UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Reliability Technical Conference	**)**	**Docket No. AD18-11-000**

PREPARED RESPONSE OF PETER BRANDIEN VICE PRESIDENT OF SYSTEM OPERATIONS, ISO NEW ENGLAND INC.

My name is Peter Brandien and I am the Vice President of System Operations at ISO New England Inc. ("ISO-NE"). In that capacity, I am responsible for the day-to-day operations of the New England Bulk Power System and oversight of transaction management, transmission technical studies, outage coordination, unit commitment, economic dispatch, system restoration, operator training, certain North American Electric Reliability Corporation ("NERC")/Northeast Power Coordinating Council ("NPCC") compliance, and development of operating procedures. In addition, I am the current Chair of the NERC Reliability Issues Steering Committee ("RISC"), an advisory committee to the NERC Board of Trustees. I want to thank the Federal Energy Regulatory Commission ("Commission") for setting up this technical conference to discuss policy issues related to the reliability and resilience of the Bulk Power System, and I am pleased to be here to provide our perspective on these important issues.

Introduction

On March 9, 2018, ISO-NE filed its response to the Commission's January 8, 2018 order, in Docket No. AD18-7-000,[1] which sought to comprehensively examine the Bulk Power System's resilience with the goals of developing a common definition of resilience, understanding how each RTO/ISO assesses resilience in its region, and evaluating whether

[1] *Grid Resilience in Regional Transmission Organizations and Independent System Operators*, 162 FERC ¶ 61,012 (2018) ("Resilience Order"). The Resilience Order terminated a rulemaking initiated by the United States Department of Energy's Proposed Rule on Grid Reliability and Resilience Pricing, and established a new proceeding to examine the resilience of the Bulk Power System in RegionalTransmission Organization ("RTO") and Independent System Operator ("ISO") regions.

further Commission action regarding resilience is necessary.[2] To those ends, the Commission proposed a definition of resilience for comment, and posed specific questions to the RTOs/ISOs seeking information on how each RTO/ISO understands resilience, assesses resilience in its respective region, and mitigates resilience risks.[3] ISO-NE's response addressed how reliability and resilience are related, how ISO-NE currently assesses and supports the resilience of the Bulk Power System within the New England footprint, the specific unique challenges facing the region, and the path forward within the region to address the challenges to resilience. The response further provided an extensive background on how resilience is already accounted for in ISO-NE's work in planning, markets, and operations, which helps to ensure that the region has the power resources and transmission facilities needed to meet demand and reserve requirements, resulting in a system that has many resilience attributes. While there are a number of factors that can impact the Bulk Power System's resilience, ISO-NE's response focused on the region's most significant resilience challenge – namely, fuel security or the possibility that the region's generators will not have, or be able to obtain, the fuel they need to run, particularly during extended cold weather (or other stressed system) conditions – and the range of efforts to date at addressing the challenges presented.

This prepared response addresses the specific questions laid out for Panel II: Advancing Reliability and Resilience of the Grid in the notice for this technical conference.

[2] *See* Resilience Order at P 19 (explaining, "[w]e recognize that the RTOs/ISOs are well-suited to understand the needs of their respective regions and initially assess how they address resilience given their individual geographic needs.").

[3] *Id*. at P 23 (noting that the Commission understands resilience to mean "[t]he ability to withstand and reduce the magnitude and/or duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recovery from such an event."). *See id*. at P 19 (emphasizing, "[t]he efforts of RTOs and ISOs on grid resilience encompass a range of activities, including wholesale electric market design, transmission planning, mandatory reliability standards, emergency action plan development, inventory management, and routine system maintenance.").

Panel II Questions

a. The NERC Reliability Standards require that the grid be able to maintain reliable operations for certain disruptions and require that entities maintain and test plans to restore and recover from blackouts. What level of resilience do the NERC Reliability Standards' planning and operating requirements mandate? What attributes of the bulk power system, or component of the bulk power system, could the Reliability Standards address that would both improve reliability and also enhance the resilience of the grid? What other actions to the ERO and industry take, or could these entities take, to enhance resilience, including the development and application of new or existing Reliability Standards and best practices?

The NERC Reliability Standards provide a robust baseline set of criteria, including contingency or event criteria, that the Bulk Power System must be designed to in order to provide for Reliable Operation of the system. These standards and criteria are designed to ensure the operation of the Bulk Power System can withstand pre-defined disturbances without resulting in cascading failure of the system. Resilience, in turn, is part of how we plan for, design and build the Bulk Power System based on the NERC-established contingency criteria. The system has to be able to withstand or minimize the impact and restoration time following a contingency, such as cyber and physical attacks, acts of nature such as storms, and the effects of geomagnetic disturbances.

