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Pennsylvania State Senate
Joint Public Hearing with the Ohio Public Utilities Committee

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Good morning, Chairman Yaw, members of the Pennsylvania Senate Environmental Resources and Energy Committee, and invited guests of the Ohio General Assembly. Thank you for the opportunity to participate in this discussion on the reliability challenges that we face as we transition to our green grid of the future. ReliabilityFirst (RF) provided testimony[1] in February to the Pennsylvania State Senate following Winter Storm Elliot, and I am privileged to continue the conversation, especially right here in my hometown of Pittsburgh. My name is Diane Holder, and I am the Vice President of Entity Engagement and Corporate Services at RF. My role includes oversight over our state outreach activities. I am an electrical engineer and have worked in the electric utility industry for approximately 29 years with roles in engineering, operations, and external affairs.

RF is one of the six North American Electric Reliability Corporation[2] (NERC) Regional Entities responsible for preserving and enhancing the reliability, resilience, and security of the bulk power system (BPS).[3] Collectively, NERC and the Regional Entities comprise the ERO (Electric Reliability Organization) 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.[4] 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 (RTOs), specifically PJM and MISO, utility companies, and generators. We also provide outreach, training, and education to those registered entities, and technical expertise to state public utility commissions, legislators, and other stakeholders.

The ERO Enterprise is committed to working with states and policy makers as an objective, expert resource on reliability topics such as resource adequacy, essential reliability services, winterization, inverter-based resources (IBRs), blackstart resources, and physical and cyber

[1] https://consumer.pasenategop.com/wp-content/uploads/sites/129/2023/02/PA-Senate-Committee-Hearing-Written-Testimony-02272023-ReliabilityFirst.pdf

[2] 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.

[3] See Appendix A for a map depicting the footprints of NERC and the Regional Entities.

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

security. Our staff is comprised of employees with past experience such as power system engineers, control area operators, and forensic cyber experts, as well as data analysts, auditors, attorneys, and others. We participate with FERC (Federal Energy Regulatory Commission) 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 describe actions taken by RF and the ERO Enterprise to help mitigate these risks. While energy policy should appropriately consider and prioritize BPS reliability, our statements are not intended, and should not be interpreted, as advocating for a specific policy outcome.

My previous testimony focused on describing the NERC reliability assessments[5] and their value as a resource for policymakers, regulators, and industry stakeholders. These assessments evaluate several factors, including the reliability impacts of the retirement of conventional generation such as coal and nuclear, and the addition of new (IBRs) such as wind and solar. They also consider severe weather scenarios, incorporating generation outages under peak load conditions.[6] The latest Long-Term Reliability Assessment (LTRA) and Winter Assessment will be published later this year. Regional Entities like RF also conduct reliability assessments specific to their regions.

These assessments provide critical insights for ensuring the reliability and security of a rapidly changing grid. Section 215 of the Federal Power Act requires that the ERO conduct these periodic assessments, but it also states that the ERO does not have the authority to set or enforce mandatory standards for resource adequacy, or to require the construction of generation or transmission assets. Communication, coordination, and collaboration among policy makers, state stake holders, and industry is key to ensure a reliable grid transformation.

The transformation of the grid presents an "energy trilemma," that is, the need to ensure reliability while also balancing cost and environmental factors. Electricity is vital to modern life: to ensure the health and well-being of citizens, and to maintain the economy and national security. As such, electric reliability is of critical importance, and it is RF's area of expertise. Cost also plays a key role, as unaffordable electricity can hinder economic opportunities and disproportionally affects the most vulnerable among us. Finally, grid transformation solutions must be environmentally sustainable.

In my last testimony, I discussed our core concerns around transitioning the grid reliably and these included ensuring resource adequacy, ensuring the changing resource mix continues to provide the essential reliability services, and managing the pace of change of the electric system. I noted that grid retirements are outpacing new generation being brought online and new resources in the interconnection queue have much different reliability characteristics than the generating units that are being retired. I also discussed how this transformation is happening at a rapid pace, with many state renewable portfolio standards setting aggressive decarbonization goals for 2030 and beyond.

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[5] See NERC's reliability assessments here.

[6] 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 2023 Summer Assessment..

My testimony today will focus on the five risk profiles associated with this rapid change, as highlighted in the latest NERC Reliability Risk Priorities Report (Risk Report).[7] The Risk Report is the result of the NERC Reliability Issues Steering Committee's (RISC) work to strategically define and prioritize risks to the reliable operation of the BPS and recommend ways to enhance reliability and manage those risks. The five risk profiles in the Risk Report are interdependent, with important linkages between the risks and recommended actions.

