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FERC-NERC Joint Technical Conference on the Physical Security of the Bulk Power System, Docket No. RD23-2-000

Panel 4: Grid Planning to Respond to and Recover from Physical and Cyber Security Threats and Potential Obstacles

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On behalf of PJM Interconnection, L.L.C. ("PJM"), I appreciate the opportunity to participate on this panel and share PJM's perspective on planning to respond to and recover from physical and cybersecurity threats as well as potential obstacles to developing and implementing such plans. My name is Ken Seiler, and I currently serve as Vice President of Planning for PJM. I have included with this testimony my background and work history in the industry. As part of my work for PJM, I am responsible for activities related to resource adequacy, generation interconnection, and regional and interregional transmission planning, including the development of the Regional Transmission Expansion Plan ("RTEP"). I was previously the executive director of System Operations and was responsible for the reliable operation and coordination of the Bulk-Power System, including PJM's real-time dispatch operations and near-term reliability studies.

PJM appreciates that the Federal Energy Regulatory Commission ("FERC") and the North American Electric Reliability Corporation ("NERC") have convened this technical conference to discuss physical security of the Bulk Power System. PJM acknowledges that the Bulk-Power System is facing increasing threats in the form of extreme weather, as well as man-made threats such as cyber and physical attacks. Further, PJM strongly believes that action needs to be taken in order to ensure the industry is able to prepare for, withstand and/or respond to events like these.[1]

With that in mind, I would like to provide additional information about: (i) system conditions that present current and future reliability- and resilience-related concerns; (ii) PJM's actions to date to improve transmission system resilience, including through transmission planning, market-related studies and analyses, and operations; and (iii) PJM's request for the identification of an intermediate- and long-term planning driver to focus on resilience of the transmission system.

System Conditions That Present Current and Future Reliability- and Resilience-Related Concerns

A number of emerging system conditions present challenges to reliable system operations, including, for example: (i) extreme weather; (ii) cyber and physical attacks; and (iii) generation fleet shift driven by natural gas and increased deployment of renewable resources. Notably, Winter Storm Elliott hit the eastern United States over the December 23–25, 2023 weekend and tested the reliability of much of the Eastern Interconnection. Precipitous temperature drops and powerful winds caused widespread generator failures and froze up natural gas supplies while driving up electricity demand, leading to power outages in some of PJM's neighboring regions. PJM and its members were able to maintain the reliability of the system, serve customers and even support neighboring systems during some periods, which was a significant accomplishment. Specifically, PJM operators were able to avoid electricity interruptions throughout this event. Nevertheless, PJM operators had to implement multiple emergency procedures and a public appeal to reduce energy use to maintain reliability in the PJM footprint serving 13 states and the District of Columbia.[2]

[1] Indeed, PJM has urged FERC to adopt a common definition of resilience and a specific resilience planning driver for grid enhancements, applicable to all planning entities. *See, e.g.*, *Building for the Future Through Electric Regional Transmission Planning and Cost Allocation and Generator Interconnection*, Initial Comments of PJM Interconnection, L.L.C., Docket No. RM21-17-000, at 11-25 (Aug. 17, 2022) ("PJM Initial NOPR Comments").

[2] PJM published its Winter Storm Elliott Event Analysis and Recommendation Report on July 17, 2023 ("Winter Storm Elliott Report").

Additionally, capacity shifts driven by federal and state public policy present increasing reliability risks[3] due to a potential timing mismatch between generation retirements, load growth and the pace of new generation entry. PJM has observed the following trends in the PJM Region:

- The growth rate of electricity demand is likely to continue to increase from electrification coupled with the proliferation of high-demand data centers in the region.[4]
- Thermal generators are retiring at a rapid pace due to government and private sector policies as well as economics.[5]
- Retirements are at risk of outpacing the construction of new resources due to a combination of industry forces, including siting and supply chain, the long-term impacts of which are not fully known.[6]
- PJM's interconnection queue is composed primarily of intermittent and limited-duration resources.[7] Given the operating characteristics of these resources, PJM will need multiple megawatts ("MW") of these resources to replace 1 MW of thermal generation.

