

Large Load Interconnection Reliability Requirements (LLWG)

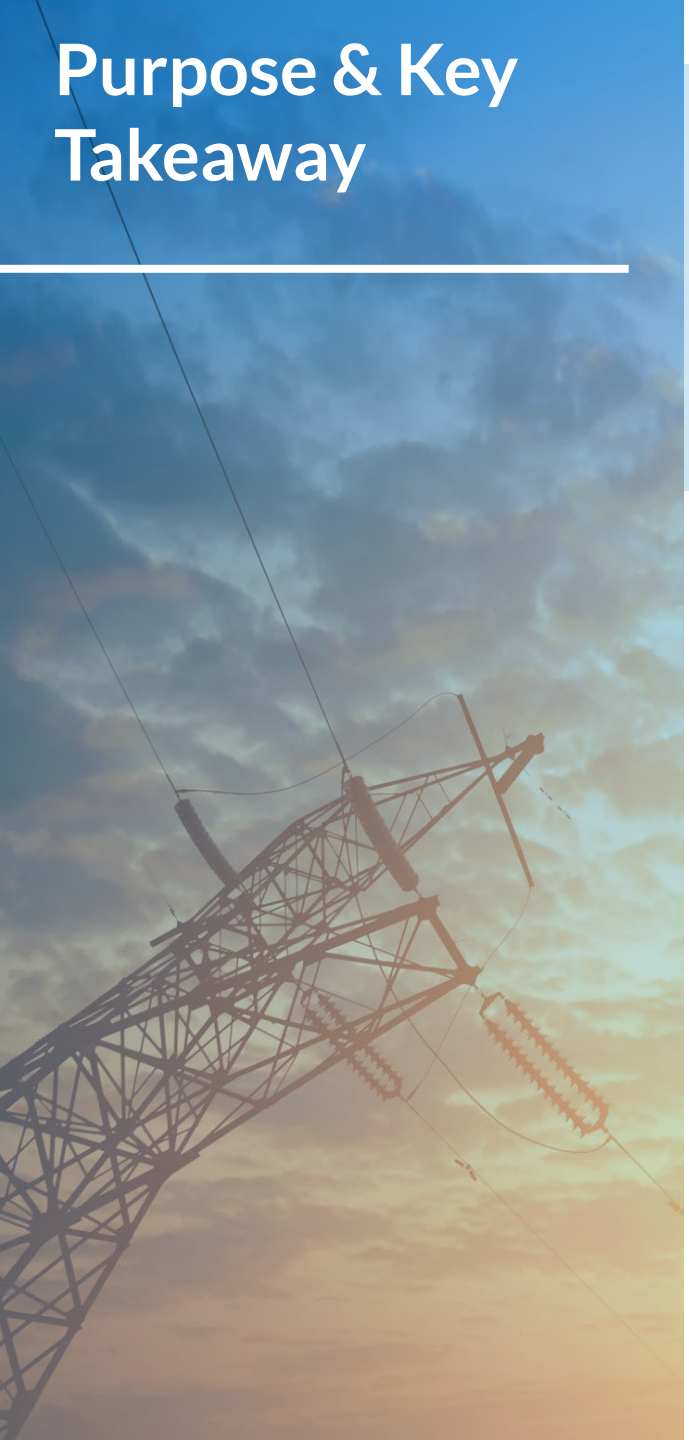
Updated as of 7/27

- Slide 7 –Large Load and Computational Load definitions update in yellow highlights
- Slide 9 – Applicability update in yellow highlights
- Slide 12 – Transitional Provision update in yellow highlights
- Slide 17 – corrected PMU requirements language

Large Load Working Group

July 27, 2026

Purpose & Key Takeaway



Purpose

Review tariff redline for the large load interconnection reliability requirements based on stakeholder feedback.

