be held at
RSC

OPERATIONAL CHALLENGES

- Large load volatility and uncertainty (fast demand increase / decrease)



- Sudden loss of co-located generation or large load



CURRENT EFFORTS

- The Reliability Subcommittee is working through a dynamic regulation and ramp product in which volume of reserves increases with uncertainty

POSSIBLE SOLUTIONS

- Revised quantity and demand curves for existing reserve products to account for uncertainty introduced by large loads
- Ensure sufficient downward reserve capability

Next Steps

Broader topics will be discussed in quarterly workshops while specific work regarding requirements, solutions and policy work will be handled in stakeholder meetings

Outcome	Milestone	Forum
Speed to Reliable Power	ZGIA supports faster service for co-located generation and load	PAC
	Firm service ramp-up enables service as upgrades come online	PAC
	Use of available excess transmission capacity is considered	Forum TBD
Interconnection Reliability Requirements	Interconnection reliability requirements and guidelines support system reliability as large load penetration increases	Workshops / PAC
Reliable Operation	Adjustments to operating time-frame reserves ensure coverage of large load risks	RSC

Currently-Scheduled Workshops
 April 30
 July 31
 October 29

This is a partial list and does not reflect all options MISO is considering. Workshop model allows single forum for cross-functional discipline discussion. Additions will be made to stakeholder entity management plans as appropriate.

Stakeholder Feedback Request

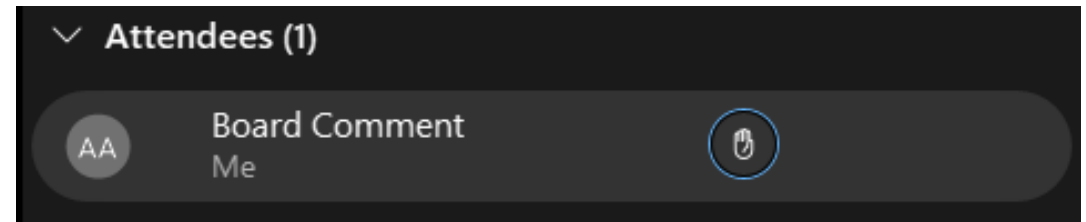
- MISO requests feedback on the **Considerations and Outcomes of Large Load Additions** by February 23, 2026
 - Please provide feedback on the following:
 - Are there any additional **considerations** MISO should include as it frames large load additions? (slide 12)
 - Are there more details or aspects of the **considerations** MISO should take into account? (slides 13-15)
 - Are there any additional **outcomes** MISO should include as it frames large load additions? (slide 16)
 - Are there more details or aspects of the **outcomes** MISO should take into account? (slides 19-34)
 - MISO would be interested in specific answers to questions on slide 23 and 30
- Feedback requests and responses are managed through the Feedback Tool on the MISO website: <https://www.misoenergy.org/engage/stakeholder-feedback/>

Public Comments

To make a public comment, please use the “Raise Your Hand” feature on Webex.



Located next to your name and bottom of Webex



Once the Moderator unmutes your line, please state your name, Company affiliation and Advisory Committee Sector.



Send questions or comments to:
LargeLoadProgram@misoenergy.org