Each of these factors could have an impact on the PJM transmission system. For instance, as observed during Winter Storm Elliott, extreme weather events can cause significant disruptions to the transmission system. The same is true for coordinated cyber/physical attacks. Generator deactivations alter power flows that can cause transmission line overloads, and given reductions in system reactive support from those generators, can reduce voltage support. PJM may need to order transmission upgrades or additions built by transmission owners to accommodate the generation loss. Concentrated load growth associated with increased electrification and the proliferation of data centers also drives the need for transmission system reinforcements. And, the shift to intermittent and limited-duration resources will alter how power flows across the PJM Region and will drive future grid expansion to ensure reliable power delivery to load centers.

PJM's current processes for addressing these concerns are described below, as is PJM's position regarding the need to consider resilience in intermediate- and long-term regional planning processes.

[3] PJM recently released the Energy Transition in PJM: Resource Retirements, Replacements and Risks report (Energy Transition Report), which analyzes the impact of industry trends and state and federal decarbonization policies within the PJM Region.

[4] Due to the expansion of highly concentrated clusters of data centers, combined with overall electrification, certain individual zones exhibit more significant demand growth – as high as 7% annually. Energy Transition Report at 2.

[5] PJM's analysis shows that 40 gigawatt ("GW") of existing generation are at risk of retirement by 2030. This figure comprises: 6 GW of 2022 deactivations, 6 GW of announced retirements, 25 GW of potential policy-driven retirements and 3 GW of potential economic retirements. Combined, this represents 21% of PJM's current installed capacity. *Id.* And, PJM's long-term load forecast shows demand growth of 1.4% per year for the PJM footprint over the next 10 years. *Id.*

[6] The projections in the Energy Transition Report indicate that the current pace of new entry would be insufficient to keep up with expected retirements and demand growth by 2030. *Id.*

[7] PJM's New Services Queue consists primarily of renewable resources (94%), with the remaining 6% consisting of gas units. Despite the sizable nameplate capacity of renewable resources in the interconnection queue (290 GW), the historical rate of completion for renewable projects has been approximately 5%.

PJM's Actions to Date to Improve Transmission System Resilience

How PJM Is Addressing Resilience in Transmission Planning

Avoidance of CIP-014 Facilities[8]

The PJM transmission owners use planning procedures set forth in Attachment M-4 to PJM's Open Access Transmission Tariff ("Tariff") to mitigate the risk associated with critical transmission stations and substations identified pursuant to NERC reliability standard CIP-014-2. The Attachment M-4 planning procedures are limited to a subset of Supplemental Projects.[9] The PJM transmission owners incorporated Tariff, Attachment M-4 to plan transmission projects for the purpose of mitigating risks associated with CIP-014 transmission stations and substations more effectively and beyond the physical security measures alone. The Attachment M-4 procedures allowed PJM transmission owners to ultimately remove these facilities from the CIP-014 list ("CIP-014 List") of critical facilities without disclosing highly sensitive information about those stations and substations that could threaten their security.[10] Attachment M-4 limited the maximum number of CIP-014 mitigation projects ("CMPs")[11] permitted to 20; and it terminates five years after FERC-approved Attachment M-4 for inclusion in the Tariff.[12] The Attachment M-4 planning procedures allow for consultation with PJM and the affected state commissions regarding CMPs, including discussion of siting issues and the estimated costs of a CMP, subject to appropriate confidentiality safeguards. PJM plays a significant role in reviewing and assessing a transmission owner's preferred and potential alternative means of eliminating a transmission station or substation from the CIP-014 List.[13]

PJM is also actively engaged through the Transmission and Substation Subcommittee in the development of transmission system hardening practices, including design philosophy, design requirements, and operating practices for grid enhancements, to prepare for extreme weather events.[14]

