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NERC Activities and Plans to Address Reliability Impacts from Large Load Integration

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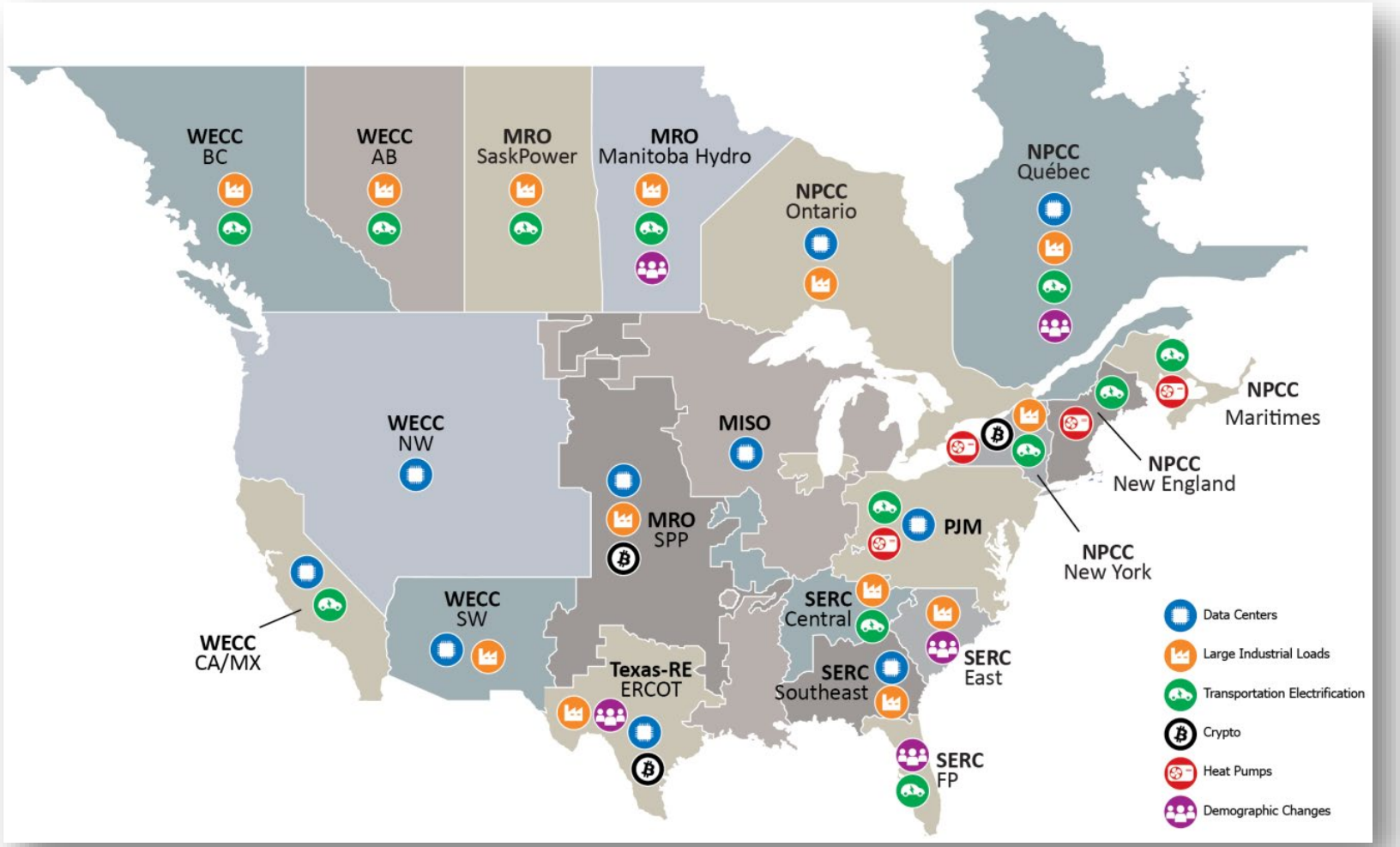
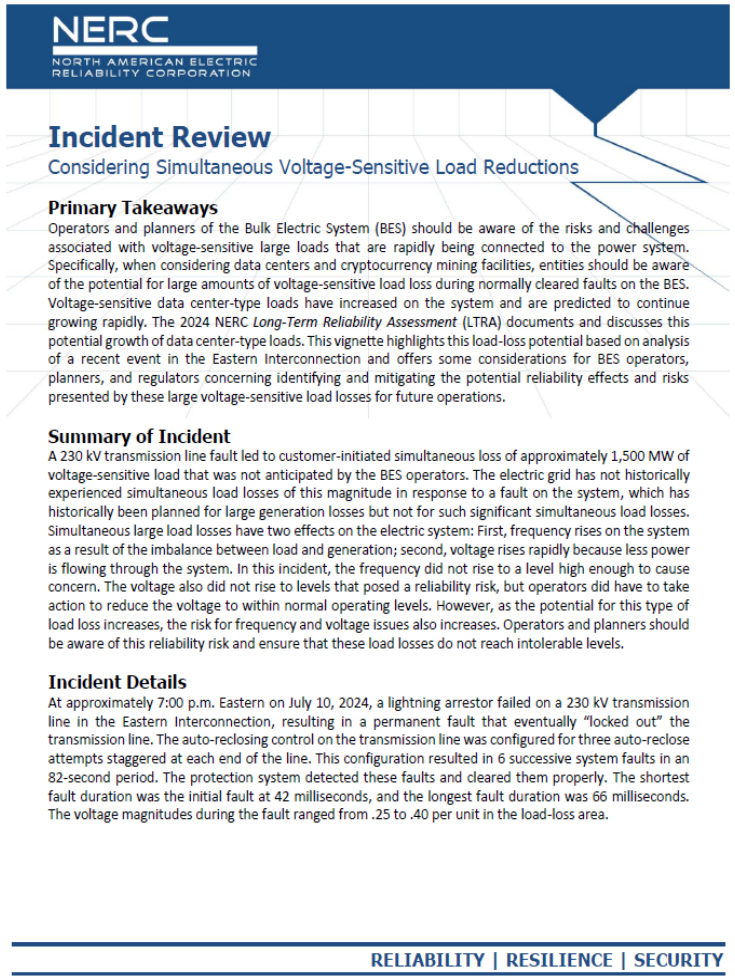
Primary Demand Drivers by Assessment Area



