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Technical Panel Education: Technical Requirements for Large Computational Loads in Ontario's Power System

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Agenda

- Introduction and Background
- New Technical Requirements
- Market Rule/Manual Amendments
- Summary of Stakeholder Engagement and Next Steps

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Summary

- The proposed market rule amendments establish clear requirements ahead of significant growth in large computational loads and provide connection certainty enabling the reliable integration of emerging large-load technologies.
- Existing requirements do not fully address the potential for large computational loads to disconnect unexpectedly and unnecessarily during system disturbances, creating material reliability risks.
- The proposed market rule amendments and manuals will establish modelling, performance, monitoring, and commissioning expectations to enable the reliable integration of large computational load projects, aligning Ontario with upcoming North American Electric Reliability Corporation (NERC) reliability standards.

Introduction and Background

Large Computational Loads: What They Are and Why They Are Different

Very large facilities whose electricity demand is driven primarily by computing equipment used for cloud computing, artificial intelligence and cryptocurrency mining.

1 LARGE AND CONCENTRATED

A single facility or campus can require hundreds of megawatts, and multiple projects may cluster in the same electrical area.

2 FAST AND ELECTRONICALLY CONTROLLED

Can change demand very quickly or disconnect within milliseconds.

3 RAPID AND EVOLVING CONNECTIONS

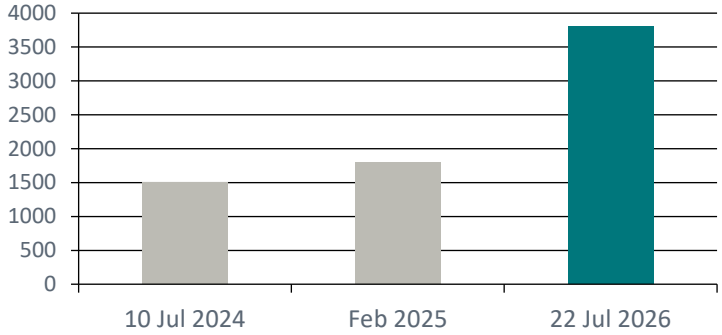
Projects often seek accelerated in-service dates, while equipment designs and operating profiles may continue to evolve.

WHY THIS MATTERS | The reliability concern is not simply the amount of electricity consumed. It is the scale, speed, concentration and common response of the load.

Recent PJM load-loss event

Selected reported PJM events

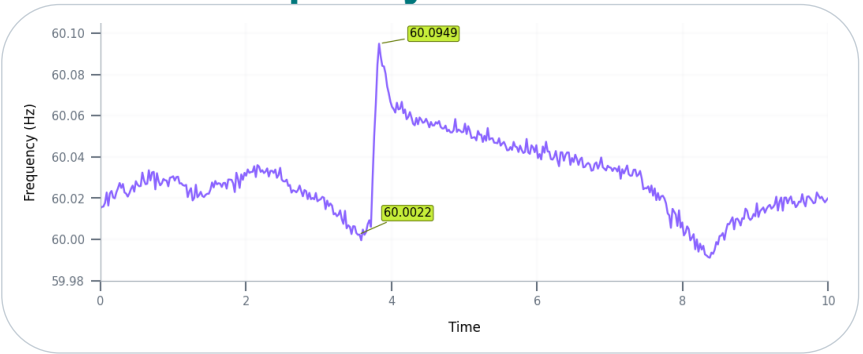
Approximate grid-demand reduction (MW)



Individual events, not annual totals or a complete event history.

Ontario response on 22 July 2026

≈0.093 Hz frequency rise at Richview



A sudden demand reduction raises frequency across the interconnected grid.

WHAT HAPPENED: ~4,000 MW of data-centre load dropped off in about a minute

1. A routine 230 kV line fault cleared normally within milliseconds.
2. ≈2,970 MW of data-centre load transferred to backup power.
3. The voltage response triggered a second wave of ≈1,100 MW.
4. Operators rebalanced in 9 min; load returned within about 30 min.