Key Takeaways

- MISO is targeting a Tariff filing in the second half of August to establish clear, enforceable interconnection reliability requirements that protect system reliability.
  - Revised Tariff language is posted with today's material.
- MISO's proposed framework is consistent with the recent FERC show cause order, as well as the emerging NERC guidance and broader industry practices.
- Stakeholder feedback has significantly influenced the revised Tariff language, particularly around applicability, transition provisions, and requirement specific language.
- A well-defined transition plan is critical to manage active projects while preventing unnecessary retroactive obligations.

Stakeholder Coordination



Large Load Interconnection Reliability Requirements Introduction

Workshop:

January 30, 2026*



Large Load definition development

PAC Meeting:

February 25, 2026*

April 22, 2026

May 27, 2026



Review drafts on requirements and discuss tariff language

LLWG Meeting:

April 20, 2026*

May 14, 2026*

June 10, 2026

June 29, 2026*

July 27, 2026



File Tariff

Second Half of August 2026

* Formal Stakeholder Feedback Requested

7/16 LLWG Update - Large Load Interconnection Reliability Requirements

- MISO has been working with stakeholders to develop reliability requirements for large loads for the last few months
- A key consideration has been to ensure reliability while avoiding disruption to loads at a late stage of development, a consideration reflected in FERC's Show Cause order
- We have received significant stakeholder feedback indicating that our current proposal does not achieve this
- MISO is therefore revising our approach in our upcoming filing to:
  - Apply full requirements only to loads that MISO has not yet approved through our planning processes
  - Apply visibility requirements to a broader set of large loads, consistent with MISO's proposals discussed with stakeholders to-date
- In subsequent filings this fall we will take additional steps to ensure reliability, including in planning (e.g., enhanced MTEP stability studies) and operations (e.g., regulation reserve requirements to handle large load ramps)
- Next steps:
  - Special LLWG 7/27 to further outline specific elements of the revised MISO proposal
  - New target filing date in mid-August

Large Load Interconnection Reliability Requirements
August 2026 Filing Index

Large Load

- Computational Load Definition*
- Large Load Definition
- Point(s) of Withdrawal*
- Applicability*
- Transitional Provision*

Ramp

- Up-ramp and Down-ramp

Visibility

- Basic Facility Data
- Modeling
- Telemetry
- PMU
- Forecast

Ride-through

- Voltage*
- Frequency

*Focus Area

MISO's interconnection framework relies on the Tariff to set requirements and the BPM to guide consistent implementation

Tariff Filing



- Provides high-level framework and requirements, focusing on who, what, when, and where
- Legally binding through FERC
- Target Filing: August 21, 2026

Large Load BPM



- Provides specific guidelines for how the Tariff requirements are implemented
- Must be consistent with Tariff
- Target Development: June 2026 – December 2026
- July 16th Large Load BPM Development Presentation

BPM: Business Practices Manual

Large Load definition was updated based on stakeholder feedback

Updated Tariff Language – Module A

Computational Load: ~~Load comprised of electric demand from information technology equipment, such as servers, storage, and networking hardware. [referencing NERC's definition]~~ Large Load comprised of 25 MW or more of Demand from information technology equipment, such as servers, storage, and networking hardware. ~~The determination of Computational Load shall be made in a manner consistent with the definition of such term established by NERC.~~

Large Load Equipment: Any of the facilities, devices, or equipment that constitutes a part of a Large Load, or are used to interconnect the Large Load to the Transmission System.

Large Load : ~~The~~ Load with Demand of 50 MW or more associated with any facility or aggregation of facilities located at a single substation behind one or more Point(s) of Withdrawal from the Transmission System that is owned, operated, or controlled by: (a) a single entity or (b) a group of entities that will coordinate with respect to the profile of the Load. Large Load does not include Load associated solely with an Electric Storage Resource~~. and that results in either:~~

~~(i) any new Load with a forecast Demand of 50 MW or more or,~~

~~(ii) any modification or series of modifications that results in a cumulative increase of Demand by 25 MW or more, provided the total aggregate Load is 50 MW or more .~~

Point(s) of Withdrawal: The point(s) where a non-transmission facility that is used to withdraw Energy from the Transmission System to serve Load connects to the Transmission System.