PJM's Cascading Trees Tool

PJM incorporates probabilistic methods into its planning process to analyze High-Impact-Low-Frequency ("HILF") events and to identify areas of risk and potential resilience enhancements to the grid. This methodology (called "Cascading Trees") consists of quantifying the probability of cascading outages and its associated impact after an *N-k* disturbance such as a multiple facility trip event, like the loss of an entire substation and all the lines emanating from the substation. At its most fundamental level, a Cascading Tree analysis evaluates an extreme event that encompasses a risk that may, after some number of additional cascading events, lead to system collapse

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[8] NERC developed reliability standard CIP-014-2 to identify and protect transmission stations and substations, and their associated primary control centers that, if rendered inoperable or damaged by physical attack, could result in instability, uncontrolled separation, or cascading ("CIP-014 Facilities"). The standard requires transmission owners to conduct assessments to identify such critical facilities. Currently, however, no industry standard or uniform planning driver exists by which RTOs/ISOs (and transmission providers in non-RTO/ISO regions) can plan the regional transmission system specifically in order to mitigate CIP-014 Facilities.

[9] A Supplemental Project is a transmission expansion or enhancement that is not required for compliance with the following PJM criteria: system reliability, operational performance or economic criteria, pursuant to a determination by the Office of the Interconnection, and is not a state public policy project pursuant to Operating Agreement, Schedule 6, section 1.5.9(a)(ii). *See* Operating Agreement, section 1, Definitions S-T.

[10] *See Appalachian Power Co.*, Proposed Tariff Revisions to Add New Attachment M-4, Docket No. ER20-841-000, at 2 (Jan. 17, 2020). *See also Appalachian Power Co.*, 170 FERC ¶ 61,196 (2020), *order on reh'g*, 173 FERC ¶ 61,157 (2020).

[11] A CMP is a Supplemental Project that is: (a) designed specifically to remove a transmission station or substation from the CIP-014 List identified as of September 30, 2018; and (b) reviewed by PJM in accordance with Step 4 of Attachment M-4.

[12] *See* Tariff, Attachment M-4, sections (b)(2) and (d).

[13] *See id.*, section (b)(4).

[14] *See* PJM's Recommendations of Resilience and System Hardening Practices.

(*i.e.*, blackout). Major blackouts are usually caused by HILF events. Since the attacks of 9/11, the power industry has taken a closer look at system contingencies not only driven by naturally occurring events but additional man-made threats as well, including: (i) cyberattacks; (ii) loss of interdependent systems; (iii) earthquake; (iv) physical attack; (v) severe terrestrial weather; (vi) geomagnetic disturbance; and (vii) electromagnetic pulse.[15]

PJM uses the Cascading Tree analysis to assess the probability and consequence of cascading outages in electric systems. A cascading tree is the set of all likely cascading paths; these, in turn, describe a sequence of potential cascading outages that could reasonably be expected. These possible outages are then classified based on whether the propagation of a disturbance can be confined to a certain area or if the exact extent of the cascading event cannot be determined. The initial *N-k* event equates to the complete loss of a substation. Cascading trees quantify the probability of cascading and the extent of associated consequence, leading to a natural ranking of substations. Substations then can be grouped into different tiers, each having a different priority and a discrete set of mitigation actions. The current implementation of the Cascading Trees analysis is to ensure focus on areas of the system with potential sensitive issues in upcoming reinforcement decisions.[16]

How PJM Is Addressing Resilience in Operations

Annual Fuel Security Initiative and Gas-Electric Coordination

PJM performs an annual fuel security analysis to identify any risks to grid reliability that can result from prolonged extreme weather coupled with fuel unavailability ("Fuel Security Initiative").[17] The Fuel Security Initiative began with PJM's 2017 analysis that defined several attributes that are critical for system reliability and highlighted the change in reliability attribute needs to support the evolution of the PJM resource mix.[18] In 2018, as a deeper dive into one of these attributes, PJM embarked on a study of fuel security for the generation on its power system.[19] The analysis deliberately stressed the system to find the tipping point at which issues would arise and to identify key drivers of reliability risk.[20] As in any stress test, the analysis was intended to discover the tipping point at which issues begin to emerge on the PJM system. Under the more extreme escalated retirement scenarios, combined with extreme winter load, the system may be at risk for emergency procedures and load loss. The study reported that while there is no imminent threat to the PJM system, fuel security is an important component of ensuring reliability and resiliency – especially if multiple risks come to fruition.