Large computational loads can turn a local disturbance into a broader interconnected reliability event.

NERC Reliability Landscape

- NERC has recognized the emerging reliability risks driven by large computational loads that are connecting to the Bulk-Power System (BPS) at an unprecedented speed and scale. These loads are reshaping the demand profile and exposing reliability gaps in both operational and planning time horizons.
- NERC initiated project 2026-02 Computational Loads Phase I to establish the foundational elements needed to reliably integrate large computational loads into the BPS.

Why New Requirements — and Why Now

Close a reliability gap

Today's Market Rules were built for conventional loads — not voltage-sensitive, fast-ramping computing loads

Act before they connect

~10,000 MW, 41 projects (≥50 MW) is in the pipeline. Setting rules up front is far cheaper than retrofitting later

Enable, don't block

Built with OEMs, developers & utilities so today's equipment can comply — clear rules and expectations facilitate reliable connections

Align with NERC

Ensure reliability by aligning with NERC's Level 3 actions and complement NERC's foundational standards

Align with Other Jurisdictions

ERCOT, Dominion Energy, ATC, SPP, NYISO, AESO, Energinet, Fingrid, etc. have developed comparable requirements.

Roadmap for Developing the Requirements



✓ Complete	✓ Complete	Q2–Q4 2026 • now	Dec 2026 – Jan 2027	Q2 2027
Benchmarked NERC, ESIG & peer utilities	Planning, operations & study teams	Posted May 1; sessions Jul 23 & Nov 19	Education, vote to post & recommend	Board Mar 2027, then implementation

IN COLLABORATION WITH

Industry working groups

NERC, ESIG

Utilities, OEMs, developers & applicants

ERCOT, Dominion Energy, AESO, NYISO, QTS, Electranix, Siemens

IESO internal teams

9 teams across planning, operations and markets

New Technical Requirements

New Requirements: Four Categories

Modelling & Data

WHY *We can't plan for what we can't model*

WHAT WE REQUIRE

- Detailed facility design & operating data (UPS, backup, ramp rates)
- Power System Simulator for Engineering (PSS/E) and Electromagnetic Transients (EMT) computer models

RISK MITIGATED

Inaccurate and incomplete assessment due to insufficient load modelling

Performance

WHY *Loads must not amplify grid disturbances*

WHAT WE REQUIRE

- Ride-through (i.e. remain connected) voltage & frequency disturbances
- ≤600 MW lost from any single failure
- Limits on ramping, fluctuation & oscillation

RISK MITIGATED

Mass load trips, voltage & frequency swings, equipment stress

Monitoring

WHY *Fast behaviour needs fast measurement*

WHAT WE REQUIRE

- Phasor measurement unit (PMU)
- Dynamic disturbance recorder
- Transmission-connected ≥20 MVA

RISK MITIGATED

Blind spots: fast swings go unseen and events can't be analyzed

Commissioning

WHY *Verify before full operation*

WHAT WE REQUIRE

- Prove ride-through with manufacturer or field tests
- Results must match the submitted models
- Registered during commissioning

RISK MITIGATED

Equipment that performs differently in as built than as designed

New Technical Requirements (1/2)

#	Requirement	High-Level Description	Purpose
1	Data Collection (Enhanced)	• Detailed facility design and operating philosophy • Much more information than conventional load	• Understand special load behavior
2	Connection Arrangement	• No internal single point failure results in a load loss above 600 MW • Automatic load transfer between different connection points is not allowed	• Address hyperscale characteristics
3	Voltage Ride-Through (Enhanced)	• Ride-through voltage disturbances • Define two sets of ride-through settings: transmission & distribution-connected facilities • Respect equipment limitations for UPS loads and small motor loads	Address the following: • Voltage sensitive behavior • Hyperscale characteristics
4	Frequency Ride-Through	• Ride-through frequency excursions • Allow UFLS provide controlled load tripping to restore system frequency	• Address hyperscale characteristics
5	Voltage Phase Angle Jump	• Ride-through phase angle jump initiated by no-fault switching events of less than or equal to 25 electrical degrees	• Address special behavior with electronic load