Resiliency, and many of the concerns associated with it, are part of and can be addressed in the design and, ultimately, the construction of the power system. ISO-NE, in its regional planning process, assesses the performance of and designs the Bulk Power System to NERC planning standards and criteria (in addition to those prescribed by NPCC, as ISO-NE's Regional Entity). As a result, the New England Bulk Power System has inherent attributes of resilience in that it is planned for and designed to meet deterministic planning criteria established by NERC, and built to withstand a wide range of possible events on the system, including physical threats and environmental conditions, up to certain design levels. In order to meet NERC planning criteria, a highly networked system, consisting of many parallel paths, has been built in New England. For instance, upon the loss of a transmission facility, the remaining parallel facilities continue to carry power to other parts of the network. Further, in New England, transmission facilities are planned using two of the four available equipment ratings (i.e., normal ratings, which are continuous ratings, and long-term emergency ratings, which can be used for 12 hours in the summer). The remaining two higher ratings are reserved for system operations, with a short-time emergency rating that can be used for fifteen minutes and a drastic action limit that can be used for five minutes in dire emergencies. Planning the system in this manner allows for some margin between the planned system and the system that the operators face in real-time operations.

Designing and building the Bulk Power System to withstand certain contingency events, such as those relating to the environment, further contributes to the resilience of the power system. All transmission upgrades must meet reliability performance requirements, which help ensure a reliable electric power system design. This means, for example, ensuring that equipment will remain within its emergency ratings following the loss of a system element or the loss of multiple system elements that can result from a common event like the loss of two circuits that share a common tower. New England Transmission Owners further contribute to the Bulk Power System's resilience by constructing the facilities to withstand the events. For example, New England Transmission Owners are in the process of implementing measures at certain substations to ensure that they can better withstand flooding associated with severe weather events, such as hurricanes. These coastal flood events have occurred more frequently in recent years, raising questions about their low frequency status. The efforts to mitigate the impacts of seawater intrusion on Bulk Power System facilities have included measures, such as, raising sensitive equipment, installation of flood walls, and complete relocation and rebuild of a substation.

The changes to the Bulk Power System resulting from the evolving resource mix provide an opportunity to design a more resilient system. In New England, the most pressing challenges to the resilience of the power system do not relate to transmission, but to the possibility that the region's generation fleet will not have, or be able to obtain, the fuel they need to produce the power required to meet system demand and maintain required reserves, particularly during extended periods of cold weather, such as the recent December 2017 to January 2018 Cold Spell,[4] or other system-stressed conditions. ISO-NE refers to these challenges as fuel-security

[4] During the 2017/2018 Cold Spell average temperatures in all major cities in New England were below normal for at least 13 consecutive days, of which 10 days averaged more than 10ºF below normal. *Cold Weather Operations*, ISO New England Inc. (Jan. 16, 2018), https://www.iso-ne.com/static-assets/documents/2018/01/20180112_cold_weather_ops_npc.pdf.

risks. As detailed in ISO-NE's response to the Resilience Order, the New England power system is changing rapidly, further exacerbating the region's fuel-security risks. The region's resource mix continues to evolve with the addition of natural gas-fired generation relying on "just-in-time" fuel delivery,[5] the retirement of nuclear plants and oil and coal generation with significant on-site fuel storage capability,[6] and the addition of weather-dependent technologies, such as wind and solar.[7] Reliability must be ensured as the on-site fuel profile of the resources making up the New England fleet continues to evolve. Operating experience in recent winters and current industry trends changing the makeup of the New England power system, however, indicate the region's fuel-security challenges impacting reliable system operation are likely to intensify.

While fuel security is a critical element to reliable system operation, there currently is no national or industry definition for fuel security, or established methodologies, industry standards or best practices for fuel security analysis. Given the challenges facing New England, ISO-NE developed a framework to evaluate the operational impacts of the region's fuel-security risks, and facilitate regional discussions on how to address the risks. Specifically, ISO-NE developed an operational fuel-security analysis, using a deterministic method to account for adequacy of cumulative fuel energy (as opposed to capacity) of all types on the system over an entire 90-day winter period.[8] The analysis examined how a wide range of anticipated generating resources and fuel-mix combinations and the winter-long outages of certain key facilities could impact reliable

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[5] The percentage of electricity generated from natural gas in New England has significantly increased from just 15% in 2000 to 48% in 2017, and it is expected to grow to 56% by 2026. While the region is increasingly dependent on natural gas, regional gas capacity has remained static, and existing infrastructure is not always adequate to deliver all the gas needed for both heating and power generation in the winter.

