Grid Reliability and the Response to Winter Storm Elliott

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Good morning. Thank you for the opportunity to address the reliability challenges that we face here in my home state of Pennsylvania and across the country. My name is Diane Holder and I have worked in the electric utility industry for about 29 years. I am an electrical engineer and have had roles in engineering, operations, and external affairs. My role as a senior executive at ReliabilityFirst Corporation (RF) includes oversight of our corporate services functions and our external engagement activities.

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).[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 and supports health and safety by assuring BPS reliability for over 73 million customers in our 13 states and the District of Columbia.[3] We are responsible for auditing and enforcing the NERC Reliability Standards for more than 270 registered entities in our footprint, which include Regional Transmission Organizations (specifically PJM and MISO), utility companies, and generators. We also provide outreach, training, and education to registered entities in our footprint, and technical expertise to state public utility commissions, legislators, and other stakeholders.

The ERO Enterprise is committed to work with states and all policy makers throughout this energy transition and beyond. RF is an independent, objective resource and we are available to answer your questions on resource adequacy, essential reliability services, winterization, inverters, or other related grid reliability and security topics. Our staff is comprised of employees with past industry experience such as power system engineers, control area operators, and forensic cyber experts, as well as data analysts, auditors, attorneys, and others. We participate

[1] The North American Electric Reliability Corporation (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. Collectively, NERC and the Regional Entities comprise the ERO Enterprise. The ERO Enterprise jurisdiction includes users, owners, and operators of the BPS, which serves nearly 400 million people in the continental United States, Canada, and Mexico.

[2] See the appendix for a map depicting the footprints of NERC and the Regional Entities.

[3] RF does not have jurisdiction over the local distribution of electricity, which is a state responsibility.

with FERC and NERC on inquiries, task forces, and working groups, and have a unique perspective working on these complex challenges.

To that end, RF's role in today's discussion is to serve as a technical resource concerning the reliability risks associated with the rapidly changing generation resource mix and extreme weather, and describe actions taken by RF and the ERO Enterprise to help mitigate these risks. 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.

NERC reliability assessments are well-known resources for policymakers, regulators, and industry stakeholders.[4] They evaluate various factors, including the reliability impacts of the retirement of conventional generation, such as coal and nuclear, and the addition of new, inverter-based resources. They also consider severe weather scenarios, incorporating generation outages under peak load conditions.[5] Regional Entities like RF also conduct reliability assessments specific to their regions.

By identifying and quantifying emerging reliability and security issues, the ERO Enterprise provides risk-informed recommendations and supports a learning environment for the electric sector to pursue improved reliability performance. The assessments' recommendations, along with the associated technical analysis, provide the basis for enhancements to resource and transmission planning methods, planning and operating guidelines, and the NERC reliability standards. In short, these independent ERO assessments provide critical insights for assuring the reliability and security of a rapidly changing electricity sector.

From our standpoint, the key pillars of a successful grid transition require an optimal balance of environmental/sustainability factors, cost, and reliability. Reliability is RF's area of expertise. There are three reliability topics that broadly apply across our region regarding the changing resource mix: the pace and complexity of change, resource adequacy, and essential reliability services. These are not the only reliability considerations, but they drive many conversations with states.

I will start with the pace and complexity of change. To be clear, grid transformation can be achieved in a reliable way with appropriate tools to understand and plan for the impacts of the transforming BPS. Managing the pace of change is the central challenge for reliability. The rapidly changing generation resource mix is driving BPS transformation. Traditional baseload generation plants are retiring, and replacement energy is largely supplied by significant amounts of new natural gas and variable generation resources (mostly wind and solar) that do not yet have the same operating features essential for reliability, commonly referred to as Essential Reliability Services (ERS). Until energy storage is fully developed and available at scale, sufficient amounts of flexible, dispatchable generation will be needed as a balancing resource for grid reliability. Transmission is also critical for reliability. New inter-regional transmission can provide operating flexibility to import power where it is needed most during potential energy shortages. In addition, new transmission is critical to supporting state clean energy goals, where is it necessary to import renewable energy from remote sources to load centers.

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[4] See NERC's reliability assessments here.

[5] Areas of the United States at risk of extreme weather impacts are identified in NERC's Winter and Summer Reliability Assessments. See NERC's 2022/2023 Winter Assessment, and NERC's 2022 Summer Assessment..