Voltage Sensitive Load Loss Events

- EI Data Center Load Loss Events
  - Impacts the state of Virginia
    - July 2024 – 1,500 MW Load Loss in Loudoun County
    - February 2025 – 1,800 MW Load Loss in Loudoun & Fairfax Counties
- ERCOT Crypto-Mining Load Loss
  - 25 Load Loss Events (Nov 2023 – Jan 2025)
  - 100MW – 400MW Load loss

Data Center Load Loss Event



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Incident Review

Considering Simultaneous Voltage-Sensitive Load Reductions

Primary Takeaways

Operators and planners of the Bulk Electric System (BES) should be aware of the risks and challenges associated with voltage-sensitive large loads that are rapidly being connected to the power system. Specifically, when considering data centers and cryptocurrency mining facilities, entities should be aware of the potential for large amounts of voltage-sensitive load loss during normally cleared faults on the BES. Voltage-sensitive data center-type loads have increased on the system and are predicted to continue growing rapidly. The 2024 NERC *Long-Term Reliability Assessment* (LTRA) documents and discusses this potential growth of data center-type loads. This vignette highlights this load-loss potential based on analysis of a recent event in the Eastern Interconnection and offers some considerations for BES operators, planners, and regulators concerning identifying and mitigating the potential reliability effects and risks presented by these large voltage-sensitive load losses for future operations.