[6] Over 4,600 MW of non-gas-fired power plants will have retired by 2021, including nuclear facilities (Vermont Yankee and Pilgrim), and coal-and oil-fired generators (Brayton Point, Salem Harbor, Norwalk Harbor, Mount Tom, and Bridgeport Harbor 3). Additionally, more than 5,000 MW of coal- and oil-fired generation are at risk for retirement or will be retiring in the coming years.

[7] Wind energy resources have grown significantly from 375 MW of nameplate capacity in 2011 to approximately 1,300 MW today (including about 30 MW of off-shore wind), and approximately 8,600 MW of more on- and off-shore wind resources are proposed. The queue of new projects seeking to interconnect to the power grid also includes approximately 1,000 MW of proposed solar and 400 MW of battery storage projects. Additionally, the region has approximately 2,400 MW of "behind-the-meter" solar PV of which system operators can only see about 100 MW in real time, and we anticipate the addition of almost 6,000 MW of nameplate PV capacity by 2027.

[8] *Operational Fuel-Security Analysis*, ISO New England Inc. (Jan. 17, 2018), https://www.iso-ne.com/static-assets/documents/2018/01/20180117_operational_fuel-security_analysis.pdf.

system operation during a future winter. Operational impacts were measured in terms of frequency and duration of instances when the system's 10-minute operating reserves would be depleted in the absence of a system contingency (a violation of reliability criteria established by NERC), and the electric system would be unable to produce sufficient energy to meet system demand, and the ISO therefore would have to shed load (i.e., impose rolling blackouts). This analysis has provided further clarity on New England's fuel-security risks; the results illustrate the range of potential risks that could confront the power system if fuel and energy were constrained during the winter. It has also served as a framework for evaluating operational impacts of future retirements. However, it would be helpful to have NERC and industry standardization or guidance on the meaning of fuel security and for conducting fuel-security analysis.

b. What data and metrics are available to measure and track the resilience of the grid? For example, is it possible to expand the definition of an adequate level of reliability, used as the basis for the NERC Reliability Standards, to include resilience? Are there gaps in the data and metrics that, if filed, could shed additional light on the resilience of the grid?

To determine what aspects of resilience are important and then measure those attributes, we first need to define resilience. The Commission's proceeding to examine the resilience of the Bulk Power System provides an opportunity for the industry to develop a common understanding of resilience and its attributes. In the Resilience Order establishing that proceeding, the Commission sought comment on its proposed definition of resilience, which is based on the National Infrastructure Advisory Council ("NIAC") Framework for Establishing Critical Infrastructure Goals consisting of four outcome-based abilities: robustness, resourcefulness, rapid recovery, and adaptability. These attributes closely align with the Bulk Power System elements considered in assessing reliability under the NERC framework.

In addition to the Commission's effort, NERC's RISC[9] has been tasked by the NERC Board to develop a common framework, understanding and definition of the key elements of

[9] RISC is an advisory committee to the NERC Board of Trustees that provides key insights, priorities, and high-level leadership on issues of strategic importance to Bulk Power System reliability. It advices the Board, NERC standing committees, NERC staff, regulators, Regional Entities, and industry stakeholders to establish a common understanding of the scope, priority, and goals for the development of solutions to address emerging reliability issues.

Bulk Power System resilience, understand how those elements fit into the existing Electric Reliability Organization ("ERO") or NERC framework, and evaluate whether additional steps within that framework are needed to address those key elements of Bulk Power System reliance beyond what is already in place or underway in connection with ERO activities, including work being undertaken by each of the NERC standing committees. To those ends, RISC has been working on developing a resilience framework based on adequate level of reliability and the NIAC resilience framework. As part of this effort, RISC is also identifying and providing guidance on how ongoing NERC activities fit within the NIAC framework, and evaluating whether there are any gaps. The RISC is also considering the ISO/RTO and industry responses in this regard and will be reporting its findings to the NERC Board.