Natural gas dependency also presents reliability challenges, as a greater reliance on natural gas-fired generation elevates the risk from weather-induced natural gas fuel supply disruptions. Given the new portfolio of generation resources, the BPS has grown more sensitive to the effects of extreme weather. As the grid continues to undergo rapid transformation, managing the pace of change is a central challenge for reliability. RF and the ERO Enterprise are taking specific actions to identify, assess, and mitigate these risks. We are also making it a priority to serve as a resource for the states on these issues, in forums such as this hearing.

Resource adequacy is the next key area I'd like to discuss. Resource adequacy refers to matching supply with demand to ensure that the grid has adequate resources to supply loads twenty-four hours per day, seven days per week, three-hundred sixty-five days per year, during all operating conditions. Over a ten-year horizon, NERC's 2022 Long-Term Reliability Assessment finds that numerous areas of North America are at risk of energy shortfalls during extreme weather conditions and even during normal peak conditions:[6]

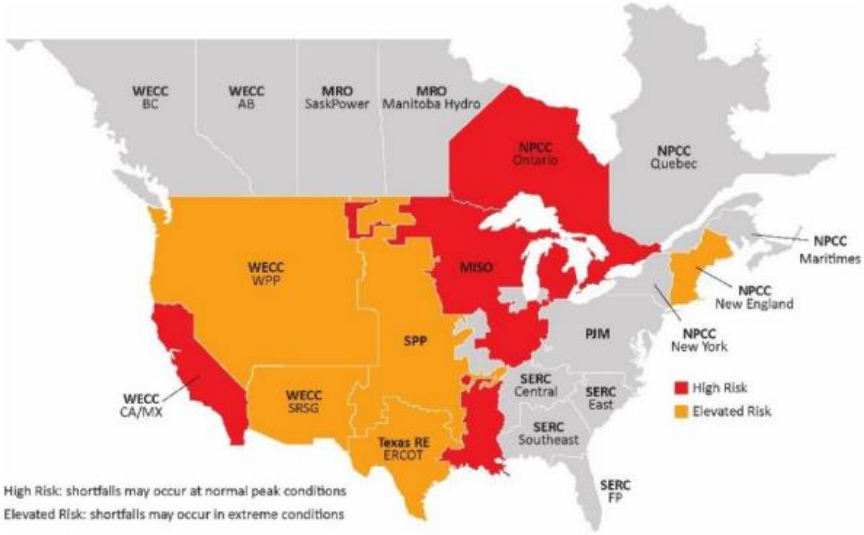

Figure 1: Risk Area Summary 2023–2027

This risk is driven by generation retirements that reduce reserve margins (commonly understood as available, dispatchable energy that can be quickly brought online to satisfy demand). With the increasing generator retirements over the past ten years, the traditional reserve margins are shrinking, which presents a reliability risk. Economic factors play a role in this, and that is an important conversation for those who own and operate the market. At the same time, our role as a reliability expert is to provide information on the potential risk that reserve margins could be depleted more quickly than existing tools, processes, and operators can recover, and to highlight resource adequacy issues we identify through assessments.

Traditionally, resource adequacy meant asking, "How much supply do I need to ensure I have enough megawatts to serve my peak demand for the year?" The industry was able to do that because of the flexibility that conventional resources offer, including having fuel on site and the

[6] See NERC 2022 LTRA, p. 6.

ability to quickly ramp up or down in response to changes in demand. However, as the generation resource mix evolves to include more intermittent resources, the questions become more complex, such as:

- How much load is in my forecast at 3PM and will the wind be blowing then?
- What hours will the sun be shining tomorrow, and in what areas?
- During periods of low output from variable resources, is there sufficient available energy from other generation resources or import capability from another area to meet demand?

The changing resource mix is necessitating a shift in the electric industry from a demand forecasting model to a supply forecasting model. Wind and solar resource availability depends on the wind and sun, requiring the study of weather patterns and a new, more probabilistic, approach to planning and forecasting. This new forecasting approach will require the development of new tools, methods, and skillsets.

There are also emerging complexities on the demand side to consider, such as electrification in transportation and other sectors, and the proliferation of Distributed Energy Resources (DERs). A surge in projected electricity demand, coupled with increased reliance on variable resources and natural gas, means that balancing and forecasting is becoming more complex, and keeping that balance between supply and demand is essential to reliability.

Finally, I'll discuss the importance of Essential Reliability Services (ERS). ERS refers to the combination of services that provide sufficient voltage, frequency support, and ramping capability necessary to keep the electric grid in balance and stable. Reliably operating the grid requires voltage and frequency to be maintained within tight limits.[7]

The term conventional resources refers to synchronous generation, the spinning metal and turbines that keep the grid operating at a frequency of 60 Hz. Traditionally, the resilience of the power grid has been its ability to withstand faults and system outages due to the number and magnitude of spinning generators on the system consisting of nuclear, coal, natural gas, and oil turbines. The turbines on these resources can respond and react quickly to system disturbances to prevent cascading, voltage instability, or uncontrolled loss of load. In this way, conventional resources, by their nature, can be dispatched quickly in response to changes in demand, and in doing so, they help ensure reliable operations.

