RELIABILITY FIRST

February 28, 2025

Maryland General Assembly
Maryland Department of Legislative Services
90 State Circle
Annapolis, Maryland 21401

Re: RF Testimony on Technical Reliability Considerations Related to Resource Adequacy

Dear Members of the Senate Committee on Education, Energy, and the Environment and of the House Economic Matters Committee,

As a supplement to ReliabilityFirst Corporation's (RF) upcoming testimony on February 28, 2025, RF respectfully provides comments on technical reliability considerations related to resource adequacy.

RF is one of the six North American Electric Reliability Corporation[1] (NERC) Regional Entities responsible for preserving and enhancing the reliability, resilience, and security of the bulk power system (BPS, or "system").[2] Collectively, NERC and the Regional Entities comprise the ERO Enterprise. With specific authorities under the Federal Power Act and through a delegation agreement with NERC, RF's mission serves the public good by assuring BPS reliability for over 73 million customers in 13 states (including Maryland) and the District of Columbia.[2] We audit and enforce the NERC Reliability Standards for more than 300 registered entities. We also provide outreach and education to registered entities in our footprint, and technical expertise to state public utility commissions, legislators, and other stakeholders.

RF's role with the states is to serve as an independent, objective technical resource concerning reliability topics. While energy policy should appropriately prioritize BPS reliability, our statements are not intended, and should not be interpreted, as advocating for a specific policy outcome.

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[1] NERC is a not-for-profit international regulatory authority designated by the Federal Energy Regulatory Commission (FERC) to assure the effective and efficient reduction of risks to the reliability and security of the grid. Through delegation agreements and with oversight from FERC, NERC works with six Regional Entities (including RF) on compliance monitoring and enforcement activities.
[2] RF does not have jurisdiction over the local distribution of electricity, which is a state responsibility.

Resource Adequacy Reliability Considerations

Resource adequacy refers to matching supply with demand to ensure that the grid has adequate resources to supply loads 24 hours per day, 365 days per year, during all operating conditions. NERC annually assesses and reports on the adequacy of the Bulk Electric System in the United States and Canada over a 10-year period. This report, the Long-Term Reliability Assessment (LTRA),[3] projects electricity supply and demand and discusses key issues and trends that could affect reliability.

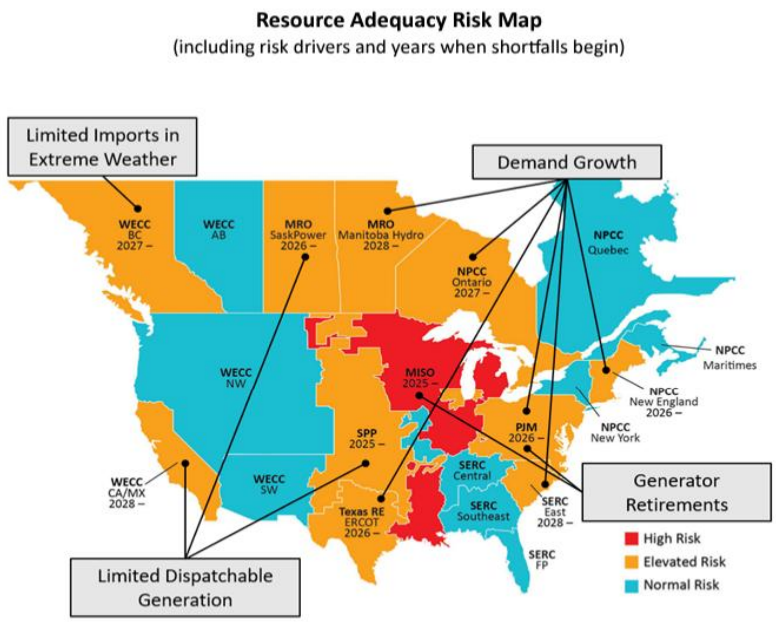

Figure 1: The 2024 LTRA risk map by region

Over a ten-year horizon, the 2024 LTRA finds that many areas of North America are at risk of energy shortfalls during extreme weather conditions (designated as “elevated risk” in Figure 1) and even during normal peak conditions (designated as “high risk” in Figure 1). Reliability concerns discussed in the 2024 LTRA include demand growth,[4] generator retirements (with over 79 GW of fossil-fired and nuclear generator retirements planned through 2034),[5] capacity shortage from limited dispatchable generation, and the impact of extreme weather events exacerbated by reliance on natural gas supply. From the 2023 to the 2024 LTRA, the PJM region was raised from normal to elevated risk (with the primary concern identified as demand growth, as seen in Figure 1).[6] The combined factors of generation retirements, rapid demand growth, and slower-than-anticipated online new generation have elevated reliability risks across the country.

[3] See, 2024 LTRA, 2024 LTRA infographic.
[4] 2024 LTRA at p. 8.
[5] 2024 LTRA at p. 27. These risks may be escalated during the winter peak in the PJM region due to weather-dependent resources and fuel supply issues.
[6] 2024 LTRA at p. 7.