[15] Any such initial precipitating event could cause one or more transmission line overloads (on a common right-of-way), transformer overload, loss of substation, generator under-voltage or load under-voltage conditions, among others. The high-voltage transmission network that crisscrosses the country was planned based on a set of reliability and efficiency criteria. These criteria generally ensure that the transmission system is capable of withstanding a significant outage to one or a few critical pieces of equipment. These planning criteria do not assess, however, what would happen to the system should a significant disruption of many pieces of equipment occur at once or in quick succession, as might be triggered by an extreme weather event.

[16] The Cascading Trees methodology could also be used as a driver for new projects. For example, transmission corridors that appear frequently across multiple cascading paths are good candidates for system reinforcements. Transmission planning for resiliency should not be associated with "gold plating" the system. Surgically addressing a couple of corridors can cut the probability of a severe cascading outage in half.

[17] For purposes of these Comments, the use of the term "fuel security" refers to the availability of fuel, both on-site and the associated delivery systems, required for a unit to generate consistent with dispatch signals or Operating Instructions. "Fuel supply" is defined as the production, delivery and storage of fuel resources for generation.

[18] *See* PJM's Evolving Resource Mix and System Reliability, Mar. 30, 2017.

[19] *See* Fuel Security – Analyzing Fuel Supply Resilience in the PJM Region, Nov. 1, 2018 ("2018 Fuel Security Study").

[20] Looking forward over five years using a 2023/2024 system model, PJM analyzed more than 300 different scenarios ranging from typical operations to extreme conditions, varying elements including generation retirements, customer demand, fuel delivery and fuel supply disruptions.PJM also took into account (i) generation retirements announced as of October 1, 2018, (ii) planned new generation and (iii) interstate pipeline buildout.

As part of its ongoing initiative to ensure the resilience of the Bulk-Power System into the future, PJM and stakeholders embarked on additional work around Fuel Security throughout 2019 in the Fuel Security Senior Task Force.[21] From there, PJM refined its approach for an annual study that incorporates probabilistic approaches, in addition to the primarily deterministic analysis utilized in the 2018 Fuel Security Study. Specifically, the Fuel Security Resource Adequacy Assessment is a probabilistic "stress test" for potential future resource mixes by calculating a portfolio's loss of load expectation conditional on the occurrence of a loss of generation beyond the modeled forced outages coincident with an extreme weather event.[22]

PJM is also seeking to address the near-term operational issues associated with coordination of day-ahead commitment and real-time dispatch with gas pipeline nomination cycles. These issues are under intensive review in our Electric Gas Coordination Senior Task Force. However, as the NERC/FERC report on Winter Storm Uri[23] recognized, many of these issues are not ones that PJM alone can resolve − they involve addressing some of the fundamental disconnects between how the natural gas and electric systems are planned, operated and regulated. PJM has been active in the NAESB Gas/Electric Forum and intends to continue to be at the table to address these issues on a wider national basis.

The Fuel Security Initiative underscores the importance of system operators exploring proactive measures to value fuel security attributes. PJM intends to start using this analysis in the process used to determine reserves both in the longer term to determine installed reserve margins and in the shorter term to determine contingency reserve calculations.

System Restoration Plans and Black Start Units

System restoration and black start plans are critical to maintaining a resilient grid during HILF events. Restoration of service is a shared responsibility among local utilities and RTOs such as PJM, with assistance from end-use customers as well as the federal government and state and local authorities. PJM's policy is to maintain at all times the integrity of the PJM transmission system and the Eastern Interconnection and to prevent any unplanned separation of the PJM transmission owners' systems.