Removed Large Load Customer definition

MISO applies interconnection reliability requirements based on the specific characteristics of Large Load

Non - Computational Load

Process and mechanical equipment driven load behavior

Load Type	Description	Profile	Ramping
Industrial Production & Extraction	Process-driven industrial operations	Cyclical / Process-driven	Low - Medium
Infrastructure & Public Service	Essential service	Mostly flat to peaky	Low - Medium
Agricultural & Processing	Product-processing demand	Seasonal / Process driven	Medium

Baseline Requirements

Basic Facility Data, Modeling, Telemetry, Forecast

Computational Load

Digitally driven, software-managed load behavior

Load Type	Description	Profile	Ramping
Data Center Cloud Storage	Computing infrastructure for data storage	Mostly flat / Continuous	Low-Medium
Data Center Artificial Intelligence; HPC[1]	Computing infrastructure for data processing	Dynamic / Workload-driven	High
Cryptocurrency Mining	Highly concentrated digital facility for validating blockchain	Moderate / Controllable	High

All Requirements

Baseline Requirements + Advanced Modeling + Ramp + PMU + Ride-through[2]

[1]HPC: High-performance Computing
[2]Applied to the computational component of the Large Load

Applicability of Reliability Requirements to Large Load

Updated Tariff Language

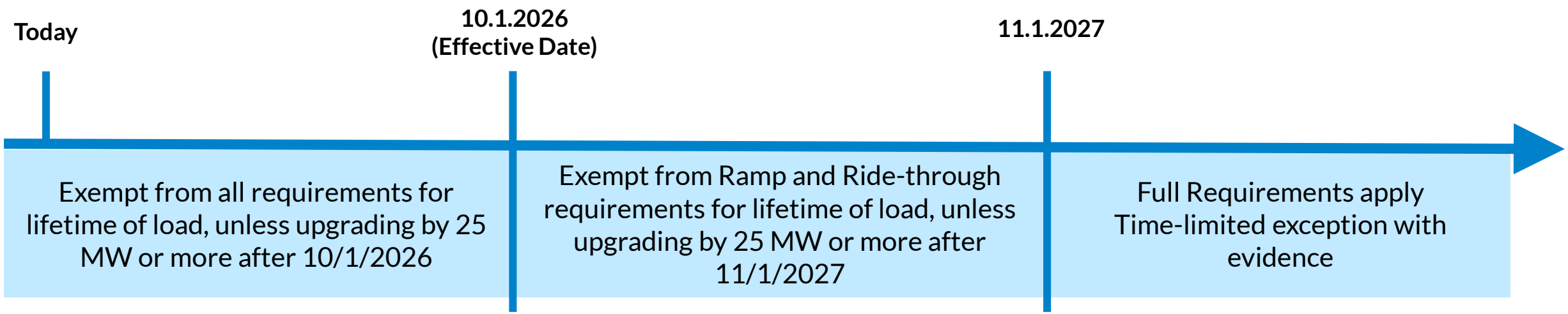
Except as set forth in Section 37A.II, all Large Load shall be subject to the Basic Facility Data, Modeling, Telemetry, Forecast Data, and Audit requirements set forth in Sections 37A.1 through 37A.4 and section 37A.8 of the Tariff.

Except as set forth in Section 37A.II, Computational Load, shall be subject to the Phasor Measurement Unit, Ride-Through and Ramp requirements set forth in Sections 37A.5 through 37A.7 of the Tariff. The Transmission Provider shall determine whether Computational Load is associated with a Large Load based on information provided by the Transmission Customer to the Transmission Provider for such purpose.