New Technical Requirements (2/2)

#	Requirement	High-Level Description	Purpose
6	Load Ramping	• Be capable of operating with ramp rates not exceeding 20 MW per minute during normal operation • Max 5 MW over any 15-second period	• Address fast ramping behavior
7	Periodic Oscillation and Damping	• Introduce no periodic power oscillation within the sub-synchronous frequency band exceeding the lesser of +/-2.5 MW or +/-0.25 % of the nominal power of the project • Introduce no net negative damping to system oscillations	• Address periodic oscillation behavior
8	Monitoring	• Phasor measurement unit and dynamic disturbance recorder are required for transmission connected projects equal/greater than 20 MVA	• Track fast ramping, oscillation, fluctuation • Capture transient load behavior
9	Modelling and Validation	• Submit a PSS/E phase-domain model and an EMT model • Demonstrate the project's performance meet the IESO requirements	• Model load behaviors • Performance validation

Market Rule/Manual Amendments

Market Rules and Manuals

- Rule amendments and market manual changes will be required to integrate large computational loads into our system while avoiding the potential adverse impacts on reliability that they may cause.
- The proposed rule and manual changes reflect comments on the Technical Requirements document (Version 3) received during the stakeholder engagement stage, plus required amendments to establish a commissioning process.
- The rules and manuals can be found on the stakeholder engagement page.

Market Rule Amendments

Rule	Description	Reason
Ch.4 s.7.2.1	The existing provision requires the installation of synchrophasor equipment for certain customers and facilities.	The amendment expands these requirements to explicitly include large computational loads.
Appendix 4.3	Appendix outlines the performance requirements for directly connected wholesale customers and distributors.	Amendments are proposed to introduce additional technical performance requirements specific to large computational loads.
Appendix 4.17	Appendix outlines the synchrophasor data requirements that wholesale customers must provide to the IESO.	A new section is proposed to establish specific synchrophasor data requirements for large computational loads.
Ch.7 s.2.2B	A new section is proposed to establish a commissioning process for large computational loads.	This amendment addresses a gap in the market rules which do not include a commissioning process for wholesale customers.
Ch. 11	Two new defined terms are proposed.	New terms are required to enable rules specific to large computational loads.

Market Manual Changes

Market Manual	Description
1.6: Performance Validation	New section 4 is added to provide more detailed description and clarify the technical requirements for large computational load facilities. Subsequent sections are renumbered accordingly. Additional figures are included in section 4, requiring renumbering of all subsequent figures and the corresponding cross references.
1.7: Synchrophasor Data Requirements	New section 5 is added to establish detailed requirements for large computational loads. Subsequent sections are re-numbered accordingly.
7.3: Outage Management	New section (5.2.5) is proposed that outlines commissioning process for large computational loads.

Summary of Stakeholder Engagement and Next Steps

Stakeholder Engagement

- Technical Requirements document was initially posted on May 1, 2026
  - it has subsequently been revised on July 15, 2026 and September 3, 2026
- One-on-one sessions were held between May 1, 2026 and July 23, 2026 to obtain feedback.
- Stakeholder engagement session was held on July 23, 2026
- The stakeholder engagement session, where the market rules and manuals were presented, was held on November 19, 2026 – written feedback is due on December 4, 2026.

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Stakeholder Feedback To Date

Feedback received to date has been appreciative of the need and supportive. Stakeholders have also requested additional clarity regarding:

- Commercial availability of technology capable of meeting the requirements
- The specifics of some technical requirements
- Timing of applicability of requirements

The IESO addressed feedback received to date and updated the technical requirements document accordingly. The revised document is available on the engagement website.

Next Steps

- December 1, 2026 – Technical Panel (TP) education
- December 4, 2026 - Stakeholder Engagement Feedback on draft Market Rules and Manuals due
- January 6, 2027 – TP vote to post
- February 2, 2027 – TP vote to recommend
- March 12, 2027 – IESO Board consideration/approval
- Q2 2027 – Effective date of amendments