Demand Growth

There has been a rapid increase in demand, due to the recent rise in data centers, electric vehicles, and the overall electrification of society. For example, in 2024 PJM forecasted an average 2.3% net energy load growth per year over the next 10-year period,[7] and in 2025 forecasted 4.8% growth (over double the previous year's estimate).[8] In the 2024 LTRA, NERC states that "electricity peak demand and energy growth forecasts over the 10-year assessment period continue to climb; demand growth is now higher than at any point in the past two decades."[9] This growth in demand can be difficult to match with new generation and transmission, even with the revitalization of previously retired generation being brought back online to power data centers. Large loads such as data centers can also present planning and operational concerns. NERC is currently working on a white paper on the characteristics and risks of emerging large loads, which will be released this year.

Generator Retirements and Capacity Shortage

In addition to the sharp increase in demand, there is also an increase in generation retirements. We are observing that across the country, traditional baseload generation plants are retiring, and replacement energy is largely being supplied by inverter-based resources (mostly wind and solar) that do not yet have the same operating features essential for reliability (such as ramping, voltage support, and blackstart capability, commonly referred to as Essential Reliability Services). In addition, due to the lower effective load carrying capability (ELCC) values of inverter-based resources,[10] replacing baseload generation with inverter-based resources requires more overall capacity to ensure grid reliability.[11] Generation retirements without sufficient replacements can reduce reserve margins (*i.e.*, available, dispatchable energy that can be quickly brought online to satisfy demand).[12] This can jeopardize reliability during periods of increased demand on the system, and in some cases, retirements can require extensive transmission reinforcement projects to sustain reliability.

The interconnection queue includes substantial sources of new generation, and integrating new resources onto the system expeditiously can help alleviate capacity shortages, provided the integration is done in a manner that ensures reliability. This includes conducting appropriate energy adequacy planning and modeling throughout all seasons.[13] This planning and modeling evaluates the impact of new generation projects coming online from the interconnection queue on overall grid reliability and resource adequacy, considering factors like variable generation from renewables and load forecasting. Additionally, a diverse fleet of generation sources that

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[7] https://www.pjm.com/-/media/library/reports-notices/load-forecast/2024-load-report.ashx at p.2.
[8] https://www.pjm.com/-/media/DotCom/library/reports-notices/load-forecast/2025-load-report.pdf at p.6.
[9] 2024 LTRA at p. 8.
[10] https://www.pjm.com/planning/resource-adequacy-planning/effective-load-carrying-capability
[11] https://www.rfirst.org/wp-content/uploads/2023/07/Base-Load-Generation-vs-Solar-Plus-Battery.pptx
[12] For example, PJM's "Energy Transition in PJM: Resource Retirements, Replacements & Risks" report focusing on generation retirements and replacements through 2030, states that "For the first time in recent history, PJM could face decreasing reserve margins…should these trends – high load growth, increasing rates of generator retirements, and slower entry of new resources – continue" (p. 17).
[13] See NERC and the National Academy of Engineering's Evolving Planning Criteria for a Sustainable Power Grid for additional information on this planning and modeling approach.

does not depend on a singular fuel source, supply chain, or common failure mechanism can enhance reliability.

Increased usage of weather dependent inverter-based resources can aid in expanding the diversity of the generation fleet; however, it is important to be aware of the capabilities and limitations of these energy systems, such as their intermittent nature. Battery energy storage systems (BESS) or other storage (e.g., pumped hydro) can help with the intermittent nature of a growing inverter-based generation fleet.[14] Currently the PJM interconnection queue has about 122,000 MW of solar and 50,000 MW of battery storage (the two predominant resources in the queue). While solar and battery storage generally work well in tandem, it is important to study these installations as they relate to resource adequacy, including the impact of charging the batteries.

Extreme Weather & Energy Droughts

Decreased reserve margins can create additional risk during extreme weather events, when power is needed the most. Winter Storm Elliott, where generation outages resulted in demand exceeding supply, was the fifth major storm with reliability impacts in the last eleven years. There were unprecedented electric generation outages coinciding with winter peak electricity demands, resulting in about 5,000 MW of load shed as rolling blackouts. FERC, NERC, and the Regions recently released a Joint Inquiry Report on Winter Storm Elliott with numerous lessons learned and recommendations (which led to the creation of revised cold weather reliability standards and numerous other actions by FERC, NERC, and the industry).[15]

Another reliability risk associated with extreme weather is overdependence on a limited range of energy sources. This can be seen during extreme winter weather when natural gas is a key component of the resource mix. A significant percentage of natural-gas fired power plants rely on as-available, non-firm gas supply alongside solid transportation arrangements. However, this supply can be interrupted during extreme cold weather events when demand by both generators and natural gas distribution companies is high. The 2024 LTRA finds that natural gas fired power plants generated over 40% of electrical energy consumed by end use electricity customers over the last two years, with an additional 6,500 MW of new generation expected over the next five years.[16] Given the expanding role of this fuel source, it is important to continue to address natural gas supply risks.