~~Any Qualified Change to a Large Load shall subject any incremental Load associated with the Qualified Change to all applicable requirements set forth in this Section 37A. For purposes of this Section 37A, "Qualified Change" shall mean a modification to a Large Load, including but not limited to an increase in the Demand associated with the Large Load or a significant repurposing of the Large Load, as further described in the Business Practices Manual for Large Load.~~

The Transmission Customer shall be responsible for complying with each of the requirements of this Section 37A for each Large Load it represents. A Transmission Customer shall demonstrate its ability to effectuate compliance with each of the requirements of this Section 37A, including by providing the Transmission Provider with any applicable agreement(s) between the Transmission Customer and the entity or entities that own, operate or use the Large Load demonstrating that the Transmission Customer will be provided access to all information reasonably required to enable the Transmission Customer to comply with and verify compliance with the requirements of this Section 37A, including compliance with the terms of any operating protocols adopted by the Transmission Provider and/or the Transmission Customer. Failure to provide requested information may result in a delayed Service Commencement Date, operational limitations, or disconnection from the Transmission System.

[Previous] The transitional provision ensures in-flight Large Loads are given a defined path and reasonable timeframe to meet reliability requirements while mitigating system impacts in the interim



Trigger: metered Demand equal to or greater than 50 MW

This new approach would mitigate interim system impacts while providing clear timing and expectations for existing and future large loads along with a reasonable path and timeframe to meet reliability requirements

Large Load Status As of December 2026	Visibility Requirements	Behavioral Requirements	
		Ramp	Ride-through
Prospective Large Load *Has not been MTEP approved*	✓	✓	✓
Approved Large Load *Has been MTEP approved, but not yet receiving service by Dec 2026*	✓	X	X
Large Load Receiving Service *Has been MTEP/EPR approved and receiving service*	X	X	X

Transition Provision

All Large Load shall be subject to all requirements as set forth in this Section 37A, provided that:

a) All Large Load that has achieved a Service Commencement Date prior to the initial effective date of this Section 37A shall be exempt from all requirements set forth in this Section, except that any modification or series of modifications to the Large Load that results in a cumulative increase in Demand of 25 MW or more above the amount of Demand at the effective date shall subject the incremental Load to all applicable requirements set forth in this Section 37A.~~, except to the extent such Large Load is subject to a Qualified Change.~~

b) All Large Load that has not achieved a Service Commencement Date prior to the initial effective date of this Section 37A but has been approved either in MTEP 2026 or in a prior MTEP shall be subject to the requirements set forth in Sections 37A.1 through 37A.~~4~~5 and Section 37A.8, but shall be exempt from the requirements set forth in Sections 37A.~~5~~6 through 37A.7, except that any modification or series of modifications to the Large Load that results in a cumulative increase in Demand of 25 MW or more above the amount of Demand approved in MTEP 2026, or prior, shall subject the incremental Load to all applicable requirements set forth in this Section 37A.~~, except to the extent such Large Load is subject to a Qualified Change.~~

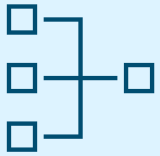
c) Notwithstanding any of the provisions above, the Transmission Provider has the right to require compliance with any or all requirements of this Section 37A if the Transmission Provider determines there is a material adverse affect on reliability.

Visibility requirements



Basic Facility Information Requirements

Basic Facility Data Requirements



- ❑ Basic facility data required to be provided to the Transmission Provider
- ❑ Load MW amounts, firm and non-firm MW amounts, any dispatchable Load MWs, power factor, metering, telemetry, breaker configuration
- ❑ Staged additions and annual energy

Minor change

A ~~Large Load~~Transmission Customer shall be responsible for providing the Transmission Provider with basic information, one-line diagrams, and a description of the electrical characteristics of the Large Load for all Large Load Equipment, in the format and consistent with the timelines specified in the Business Practice Manual for Large Load. Any changes to the characteristics of a Large Load and/or Large Load Equipment, including any changes to the modeling details for the Large Load, shall be provided to the Transmission Provider in a timely manner, consistent with the Business Practices Manual for Large Load. Such changes may include, but are not limited to, Load MW amounts, firm and non-firm MW amounts, any dispatchable Load MWs, power factor, metering, telemetry, breaker configuration, staged Load additions and annual energy as further set forth in the Business Practices Manual for Large Load.

