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THE LARGE LOAD LANDSCAPE

An overview of emerging regulatory requirements. Tom Scaramellino (GridStrong, moderator) with Todd Hillman (MISO) and Erik Ela (ESIG).

SMA GRID INTEGRATION SUMMIT / BROOMFIELD, COLORADO / OCTOBER 15, 2026

NOTHING FAILED. EVERYTHING DID WHAT IT WAS SET TO DO.

EVENT	WHAT HAPPENED	WHY IT MATTERS
Jul 10, 2024, Northern Virginia	A 230 kV fault. About 1,500 MW of data center load dropped at 60 points across 25 substations.	NERC's review found none of it was disconnected by utility equipment. Customer-side protection and disturbance counters did it, per customer settings.
Jul 22, 2026, Northern Virginia	A 230 kV line failed at 7:56 am. PJM load fell from 99,984 to 96,205 MW, about 3,800 MW, in two waves.	Largest sudden load transfer in PJM history. The fault cleared correctly with no misoperations. Area control recovered in nine minutes.
ERCOT, 2023 to 2025	26 large electronic load ride-through events during normally cleared faults.	Each one was a facility protecting itself. ERCOT's own modeling showed 1,500 MW leaving on a single West Texas fault.

Sources: NERC Level 2 Alert incident review (2024); PJM Operating Committee, Aug 6, 2026; ERCOT NOGRR 282 justification, Feb 2026.

WHY THE IBR PLAYBOOK DOES NOT TRANSFER CLEANLY

WHAT THE GRID ASSUMED ABOUT LOAD

- Motors and heaters: slow, well understood, represented in aggregate by a composite load model for decades.
- Load follows voltage and frequency. It does not have controls with an opinion.
- One facility, one owner, one technology. Positive-sequence phasor tools were enough.

WHAT A 500 MW AI CAMPUS ACTUALLY IS

- A multi-vendor microgrid: UPS, rectifiers, batteries, STATCOMs, drive-driven cooling and backup generation, each with its own protection.
- Power-factor regulated rather than voltage regulated, with single-phase equipment and training cycles that swing tens of MW in seconds.
- Control dynamics above 5 Hz, beyond what phasor-domain tools can see. EMT is becoming routine for loads, as it did for IBRs.

Draws on NERC's Reliability Guideline Risk Mitigation for Emerging Large Loads and the LLWG white paper Characteristics and Risks of Emerging Large Loads.

TWO REGULATORY TRACKS ARE CONVERGING ON THE SAME FACILITY

RELIABILITY TRACK: HOW THE LOAD BEHAVES

- **NERC Level 3 Alert** (May 4, 2026): seven essential actions covering model data, studies, qualified change, commissioning, protection, fault recording and communications. Responses were due Aug 3.
- **NERC Project 2026-02**: CLO-001 (interconnection, studies, models), CLO-002 (operational data), CLO-003 (protection and disturbance monitoring). 50 MW at 100 kV. Initial ballot passed in September; FERC filing due Dec 31, 2026 under RD26-7.
- **Regional ride-through, ramp and PMU rules**: ERCOT in effect, MISO filed, PJM proposed.

MARKET TRACK: HOW THE LOAD IS SERVED

- **FERC show-cause orders** to all six RTOs and ISOs (June 18, 2026, EL26-67 to EL26-72): study process, cost transparency, co-location, flexible-load service, electrically proximate load.
- **RM26-4**, the DOE-directed large-load rulemaking, stays open. A nationwide rule reaching non-RTO regions is still possible.
- **Non-firm and conditional service** products: SPP CHILLS approved, MISO FLITS, CAISO FILI and FLIP, ISO-NE interim and non-firm contract demand service, PJM IRAS.

The same facility must satisfy both. Most developers are tracking one.