Summary of Incident

A 230 kV transmission line fault led to customer-initiated simultaneous loss of approximately 1,500 MW of voltage-sensitive load that was not anticipated by the BES operators. The electric grid has not historically experienced simultaneous load losses of this magnitude in response to a fault on the system, which has historically been planned for large generation losses but not for such significant simultaneous load losses. Simultaneous large load losses have two effects on the electric system: First, frequency rises on the system as a result of the imbalance between load and generation; second, voltage rises rapidly because less power is flowing through the system. In this incident, the frequency did not rise to a level high enough to cause concern. The voltage also did not rise to levels that posed a reliability risk, but operators did have to take action to reduce the voltage to within normal operating levels. However, as the potential for this type of load loss increases, the risk for frequency and voltage issues also increases. Operators and planners should be aware of this reliability risk and ensure that these load losses do not reach intolerable levels.

Incident Details

At approximately 7:00 p.m. Eastern on July 10, 2024, a lightning arrestor failed on a 230 kV transmission line in the Eastern Interconnection, resulting in a permanent fault that eventually "locked out" the transmission line. The auto-reclosing control on the transmission line was configured for three auto-reclose attempts staggered at each end of the line. This configuration resulted in 6 successive system faults in an 82-second period. The protection system detected these faults and cleared them properly. The shortest fault duration was the initial fault at 42 milliseconds, and the longest fault duration was 66 milliseconds. The voltage magnitudes during the fault ranged from .25 to .40 per unit in the load-loss area.

RELIABILITY | RESILIENCE | SECURITY

Event:

- 1,500MW load loss, exclusively data center load
- Coincident with 230kV normal line fault clearing
- Widespread: 60 different load points, 25 substations

Conclusions:

- Require models for large loads to enable studies to determine risk to BES for coincident large load losses
- Determine if large loads should be a NERC Registered Entity
- Need for new or modifications to Standards

Large Load Task Force Framework to Address Reliability and Security Risks

Risk Identification
Validation
Prioritization

White Paper (Q2):
Characteristics and Risks of Emerging Large Loads

Gap Analysis

White Paper (Q3):
Assessment of Gaps in Existing Practices, Requirements, and Reliability Standards for Emerging Large Loads

Risk Mitigation

Reliability Guideline (Q1 2026):
Risk Mitigation for Emerging Large Loads

Standard Authorization Request(s):
Updates to Reliability Standards will likely be needed

Draft LLTF First White Paper: Prioritization of Risks

High	Medium	Low

• **Long-Term Planning**
  • Resource Adequacy
• **Operations/Balancing**
  • Balancing and Reserves
• **Stability**
  • Dynamic Modeling
  • Ride-through
  • Frequency Stability
  • Voltage Stability
  • Oscillations
• **Resilience**
  • Automatic UFLS Programs
	• **Long-Term Planning**
	  • Demand Forecasting
	  • Transmission Adequacy
	• **Operations/Balancing**
	  • Short-Term Demand Forecasting
	  • Lack of Real-Time Coordination
	• **Resilience**
	  • Load-Shed Obligation Impacts
		• **Power Quality**
		  • Harmonics
		  • Voltage Fluctuations
		• **Security Risks**
		  • Cyber Security
		• **Resilience**
		  • System Restoration

Draft LLTF First White Paper: Characteristics and Risks of Emerging Large Loads

Recommendations for Large Load Task Force (#1-#3)

- Standard Gap Identification
- Risk Mitigation
- Characteristic Definition & Categorization

Recommendations for Reliability Security Technical Committee (RSTC) Working Groups (#4-#6)

- Model Development and refinement for Large Loads
- Develop approaches to differentiate computation facilities
- Assess possible protection system impacts

Recommendation to Utilities (#7)

- Industry must collect data that to understand the unique risks associated with connecting a large load

NERC Draft Action Plan: Large Loads

Task Description	Target
Reliability Security Technical Committee's Large Load Task Force (LLTF)	Through Q2 – 2026
NERC-led Collaborative Industry Sessions	Through Q4 – 2025
Registration Analysis • *Legal basis for registration of large users of the bulk power system* • *Consider if Load Serving Entities (LSE) accountable for large load performance* • *Ability to write Reliability Standards Large Loads or LSEs would follow*	Through Q4 – 2025
Complementary Activities • *Load Modeling Working Group* • *Coordination with EPRI, ESIG, and large load industry groups* • *Industry Communications and outreach* • *Continued Incident Analysis and Lessons Learned*	Through Q4 – 2025

Questions and Answers