A ~~Large Load~~Transmission Customer must coordinate with the Transmission Owner where the Large Load Point of Withdrawal is located pursuant to the Transmission Provider's load interconnection guidance and applicable NERC standards.

Modeling Requirements



- ❑ Modeling data required to be provided to the Transmission Provider
- ❑ Modeling data including validated electrical models, detailed load profiles, and applicable modeling updates to evaluate system performance
- ❑ Dynamic model(s) necessary to evaluate Large Load performance

Minor change

~~A Large Load~~A Transmission Customer shall provide the Transmission Provider with verified and complete electrical models of the Large Load, as well as detailed Load ~~Profiles~~profiles, for modeled Loads, ~~as set forth~~ in the format and consistent with the timelines specified in the Business ~~Practices~~Practice Manual for Transmission Planning. Such model information must include sufficient detail for Transmission Provider to evaluate system performance under contingency conditions in accordance with currently active versions of Transmission System Planning Performance Standards.

Following completion of applicable studies and prior to ~~its~~the Service Commencement Date~~,~~ of the Large Load, the Transmission Customer shall submit final verified models to the Transmission Provider in accordance with the Business Practices Manual for Large Load. The ~~Large Load~~Transmission Customer shall provide notice to Transmission Provider of any material modifications to the Large Load and shall not implement any such proposed modifications until studied and approved by Transmission Provider in accordance with the Business Practices Manual for Large Load.

The final models of a Large Load shall reflect the as-built configuration and actual operating characteristics of the Large Load and Large Load Equipment. The ~~Large Load~~Transmission Customer shall maintain and update models as required by the Transmission Provider. ~~Failure to provide requested information may result in a delayed Service Commencement Date, operational limitations, or disconnection from the Transmission System.~~

Telemetry Requirements

Telemetry Data Requirements



- ❑ Accurate data feed to the State Estimator
- ❑ Synchronizing with Security Constrained Economic Dispatch (SCED)
- ❑ Details to be discussed in Reliable Operations Workstream

Minor Change

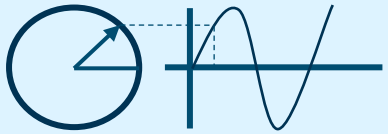
Prior to the Service Commencement Date of a Large Load, ~~a Large Load~~ a Transmission Customer must provide real-time telemetry for the Large Load, either directly, through the applicable Transmission Owner, or other Transmission Provider-approved communication path, in the form and manner as set forth in the Business Practices Manual for Large Load.

Individual metering will be required for all Large Load ~~generation resources~~and any Generation Resource(s) serving such Large Load that is located behind the same Point of Interconnection to the Transmission System as the Large Load and meeting thresholds outlined in the Business Practices Manual for Large Load. All telemetry shall be provided via Inter-Control Center Communications Protocol (ICCP) and must meet Transmission Provider update requirements as specified in the Business Practices Manual for Large Load. The ~~Large Load~~Transmission Customer must use commercially reasonable efforts to maintain telemetry availability and accuracy for the Large Load and must promptly correct erroneous data, bad mappings, and ICCP modeling issues.

The Transmission Owner must provide disturbance monitoring and event recording capability sufficient to support post-event analysis, model validation, and reliability assessment.

Phasor Measurement Unit Requirements

Phasor Measurement Requirements



- Invest in Phasor measurement unit (PMU) or better
- Details related to measured quantities, data recording and retention, power quality, and infrastructure to be discussed in Reliable Operations Workstream

Minor Change

~~Large Load comprised of any~~ Computational Load shall be subject, at a minimum, to the Phasor Measurement Unit (PMU) requirements set forth in this section. Prior to the Service Commencement Date of a Large Load, phasor measurement recording and communications equipment must be installed that is capable, at a minimum, of gathering phasor measurements as specified in Business Practices Manual for Large Load. To the extent similar quality equipment is being added or already exists, such as relays or digital fault recorders, that can collect data at least at the same rate as PMU and which data is synchronized via a high-accuracy satellite clock, such equipment may be utilized to satisfy this requirement if the equipment is located on the Transmission Owner's side of the Point of Withdrawal. The phasor measurement equipment must be installed at the Transmission Owner's side of the Point of Withdrawal and become part of the Transmission Owner interconnection facilities. Phasor measurements must be streamed in Institute of Electrical and Electronics Engineers (IEEE) C37.118 or equivalent format and be provided to the Transmission Provider by the Transmission Owner.