WHERE EACH REGION STANDS, OCTOBER 2026

REGION	RELIABILITY REQUIREMENTS	FLEXIBLE OR NON-FIRM SERVICE	NEXT DATE
ERCOT	NOGRR 282 ride-through in effect Aug 1 (75 MW, half electronic). PGRR 144 model quality. Draft 10 MW per 5 s variation cap.	SB 6 curtailment authority. Batch Zero: 326 projects, ~205 GW.	Variation NOGRR, fall
MISO	ER26-3650 filed Aug 28: data, models, PMU, ramp, ride-through at 50 MW.	FLITS non-firm service in design. Zero-injection GIA filed Aug 18.	Nov 16; Dec 4 effective
PJM	Ride-through proposed Sept 8 (50 MW at 100 kV). Ramp design in 2027.	IRAS: loads without new capacity cut first, from June 1, 2027.	FERC filing Nov 2026
SPP	HILL study process, approved Jan 14, 2026.	CHILLS approved June 5: up to seven years conditional.	Show-cause in abeyance
CAISO	50 MW definition, no voltage test.	FILI (interim), FLIP (permanent); straw proposal Aug 12.	Section 205 filing Nov 16
ISO-NE	50 MW above 60 kV. 90-day studies, EMT where needed.	Bring your own new capacity; firm, interim and non-firm service.	Section 205 filing Nov 16

NYISO is in abeyance with a firm and non-firm split under design. Compiled from public filings and stakeholder materials; several rows are proposals, not approved tariff.

RIDE-THROUGH RULES ARE CONVERGING ON THE IBR TEMPLATE

PARAMETER	ERCOT NOGRR 282 (IN EFFECT)	MISO ER26-3650 (FILED)	PJM PROPOSAL (SEPT 2026)
Applies to	Large loads of 75 MW or more, half or more power-electronic	Computational part of large loads of 50 MW or more	Large computational loads, 50 MW or more at 100 kV or more
Continuous range	0.90 to 1.10 pu and 58.8 to 61.2 Hz	0.90 to 1.10 pu, no power reduction; 58.8 to 61.2 Hz	0.90 to 1.10 pu and 58.8 to 61.2 Hz
Frequency bands	299 s at 57.0 to 58.8 and 61.2 to 61.8 Hz	Same bands; RoCoF to 5 Hz/s	299 s at 57.0 to 58.8 and 61.2 to 61.8 Hz
Deep voltage sag	0.25 s at 0.20 to 0.50 pu; 0.15 s below 0.20	Draft curve allows tripping below 0.25 pu	Reduce as needed below 0.50 pu; cooling may trip below 0.35
Recovery	90% of pre-disturbance within 2 s of V above 0.9 pu	Back to 90% within 1 s	Back to 90% within 2 s
Protection	No unfiltered instantaneous trips or counter schemes; overcurrent cap 125%	Consecutive events; 1.1 pu V/Hz for 45 s	No counter schemes; overcurrent cap 150%

Ramp limits follow the same pattern: ERCOT drafts 10 MW per 5 s, MISO sets up and down limits in its BPM, PJM designs its envelope in 2027. PRC-024 became PRC-029 for generators; these load curves have the same shape, and NERC's LLWG SAR carries a national envelope into Project 2026-02.

MISO: THE LOAD IS ARRIVING FASTER THAN THE PROCESS WAS BUILT FOR

- Peak demand of about **121 GW in 2025** is forecast at **163 GW by 2035**, up 35%, with data centers the main driver. 8 to 14 GW of data centers expected online in 2026 and 2027.
- A single AI training campus can request **200 MW to more than 1 GW** at one point of withdrawal, on 18 to 36 month timelines.
- There is **no MISO-administered load queue**: the transmission owner runs the connection, MISO assesses regional impact. ERAS and expedited project review are the speed levers so far.
- The **Zero Injection GIA** (filed Aug 18): 90-day review for generation serving load at the same substation, capped at that load. Google, Xcel and a utility coalition support it; environmental groups contest the cost-shift risk.
- MISO calls the forecast highly dependent on the AI industry finding profitability, and reports early signs of right-sizing.

MISO'S LARGE LOAD RELIABILITY REQUIREMENTS (ER26-3650)

WHAT WAS FILED ON AUG 28, 2026

- **Large Load**: new load of 50 MW or more at one substation, or a 25 MW increase reaching 50 MW. **Computational Load**: 1 MW or more of IT equipment, half or more of demand.
- Every large load: facility data, verified as-built models and load profiles, telemetry, forecasts, audit. Material modifications are studied before they are built.
- Computational loads add PMU streaming, voltage and frequency ride-through, and up and down ramp limits set through the business practices manual.
- The Tariff is binding through FERC; the Large Load BPM carries the how. Requested effective date Dec 4, 2026.

