NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Large Loads Frequently Asked Questions

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An increasing number of large commercial and industrial loads are rapidly connecting to the bulk power system (BPS). Emerging large loads, such as data centers (including cryptocurrency and artificial intelligence), hydrogen fuel plants, and others, present unique challenges in forecasting and planning for increased demand.

To begin understanding large loads and identify effective pathways for their integration, NERC's Reliability and Security Technical Committee (RSTC) established a Large Loads Task Force (LLTF) in August 2024. A work plan was developed at the Board's request, and scheduled progress updates will occur.

What characteristics are typical for large loads?

Historically, large loads referred to industrial facilities with high electrical demand. They had long interconnection[1] timelines that allowed for more study time under traditional planning processes. Currently, emerging large loads include cryptocurrency mining, data centers (conventional and artificial intelligence), oil field loads, and hydrogen production facilities. Many have a shorter timeline to interconnect (months vs. years) to the grid. In addition to these rapid timelines, some emerging large loads introduce new challenges to grid operators like rapid demand fluctuations and increased voltage sensitivity.

What challenges exist with integrating emerging large loads onto the grid?

Integrating emerging large loads onto the grid poses several challenges including accurately forecasting future demand, ensuring that transmission and generation capacity keeps pace with this demand, and managing rapid fluctuations in consumption during all conditions – both fault and normal – which can destabilize the grid.

What Reliability Challenges do Large Loads Pose to the Bulk Power System?

NERC has observed several reliability challenges resulting from large loads around timing, data collection and forecasting, and modeling.

Timing

Some large loads seek to connect within one-to-two years, and the traditional planning processes are not equipped to ensure the grid can reliably serve this new demand. Additionally, the transmission upgrades required to handle the full new requested loads cannot be completed quickly enough. Since some loads want to connect to the bulk power system as soon as possible, they submit speculative interconnection requests to find the interconnection point with the fastest timeline, significantly increasing the number of interconnection studies utilities must perform. Due to the sheer number of interconnection requests, limited time is available to study the implications of these new loads.

[1] Interconnection refers to the process of integrating new generators, loads, or other equipment into the grid.

Data Collection and Forecasting

To better quantify the risk, the electrical characteristics of large load facilities, such as ramping capabilities, power electronic settings, internal protection schemes, and coordination across multiple facilities, must be better understood. A better understanding of standardizing large-load modeling for long-term forecasting is needed.

Modeling

Current dynamic load models have challenges accurately representing the behavior of emerging large loads such as data centers. Considering the immense growth of these loads, modeling their dynamic behavior has become more critical than ever. NERC's Load Modeling Working Group (LMWG) is working on modeling methodologies that can accurately simulate these emerging loads' electrical behavior. These models can be used in studies to assess risks posed by large loads.

Transmission Planning

Currently, transmission expansion projects can take a decade from planning to energization. There is a growing urgency for processes to address the shorter-term needs associated with this rapid load growth. Additionally, rapid integration of large loads may pose short and long-term resource adequacy concerns as generation can take years to be operational, longer than some large load interconnection timelines of months to years. A proactive, holistic approach is necessary for integrating large loads.

Voltage Ride-Through

Currently, there are no specific voltage ride-through Reliability Standards for large loads. Large loads, specifically data centers, frequently house a multitude of sensitive electronics that require ideal electrical conditions. If poor electrical conditions exist (like low voltage), large loads can disconnect from the grid to protect their equipment from damage.

Rapid Changes in Demand

Rapid and repeated changes in demand can lead to frequency and voltage concerns and even oscillations, which can threaten grid stability. Rapid changes in demand can occur for multiple reasons including sudden tripping, sudden load restoration, and controlled ramping up and down based on normal processes (electric arc furnaces, artificial intelligence training, artificial intelligence inference, etc.).

What is NERC Doing to Address Large Loads on the Grid?

NERC established the Large Loads Task Force (LLTF) to better understand the reliability impacts of emerging large loads and their effect on the bulk power system. The NERC Board of Trustees requested a work plan on large load activity to better understand the risks.

Available Resources

NERC's LLTF has several ongoing projects including a white papers on *Characteristics and Risks of Emerging Large Loads* and *Gaps in Existing Practices, Requirements, and Reliability Standards for Emerging Loads*. A reliability guideline on *Risk Mitigation for Emerging Large Loads* is also included in the LLTF Work Plan. Progress on these upcoming documents can be found on NERC's website. Additionally, the NERC LLTF hosts monthly meetings for industry experts to present the latest work on large load integration to the grid. NERC also recently published an Incident Review: Considering Simultaneous Voltage-Sensitive Load Reductions,

which examined the risks and challenges posed by the increasing integration of voltage-sensitive large loads.