The first risk profile in the Risk Report is Energy Policy. Energy Policy at the federal, state, and local levels is driving changes in how the BPS is planned and operated, and policies regarding decarbonization, decentralization, and electrification can impact reliability in many ways. Examples of these reliability impacts include resource adequacy shortfalls due to generation retirements, resilience and recovery concerns during extreme weather events, and challenges with integrating and implementing new IBRs. While new NERC Reliability Standards are being developed to help address these risks, strong collaboration and partnerships are key to mitigating these challenges.

The other risk profiles highlighted in the Risk Report are grid transformation, resilience to extreme events, security risks, and critical infrastructure interdependencies. I will briefly discuss each of these in turn. Grid transformation (which I discussed in February's testimony) includes the impact of generation retirements and increasing demand for electricity, and our ability to meet this demand. Resilience to events is an increasing risk with the increasing occurrence of extreme weather across the country. FERC and the ERO have studied the reliability impact of winter storms and issued reports with recommendations to mitigate the risks of future events. FERC and the ERO will soon be releasing a report on Winter Storm Elliott. Cyber and physical security risks are ever present and are an area of focus. FERC and NERC held technical conferences on physical security following substation attacks at the end of last year and earlier this year. Critical infrastructure interdependencies refer to the ways that different sectors (such as communications, water, finance, manufacturing, oil, and natural gas) can impact the electric grid and vice-versa. Any one of these risk profiles could be the focus of an entire hearing complete with testimonies, experts, and panel discussions.

Since my last testimony, a risk we have seen intensify is the risk of generation retirements. We have seen that due to policy and/or financial reasons, some power plants, often coal-fired ones, are announcing early retirements. Retirements can impact reliability margins and reserves, and in some cases, can require extensive transmission reinforcement projects to sustain reliability. Within PJM, we have seen Reliability-Must-Run (RMR) contracts offered, but these are costly and generation owners do not have to accept them. This can force further actions such as a 202(c)-emergency order pursuant to the Federal Power Act, to keep the unit(s) available and running until transmission reinforcements are complete, which may take several years. While the reliability protections RMR contracts and 202c orders can provide are beneficial, they are not an ideal way to manage the reliability of the Bulk Power System. Furthermore, we believe we are just beginning to see these types of situations surface. Certainly, there are more generator retirements to come, and this will continue to be a complex challenge, requiring a multifaceted solution including market, policy, and interconnection process changes.

[7] https://www.nerc.com/comm/RISC/Related%20Files%20DL/RISC_ERO_Priorities_Report_2023_Board_Approved_Aug_17_2023.pdf

Winter Storm Elliott and its lessons learned[8] demonstrate the risks of generation retirements dovetailing with extreme weather events. Winter Storm Elliott 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. My February testimony described the challenges we face during winter storms such as freezing equipment, natural gas supply issues, forecasting challenges, and high transmission flows across operation regions.

This scenario becomes more challenging when generation is retired, and new generation is not keeping pace with what is being retired. Due to the variable nature of renewable generation, we know that more renewable capacity will be needed than the thermal generation that it replaces. In other words, a MW of synchronous, thermal generation retired is not equivalent to a MW of new asynchronous, intermittent generation installed.[9] Furthermore, recent NERC event reports[10] have highlighted disturbances related to IBRs not performing as expected.

What we have learned from our assessments is that our margins are getting thinner and that every megawatt matters. The Eastern Interconnection is very resilient, as described in the latest NERC State of Reliability Report,[11] however there are scenarios in the near and long-term future where certain transmission line and generation outages may be much more impactful than they are today. While we continue to coordinate with states and policy makers to help ensure a reliable energy transition, we are utilizing our outreach, training, and education program to ensure that the known risks of today are being mitigated so that we can more rapidly address the risks of the future. I will walk through a few examples.

The most relevant example of these efforts has been RF's voluntary winterization outreach program. While there are new NERC Reliability Standards becoming effective this year and next that help address reliability concerns related to extreme weather, RF began our on-site voluntary winterization visits shortly after the 2014 Polar Vortex. RF targets generating units that experienced freezing issues the previous winter, plus new generators commissioned in our footprint. RF subject matter experts go on-site to the power plants, and we spend a day visiting with their plant manager, inspecting the facility. This outreach results in a customized report for the plant including recommendations for improvement and lessons learned from other site visits and recent events. We also document best practices to share on subsequent winterization site visits. We received testimonials from the plants thanking us for our efforts and highlighting the changes made.