In terms of measuring and tracking, ISO-NE uses data obtained from experience with system-stressing events, such as recent extended extreme cold weather periods, as inputs to test against contingency events. For example, data from the 2014-2015 winter (which provided an extended-duration cold spell) served as the baseline for testing system stress in the modeled, hypothetical cases examined in the ISO's operational fuel-security analysis.

c. What opportunities exist for NERC and the Regional Entities to work with states and other jurisdictions collaboratively to improve resilience of the grid? Should the Reliability Standards be modified to define and require minimum parameters for system resilience? Should these specifically address high-impact, low-frequency events (e.g., physical and cyberattacks, accidents, extended fuel supply disruptions, or extreme weather events)?

States, as well as regional stakeholders, policymakers, and regulators, have a key role in advancing resilience. Siting and permitting of transmission facilities falls within the purview of the states and their decisions can impact the resilience of the solutions that are ultimately built. In their role as siting and permitting authority, states can take into account the resilience of the different options brought forward by the Transmission Owners and ensure that the design standards for the facilities are adequate for the environmental conditions to minimize the likelihood of experiencing beyond criteria contingencies or events for the area of the country in which they are located.

In New England, the states and market participants have a role to play to resolve the fundamental causes of fuel-delivery constraints. Investment in adequate fuel infrastructure to support the evolving nature of the resources on the grid (e.g., additional gas pipeline to support the demand brought by the generation sector or high capacity dual-fuel capability) has stalled, and increasing emissions restrictions are further limiting the addition and operation of fossil-fired resources. ISO-NE is currently engaged with regional stakeholders, including the states, to develop long-term solutions to address the increasing fuel-security challenges facing the region. All eyes should not be on ISOs and RTOs as the only entities that can address fuel-security challenges. Ultimately, ISO-NE can only do so much in its role given its legal tools. ISO-NE has no jurisdiction over fuel infrastructure – it has no mechanism or authority to direct or invest in natural gas supply infrastructure or any fuel infrastructure – and has to seek fuel adequacy through appropriate incentives/obligations for generators. ISO-NE also does not own generation assets. Nor can it contract for gas pipeline to support generation. This Commission, the states, and market participants will ultimately need to take leading roles to fill in gaps that have been identified in restructured markets, where divestiture of resources and merchant's generation's lack of obligation to serve change the paradigm that once drove the industry to ensure adequate fuel-delivery infrastructure.

Several NERC Reliability Standards already include requirements for testing against certain high-impact, low-frequency ("HI/LF") events. In addition to NERC Transmission Planning ("TPL") standards, which cover general transmission system design and also planning for geomagnetic disturbances, other NERC standards, such as CIP-014, create the obligation to limit substation vulnerabilities due to a physical attack. Designing the system to withstand certain HI/LF risk, such as those relating to the environment (e.g., hurricanes) further contributes to the resilience of the Bulk Power System. Constructing and operating the Bulk Power System to withstand all potential risks, however, would be difficult and costly to realize.

Resilience can be achieved by integrating the reliability standards, which result in a robust system built to certain events, with other resilience measures that can mitigate impacts from reliability risks. For example, in some cases, long-term transmission planning assessments show that the system can withstand a number of potential extreme events. However, some testing shows that there are certain vulnerabilities to extreme events which could have widespread consequences. To address these events, significant system redesign would be necessary, most likely requiring additional transmission circuits, potentially dictating, in turn, the creation of new and separate rights of way ("ROW") and the addition of new substations, all at significant costs. There are, however, a number of actions that can be taken to limit the likelihood of certain events. In ISO-NE planning, for example, the decision to proceed with one set of transmission solutions versus an alternative set of solutions is informed by extreme event testing, such as comparably better or worse performance for the loss of a substation and the loss of a ROW, when evaluating alternatives.

Further, some mitigation solutions also fall outside the scope of ISO-NE's jurisdiction and may need to be addressed by other appropriate entities, or may be too costly. Nevertheless, given the potential risks to reliability, system operators need to be able to respond to prevent uncontrolled load shedding and cascading outages. Accordingly, ISO-NE utilized scenarios simulated in the operational fuel-security analysis (e.g., the loss of the compressor station scenario) for the NERC GridEx IV exercise to train operators, as, on any given day, such a HI/LF event would likely require controlled load shedding and then restoration of that load after the start-up and synchronization of generators with dual-fuel capability and non-gas resources.

Thank you for the opportunity to submit these prepared remarks and I look forward to your questions.

Respectfully submitted,

__/s/ *Peter T. Brandien*__

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