PJM's role in restoring Bulk Power System differs depending on whether the system response is precipitated by a storm or other extreme weather event (referred to herein as PJM's "storm response approach") or by a blackout or other system disturbance (referred to herein as PJM's "black start" or "system restoration" approach). More specifically, under the storm response approach, PJM's role is focused on supporting its transmission owners, who are largely responsible for restoring the Bulk Power System following a storm or other extreme weather event. For example, PJM helps the transmission owners to prioritize which facilities to restore first, while the transmission owners are the entities responsible for assessing any damage to physical infrastructure resulting from the storm or extreme weather event.

On the other hand, PJM plays a much more active role when a blackout or other system disturbance requires PJM to implement its black start/system restoration approach. Based on NERC reliability standards EOP-005 and EOP-006, PJM and its members are expected to respond to system disturbance conditions or a system blackout. In that vein, PJM maintains in its manuals a detailed recovery plan for responding to loss of all or portions of the grid ("System Restoration Plan") in the event of a blackout or other system disturbance.

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[21] *See* the Fuel Security Senior Task Force's Problem Statement, Issue Charge and Meeting Materials.

[22] *See* PJM Interconnection, L.L.C., Fuel Security Monitoring Methodology (Jun. 10, 2021), and PJM's related presentation to the Operating Committee.

[23] *See* FERC, NERC and Regional Entity Staff Report, The February 2021 Cold Weather Outages in Texas and the South Central United States (Nov. 2021) ("Winter Storm Uri").

As part of the System Restoration Plan, PJM has identified key strategically located generators known as black start units that can start without needing to draw power from the grid. In the type of broad and severe outage where there is no generation synchronized within an electrical area available to restore the PJM grid, black start generation is required. Black start units therefore must be called upon to help "jump start" the system and allow service to be restored to other generation. That generation would then be brought online consistent with PJM's System Restoration Plan, in a manner that can keep the system in balance while pockets of generation are connected back to each other so as to restore the grid operating as an integrated pathway throughout the PJM footprint.

At a high level, PJM's black start/system restoration process involves: (i) assessing the system; (ii) starting black start units; (iii) building cranking paths[24] to critical loads;[25] (iv) restoring critical loads and forming "islands" of restored service; (v) synchronizing islands; (vi) connecting to neighbors; and (vii) returning to normal operations. Black start units are the first units called to start, and they then provide the foundation upon which the grid is restored.

PJM procures black start resources through a PJM RTO-wide request for proposal ("RFP") process that it administers every five years.[26] The RFP process has allowed PJM to obtain a more efficient fleet of black start units as compared to some years ago when black start – in some cases – was provided by large coal units at costs that were not necessarily competitive when compared to utilizing a more updated technology, such as a gas combustion turbine unit. Through the RFP process, PJM has established a point system to rate the many bids it receives. PJM provides additional points toward an award for units that have dual fuel capability and/or firm fuel contracts. Clearly, of the two, dual fuel capability is a superior alternative, given the benefits of diversity of fuel resources.

PJM recently submitted proposed revisions to its Tariff to mitigate the adverse impacts of black start units potentially being unavailable during a restoration event due to fuel unavailability.[27] PJM's proposal provides qualification procedures, testing, performance requirements and compensation for Fuel Assured Black Start Units. The proposal remains pending before FERC.

Preparing for Extreme Weather Events

Due to the exposed nature of electric infrastructure to severe weather conditions, PJM closely monitors both short- and long-term weather patterns. PJM has staff meteorologists who analyze weather conditions and terrestrial hazards and work closely with system operators to inform system operations decisions. PJM currently prepares for weather events by delaying scheduled outages, returning equipment being maintained to service, and entering into conservative operations to increase operational awareness and market participant and transmission owner coordination.

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[24] "Cranking path" refers to the transmission pathway from a black start unit to the critical load that needs to be brought online.

[25] "Critical load" refers to station service and start-up power requirements for non-black start generators in strategic locations that can help restore service to pockets of load that can then be connected together to restore the entire system. Critical load generators are not the black start units themselves; rather, they are the first generating units that the black start units help bring online by energizing transmission facilities along a cranking path to the critical load. Critical load may also include nuclear units (to ensure safe shutdown) and electric-powered natural gas compressor stations (to help transport fuel to generating units that need to be brought back online). "Critical load" is distinct from "priority load," which refers to retail load locations (such as hospitals and military facilities) on the distribution system that have restoration priority through transmission owner restoration plans.