Another example of a reliability risk being addressed through our outreach program is misoperations. Misoperations (relays and associated equipment that do not operate as intended) have been a risk factor in the RF footprint as measured annually by the misoperation rate, posted

[8] https://www.ferc.gov/news-events/news/presentation-ferc-nerc-regional-entity-joint-inquiry-winter-storm-elliott
[9] There is also a need for essential reliability services for the reliable operation of the grid, which is discussed in further detail in my February testimony.
[10] https://www.nerc.com/pa/rrm/ea/Pages/Major-Event-Reports.aspx
[11] https://www.nerc.com/pa/RAPA/PA/Performance%20Analysis%20DL/NERC_SOR_2023_Technical_Assessment.pdf

annually in the NERC State of Reliability Report.[12] Around 2016, RF initiated a concerted effort to reduce this rate using all our tools, including the continued auditing and enforcement of the NERC Reliability Standards plus our outreach mechanisms. Our Engineering Department began identifying the Transmission Owners with the highest misoperations rates and engaged with them in one-on-one technical discussions. Our Protection Subcommittee started performing misoperations peer reviews to learn from and prevent future misoperations. Over the past seven years, we have successfully reduced the misoperations rate. Addressing and reducing misoperations is important as we transition to the grid of the future, as relay settings need to be carefully coordinated and monitored, especially with the increase of IBRs on the system.

In another area, several years ago, we noticed a concerning trend of Energy Management System (EMS) outages, which are situations where transmission control centers would lose situational awareness tools. While an EMS outage by itself does not cause a tangible reliability impact to the grid (such as a line or generator outage), the lack of situational awareness in conjunction with system events and disturbances may result in an insufficient response to an event which can lead to cascading problems. An example of this was the 2003 Northeast Blackout,[13] where an EMS outage contributed to the event because operators were unable to respond to declining frequency following the loss of several transmission lines and generators. To address the risk of EMS outages, RF worked closely with industry to analyze hundreds of EMS disturbances to study root causes, contributing causes, and mitigations. ERO task forces and working groups also engaged with industry and vendors to discuss these risks. Real-time situational awareness will be even more important going forward as we build the grid of the future and assess the impact of voltage and frequency disturbances that may trip Distributed Energy Resources (DER) (as seen in recent NERC system event reports).

RF and the ERO are committed to addressing known reliability risks and learning from past events, plus we are turning our attention to new evolving risks. We are speaking with other countries regarding lessons learned from their own grid transformations. We also strive to learn from other critical infrastructures regarding the risks and challenges they face. For example, we have studied cyber and physical security events impacting natural gas and water to determine if the electric grid may be susceptible to the same threats and vulnerabilities. To mitigate evolving risks, especially those involving energy policy and grid transformation, the states play a vital role in shaping energy policies. RF is committed to serving as a resource regarding these issues that impact reliability, resilience, and security.

State energy policies that provide sufficient time and flexibility to align energy goals with the reliability needs of the BPS will help to ensure a smooth transition. Examples of this include maintaining a diverse portfolio of generation types and allowing the use of environmental waivers when needed to maintain reliability. Another thing to keep in mind is 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.

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[12] The misoperation rate is the total number of misoperations divided by the total number of operations, providing a percentage of which relay operations were misoperations.

[13] RF and the ERO created a video commemorating the 20th anniversary of this event: https://www.youtube.com/watch?v=sKXVT0V7SQY

There are many factors to consider when making decisions and formulating energy plans during this unique time, including: cost, environmental impact, reliability (including the level of reliability desired), energy equity, speed, impacts to key industries and the economy, land and space requirements, new transmission needs, siting issues, impact on blackstart resources, impact on essential reliability services, integration into wider state policies, and potential dependence on foreign nations with human rights violations or that are hostile to the U.S. As I stated in my February testimony, it is not possible to address all these factors in equal measures (some tradeoffs will need to occur), and each state's decisions will reflect a different mix. It is also important to consider what solutions are technologically possible currently (for example, with battery design, mineral and material availability, OBJ fuel availability, transmission capabilities and the size of the distribution system).

Reliable electricity is the backbone of economic, societal, and individual well-being. 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 policymakers 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 A

Footprints of NERC and the Regional Entities