Short-term Forecasting Requirements

Forecasting Requirements



- **Rationale:** Large Loads can change system conditions rapidly, and unlike traditional demand, their behavior cannot be forecasted accurately using historical load patterns, even when modeled with weather and calendar data in MISO's short-term forecasting system.
- Requirements will include hourly and five-minute granularity, as appropriate.

Change

Prior to the later of the Service Commencement Date of a Large Load or September 1, 2027, the ~~Large Load~~Transmission Customer must provide day(s) ahead and real-time Load Forecasts for a Large Load directly to the Transmission Provider to support the Reliability Assessment Commitment (RAC) and Security Constrained Economic Dispatch (SCED) processes, along with other reliability studies. Given the sizable reliability impact a Large Load may have on the Transmission System, the Load Forecasts shall be updated to reflect the most current information on the expected Demand, in accordance with the Business Practices Manual for ~~Operations Forecasting~~ Large Load.

Ride-through Requirement



Large Load Ride-through Requirements

Ride-through



- Maintain Large Load connectivity during applicable voltage and frequency disturbances to support Bulk Electric System reliability
- Requirements include both voltage and frequency ride-through performance criteria

Minor Change

Computational Load ~~that is associated with a Large Load~~ shall remain connected to the Transmission System and continue operation during voltage and frequency disturbances within the performance criteria established by the Transmission Provider in the Business Practices Manual for Large Load.

Ride-through requirements apply at the Point(s) of Withdrawal and may include evaluation, testing, modeling, monitoring, and other compliance measures established by the Transmission Provider in the Business Practices Manual for Large Load.

Technical Compendium Update – Performance Requirements During Voltage Disturbances

Voltage between 0.50 pu and 0.90 pu:

- The Large Loads should remain connected to the Transmission System within the ride-through envelope.
- Temporary reduction of active power may occur in proportion to the voltage reduction to support continued operation during the disturbance.
- Following recovery of system voltage above 0.90 pu, the Large Load shall restore at least 90% of its pre-disturbance active power within one second. Unless studies demonstrate that a slower recovery is necessary to maintain Bulk Electric System reliability, this shall be the default expectation. In electrically weak systems or where planning assessments identify potential adverse impacts, such as oscillatory behavior or voltage instability, MISO may require a reduced active power recovery rate or a longer recovery time. Active power recovery behavior shall be represented in the applicable dynamic models, including EMT models where required, used for interconnection and reliability assessments.

Technical Compendium Update – Performance Requirements During Voltage Disturbances