THE TRANSITION PROVISION

- Metered at 50 MW before Sept 1, 2026: exempt for life unless the load grows by 25 MW.
- Sept 1, 2026 to Nov 1, 2027: everything except ride-through and ramp.
- After Nov 1, 2027: full requirements, with time-limited exceptions on evidence plus interim operating protocols.
- OMS supports the package but argues that grandfathering MTEP-26 projects out of ramp and ride-through is a reliability risk.

FLITS: MISO'S NON-FIRM BRIDGE FOR LARGE LOADS

STUDY

The load completes MISO's study process and requests eventual firm service.

→

CONNECT EARLY

Takes non-firm service before every network upgrade is built. Firm and non-firm portions are metered separately.

→

CURTAIL

Reduced in transmission emergencies, under pre-set conditions and in supply shortages alongside firm load. MISO warns ahead where it can.

→

MARKET TERMS

No auction revenue rights and no demand response offers on the non-firm slice. It may register as a Load Modifying Resource.

→

CONVERT

Moves to firm service when upgrades complete. A permanent firm and non-firm split is under discussion.

Redlines were in stakeholder review through Oct 2. MISO's full show-cause answer is due Nov 16, 2026.

Flexible Large-load Interconnections and Transmission Service. Alliant's BITS proposal would cover the window between upgrade start and completion.

FLEXIBLE LOAD SERVICE: SIX REGIONS, SIX DESIGNS

REGION	PRODUCT	STATUS	WHAT THE LOAD GIVES UP
SPP	CHILLS: conditional service for High Impact Large Loads	FERC approved June 5, 2026	Curtailment in emergencies and constraints, up to seven years while firm service is built
ERCOT	SB 6 (June 2025): curtail or run backup on ERCOT direction during firm load shed	In law; PUCT rules pending	Mandatory curtailment for 75 MW loads with on-site backup
PJM	Interim Resource Adequacy Service	Filed Aug 13; exposure from June 1, 2027	Loads without new capacity are cut before pre-emergency load management
MISO	FLITS	Stakeholder design; answer due Nov 16	Curtailment in emergencies and shortages; no ARRs or DR on the non-firm slice
CAISO	FILI (interim) and FLIP (permanent)	Straw proposal Aug 12; filing Nov 16	A curtailable level until upgrades finish, or permanently in return for no upgrade funding
ISO-NE	Interim and non-firm contract demand service	NEPOOL design; filing Nov 16	Non-firm until upgrades and new capacity are in place, seven years or longer

ERCOT's curtailment is a statutory condition on large loads with backup generation. The other five are voluntary products a load elects into.

FLEXIBILITY AS A PRODUCT, NOT A CONCESSION

- **Duke's Nicholas Institute** (Feb 2025): the existing US grid could absorb about 76 GW of new load that curtails 0.25% of the time, and roughly 98 GW at 0.5%, under 44 hours a year.
- **Google** (Mar 2026): demand-response agreements with five utilities (Indiana Michigan Power, TVA, Entergy Arkansas, Minnesota Power, DTE), about 1 GW of curtailable data center load from shifting ML workloads.
- **ESIG's Large Loads Task Force** (May 2026): twenty recommendations on participation models for flexible and inflexible loads, short-term operational forecasts, and allocating grid-service costs to co-located configurations.
- **Still open**: non-firm pricing and ARR treatment, whether curtailable load counts toward resource adequacy, and how multi-GW sudden load loss is handled in balancing and reserve products.

ESIG's Markets and Operations project team followed RTO, ISO and FERC proceedings for twelve months before publishing.

THE NEXT EIGHT MONTHS

Q4 2026

Further Project 2026-02 ballots; ERCOT files its load-variation NOGRR.

Nov 2026

PJM files large computational load ride-through tariff language with FERC.

Nov 16, 2026

MISO, CAISO, ISO-NE and NYISO answer FERC's show-cause orders with Section 205 filings.

Dec 4, 2026

MISO's requested effective date for ER26-3650.

Dec 31, 2026

NERC files CLO-001, 002, 003 and the CLO/CLOP registry criteria with FERC after Board adoption.

Feb 28, 2027

PJM reliability backstop procurement takes effect, accepted Sept 29 and suspended five months.

Jun 1, 2027

PJM Interim Resource Adequacy Service exposure begins for loads without new capacity.

FERC's RM26-4 docket remains open. Whatever the region, the floor is the same: a validated model, ride-through to equipment capability, ramp limits, PMU visibility, a commissioning check, and a flexibility story.