That functionality (the ability to be dispatched quickly in response to changes in supply and demand), is the essence of Essential Reliability Services, but it does not naturally exist for renewable resources. Work is being done to develop technologies for renewables to help simulate some of that functionality, such as smart inverters and battery storage. However, a full solution will require a combination of strategies and sufficient time to commercialize technologies at scale.

Before leaving the topic of Essential Reliability Services, I wanted to briefly discuss Blackstart Resources. Blackstart Resources are essential to bringing the grid back to normal operations should a blackout occur, and their distinguishing characteristic is that they can be started without being connected to the grid. While not all conventional resources have blackstart capability,

[7] See NERC's resource on Essential Reliability Services, p. 7

Blackstart Resources are typically conventional. As more conventional resources are retired, fewer Blackstart Resources are available. With fewer of these resources available, we are concerned that this may extend system restoration time.

Actions that can help address the risks I have discussed include:

- Developing new tools, methods, and skillsets as we transition to more probabilistic forecasting,
- Constructing new transmission to connect the new, more widely dispersed, resources,
- Developing technologies that can simulate Essential Reliability Services for renewable resources, and
- Increasing cold weather preparedness activities and requirements.

There is a lot of work that has already started in these areas. The ERO Enterprise is publishing lessons learned from events that involved the loss of renewable generation. We are writing reliability guidelines and developing new Reliability Standards to address risks, including the risks of extreme weather. In fact, FERC approved two new winterization reliability standards last week.

The NERC Alert system is an important tool to gain awareness of generator winter preparedness and encourage industry action before the extreme weather standards become effective and enforceable. Among the three types of NERC Alerts, a Level II NERC Alert requires generator owners to answer a series of questions around specific reliability risks, with recommended mitigations. Prior the 2022-2023 winter season, NERC issued a Level II Alert to entities concerning their winter preparedness. The responses to this Alert helped the ERO Enterprise understand winter preparation status, communicate with generators, and incorporate plant preparation status into NERC's annual winter assessment.

RF's webinars, outreach, and our cold weather knowledge center are available on the RF website. Additionally, RF conducts winterization visits, conducts inquiries and event analyses, and makes resilience tools (self-assessments) available to our entities. For example, prior to Winter Storm Elliott, and post Winter Storm Uri, RF collected information on entity training, winter preparedness plans, and fuel supply. We completed several winterization site visits, held a cold weather readiness webinar, and organized a quarterly meeting to share best practices, lessons learned and updates. We also discussed cold weather topics with our Transmission and Generator Committees and included cold weather topics in our quarterly newsletter.

Immediately following Winter Storm Elliott, FERC, NERC, and the six Regional Entities initiated a Joint Inquiry to understand impacts to the BPS, and develop lessons learned and associated mitigations. This thorough, independent analysis will examine cold weather preparedness, load forecasting, generation performance, natural gas availability, grid constraints, and emergency conditions and actions. The expected outcome is that the inquiry will characterize the performance of the BPS during the event, confirm the appropriateness of the recommendations from the 2018 and 2021 inquiry reports, and where appropriate, recommend additional solutions for addressing newly identified issues. The final report is expected later this year.

As we engage with all those involved in creating this new, sustainable grid, there will be more opportunities for us to provide outreach, training, and education about how to best mitigate these

risks. During the transition, it is essential that state energy policies provide sufficient time and flexibility to align energy goals with the reliability needs of the BPS. It is important to recognize that electricity respects only the laws of physics and cares little for geographic or political boundaries and our electric system is highly interconnected. Actions taken by any one state can have resounding and immediate impacts on neighboring states.

Reliable electricity is the backbone of economic, societal, and individual well-being. To learn more about our important role in assuring reliability, we encourage you to attend our live, virtual State Energy Policy Webinar scheduled for March 13, 2023 where we will dive into these topics and more. If there is one message I want to leave with you today, it is this:

To successfully address the complex reliability challenges emerging as the grid is transformed, NERC, the Regional Entities, and state and federal policymaker will need continued collaboration, coordination, and thoughtful action. Managing the pace of change is a central challenge for reliability. 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.

APPENDIX

Footprints of NERC and the Regional Entities