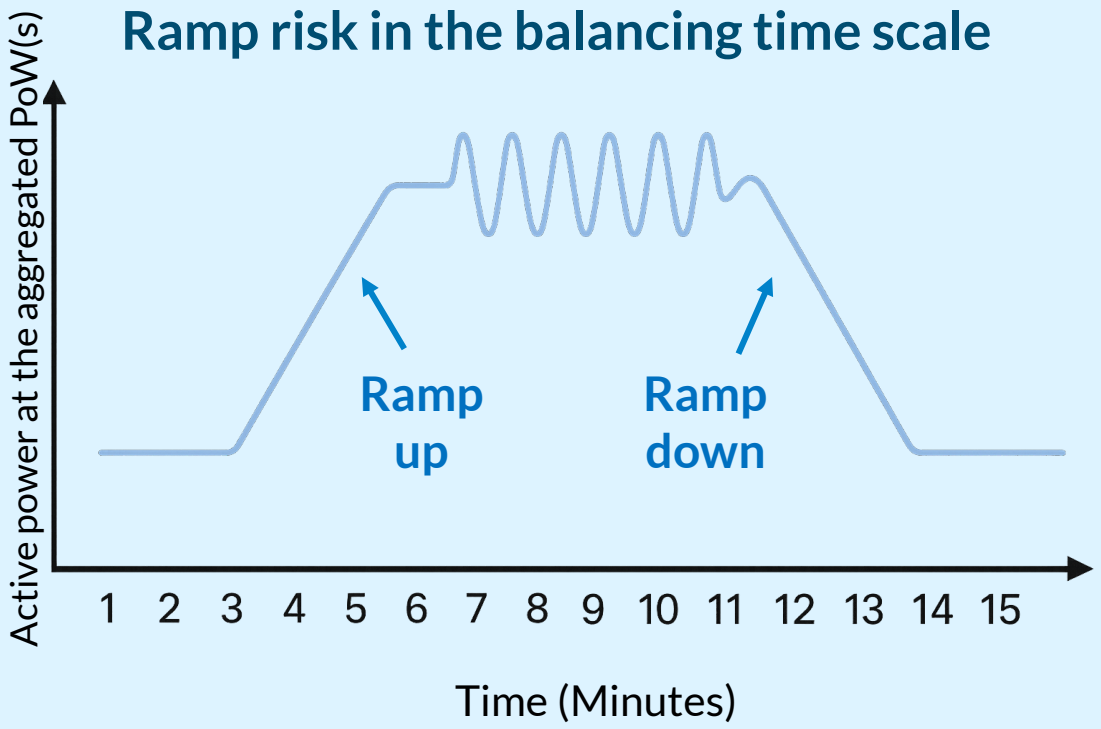
Voltage below 0.50 pu:

- The Large Loads should remain connected to the Transmission System within the ride-through envelope.
- Temporary reduction of active power may occur as necessary to maintain connection and support ride-through performance during the disturbance.
- Following recovery of system voltage above 0.90 pu, the Large Load shall restore at least 90% of its pre-disturbance active power within one second. Unless studies demonstrate that a slower recovery is necessary to maintain Bulk Electric System reliability, this shall be the default expectation. In electrically weak systems or where planning assessments identify potential adverse impacts, such as oscillatory behavior or voltage instability, MISO may require a reduced active power recovery rate or a longer recovery time. Active power recovery behavior shall be represented in the applicable dynamic models, including EMT models where required, used for interconnection and reliability assessments.

Ramp Requirements



Large Load Ramp Rate Requirements



Large loads may introduce additional variability in the Automatic Generation Control (AGC) time scale. This effect can increase the risk of inadequate system balancing at the minute-to-minute level.

Minor Change

~~Large Load comprised of any~~ Computational Load shall be subject to the ramp requirements set forth in this section. Ramp limits shall be measured in aggregate across the applicable Point(s) of Withdrawal of a Large Load during stable-state transition, including any reduction/ramp smoothing provided by generation or other resources that meets the eligibility requirements specified in the Business Practices Manual for Large Load. ~~Large~~ Computational Load shall be subject to up-ramp and down-ramp limits established by the Transmission Provider consistent with the process set forth in the Business Practices Manual for Large Load. The ~~Large~~ Computational Load must have an effective up and down ramp rate not exceeding the specified limit outlined in the Business Practices Manual for Large Load unless otherwise directed by the Balancing Authority, Reliability Coordinator, or Transmission Operator.

Stakeholder Feedback Request

- MISO appreciates informal comments on the **Large Load Interconnection Reliability Requirements Tariff updates** by Aug 3, 2026
  - Primary focus on the substantive design update show in slides 7,9 and 12
- Please email feedback to LargeLoadProgram@misoenergy.org

Next Steps



Provide Informal Comments on today's content

Due:
Aug 3, 2026



Final Tariff language review

LLWG Meeting:
Aug 12, 2026



File Tariff

Second Half of August

Send questions or comments to:

LargeLoadProgram@misoenergy.org