[26] *See* PJM Manual 14D: Generator Operational Requirements.

[27] *See PJM Interconnection, L.L.C.*, Black Start Service Revisions to Enhance Fuel Assurance, Docket No. ER23-1874-000 (May 12, 2023).

PJM and its member companies plan throughout the year for winter and summer conditions.[28] For instance:

- **Cold Weather Advisory/Alert** – In advance of the mandatory NERC Winterization Standard becoming effective on April 1, 2023, PJM established the Cold Weather Advisory. A Cold Weather Advisory provides an early notice that forecast temperatures may call for a Cold Weather Alert. The early notification of an advisory is intended to provide PJM members ample time to gather information required by NERC standards EOP-011, Emergency Preparedness and Operations, IRO-010 RC Data Specification and Collection, and TOP-003 Operational Reliability Data. Members are to take any necessary precautions to prepare generating facilities for cold weather operations. PJM attempts to issue the advisory as far in advance as possible, typically within three to five days, but given fluctuating and changing weather forecasts, advisories could be issued up to 24 hours in advance.[29]
- **Hot Weather Alert** – PJM may issue a Hot Weather Alert to prepare personnel and facilities for extreme hot and/or humid weather conditions that may cause capacity requirements/unit unavailability to be substantially higher than forecasted are expected to persist for an extended period.[30]
- **Generating Unit Reactive Capability Verification** – PJM verifies every generator's reactive capability in advance of each winter season. This is used to ensure that real-time, day-ahead and seasonal analysis accurately reflects the capability of generators to support system voltage.
- **Cold Weather Checklist** – PJM has incorporated into its manuals an extensive pre-winter preparation checklist.[31] This checklist, directed to generators, covers a variety of winterization actions to be undertaken. Generators report the results of their analysis to PJM through PJM's electronic e-DART reporting system. Even though the reporting is voluntary today, PJM has received a high level of generator compliance, particularly from those units that otherwise could face the most weather-related impacts.[32]
- **Seasonal Fuel Inventory and Emissions Survey** – PJM surveys generators about their fuel supply and delivery details, fuel inventory and emissions limitations. This information is required for reliable operations planning purposes and enhances PJM's situational awareness in preparation for extreme weather events.
- **Cold Weather Exercise** — PJM recommends that generators that have not run on their primary or alternate fuel in the preceding eight weeks leading up to December 1 should self-schedule a test to run during the month of December when temperatures are below 35 degrees.

[28] Like all generators in the United States, generators in PJM are not obligated to winterize their units by mandatory NERC standards, state legislation or any other government entity. In addition, PJM has no jurisdictional authority over the activities that occur inside the fence of a generating station with respect to the physical asset, construction and maintenance. PJM makes every effort, however, to ensure that generators are taking the proper actions to ensure their units are ready to run when the grid needs them.

[29] *See* PJM Manual 13: Emergency Operations, Section 3.3.

[30] *See id.*

[31] *See* PJM Manual 14D: Generator Operational Requirements, Section 7.5. *See also id.* at Appendix N.

[32] While reporting is voluntary, PJM requires acknowledgement of completion of the checklist. The response rate is typically 90–95%. Notably, 98% of the wind farms in PJM confirmed completion of cold weather preparations in advance of the 2020/2021 winter.

- **Annual NERC Winter Readiness Webinar** – Prior to each winter season, PJM participates in NERC's Annual Winter Preparation Webinar to review and refresh on lessons learned, review the NERC Reliability Guideline and Generating Unit Winter Weather Readiness, and discuss other winter items of interest.
- **Coordination With Neighboring Reliability Entities** – PJM coordinates winter system readiness with its neighboring systems to include New York Independent System Operator, Inc., Midcontinent Independent System Operator, Inc., Northeast Power Coordinating Council, Inc., and VACAR.[33]
- **Emergency Procedures Drill** – PJM conducts a winter emergency procedures drill prior to winter operations to exercise emergency procedures and communications with PJM operations, member company operations teams and state emergency management teams.