Intermittent resources can also pose concerns during extreme weather conditions, and when two or more resource types simultaneously experience below-normal resource output from weather

[14] In an example that RF uses, a 100 MW baseload generator that would run through an entire day would produce 2400 MWh of power. To achieve that same amount of energy, three 100 MW solar panels plus four four-hour BESS would be needed to produce the same 2400 MWh assuming 8 hours of perfect sunshine, no losses in conversion, and utilizing the battery storage during times of no solar.

[15] See https://www.ferc.gov/media/winter-storm-elliott-report-inquiry-bulk-power-system-operations-during-december-2022. FERC also released a summary of actions taken in response to the Winter Storm Elliott Joint Inquiry Report: https://www.ferc.gov/ReliabilitySpotlight#:~:text=FERC%20and%20the%20North%20American,FERC%2DNERC%20winter%20storm%20analyses.

[16] 2024 LTRA at p. 28-29.

conditions, meeting demand can be difficult.[17] These times, called “energy droughts” as seen in Figure 2 below, are more likely to occur during high-demand periods and highlight a need for robust resource adequacy planning.

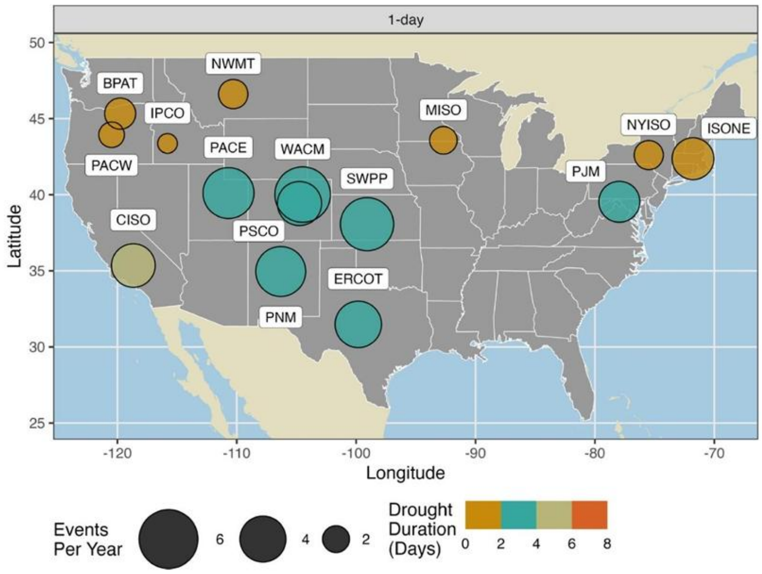

Figure 2: Daily energy droughts from the 2024 LTRA (Source: Pacific Northwest National Laboratory)

ERO Enterprise Efforts

Given the rapidly changing resource mix and its associated reliability risks, FERC and the ERO Enterprise are working to help mitigate these emerging concerns. The ERO Enterprise and industry are working to create new and revised standards to enhance reliability, such as Project 2022-03: Energy Assurance with Energy-Constrained Resources (revising several standards to require energy reliability assessments to evaluate energy assurance and Corrective Action Plans to address identified risks), and Project 2023-07: Transmission System Planning Performance Requirements for Extreme Weather. There are also several ERO Enterprise working groups working on these risks, such as the Reliability Issues Steering Committee (RISC) and the newly created Large Loads Task Force (LLTF).

NERC and the Regions partnered to perform the Interregional Transfer Capability Study (ITCS),[18] which analyzed total transfer capability (the amount of power that can be transferred between transmission planning regions to improve energy adequacy). It recommends prudent additions to total transfer capability that could strengthen reliability. The complete ITCS was filed with FERC and recently was posted for a public comment period.[19]

[17] As a recent example, the SPP footprint had to declare Conservative Operations throughout multiple days in October based on forecasts of high peak loads due to unseasonably warm temperatures combined with low expected output from wind and other intermittent resources.
[18] See Interregional Transfer Capability Study Final Report at https://www.nerc.com/pa/RAPA/Documents/ITCS_Final_Report.pdf.
[19] https://www.ferc.gov/sites/default/files/2024-11/20241125-3020_AD25-4-000-NERC%20ITCS%20Notice.pdf.

To successfully address the complex reliability challenges emerging as the grid is transformed, NERC, the Regional Entities, and state and federal policymakers will need continued collaboration, coordination, and thoughtful action. Robust resource adequacy planning that acknowledges the benefits of a diverse resource mix and the threat of extreme weather will also help fortify the grid and electricity consumers. As states craft policies for a cleaner, more sustainable grid, we are pleased to serve as a resource to help you remain well informed regarding key reliability topics.