Through outreach to the PJM Operating Committee and System Operations Subcommittee, all members are also encouraged to review and implement recommendations regarding preparedness for extreme weather events.

In addition to the above, PJM recently released its Winter Storm Elliott Report, which reviews the events up to and during Winter Storm Elliott, assesses the actions of PJM and its members during those times, and looks for lessons learned and associated recommendations to help improve grid reliability. The Winter Storm Elliott Report contains 30 recommendations that are broadly focused on:

- Addressing winter risk with enhancements to market rules, accreditation, forecasting and modeling
- Improving generator performance through winterization requirements, unit status reporting and testing/verification
- Tackling gaps in gas-electric coordination, including timing mismatches between gas and electric markets, the liquidity of the gas market on weekends/holidays and the alignment of the electricity market with gas-scheduling nomination cycles
- Evaluating how the Performance Assessment Interval ("PAI") system of rewarding or penalizing generator performance is impacted by exports of electricity to other regions, whether excusal rules can be simplified, whether PAI triggers need to be refined, and if the contributions of Demand Response and Energy Efficiency are accurately valued
- Pursuing opportunities with generation owners, other members and states to improve education, drilling and communication regarding PJM's emergency procedures, Call for Conservation and PAIs

Many of these recommendations are currently being developed through the Critical Issue Fast Path – Resource Adequacy process or through other forums.

PJM's Recommendations Regarding Resilience or "Enhanced Reliability"

In several FERC proceedings, PJM has stressed the need to develop a metric of resilience to complement and enhance a planning process that traditionally has been focused on reliability and market efficiency. While PJM appreciates FERC's recent issuance of two rules to help improve reliability of the Bulk-Power System against threats

[33] VACAR is the Virginia-Carolinas subregion of SERC Reliability Corporation.

of extreme weather,[34] PJM continues to believe that FERC should embrace the term "resilience" as a planning driver. Specifically, PJM has recommended that FERC adopt a common definition of "resilience" or "enhanced reliability" as follows:

> *The ability to withstand or reduce the magnitude and/or duration of disruptive events, which includes the capability to identify vulnerabilities and threats and plan for, prepare for, mitigate, absorb, adapt to, and/or timely recover from such an event.*[35]

Additionally, PJM has urged FERC to propose a framework by which regions can develop resilience-based industry planning "drivers" to advance resilience planning and require all regions to develop resilience planning criteria that would trigger actionable grid expansion in the intermediate- and long-range planning processes. These criteria might include resilience-specific elements, such as: (i) storm hardening of facilities and responsiveness plans; (ii) long-term restoration planning for loss of critical infrastructure; (iii) focusing on potential "sensitive" areas of the system similar to PJM's Critical Substation Planning Analysis (as approved by PJM stakeholders in 2021);[36] and (iv) planning to proactively prevent the introduction of new CIP-014 Facilities, and "de-listing" already identified CIP-014 Facilities, as discussed above. PJM also recommended that these criteria should include elements related to gas-electric planning coordination to reduce vulnerabilities shared by both sectors and should ensure consistency in long-term scenario inputs, including standard thresholds for event probability of occurrence and perhaps maximum level of load loss for those planning long-term scenarios across the Eastern Interconnection. PJM continues to believe that FERC should require these drivers to be codified in transmission providers' tariffs, both for RTO/ISO regions and non-RTO/ISO regions, as resilience events (*e.g.*, extreme weather) can often span both.

[34] *See* One-Time Informational Reports on Extreme Weather Vulnerability Assessments Climate Change, Extreme Weather, and Electric System Reliability, Order No. 897, 183 FERC ¶ 61,192 (2023); Transmission System Planning Performance Requirements for Extreme Weather, Order No. 896, 183 FERC ¶ 61,191 (2023).

[35] 2018 Resilience Comments at 10.

[36] PJM, Manual 14B: PJM Region Transmission Planning Process, § 2.9 (rev. 51, Dec. 15, 2021).