UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Grid Resilience in Regional Transmission Organizations and Independent System Operators	**)** **)** **)**	**Docket No. AD18-7-000**

COMMENTS OF THE NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

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On January 8, 2018, the Federal Energy Regulatory Commission (the "Commission") initiated a new proceeding to evaluate resilience of the bulk-power system ("BPS") in regions operated by regional transmission organizations and independent system operators (together, "RTOs").[1] Specifically, the Commission seeks to: (1) develop a common understanding of the term resilience; (2) understand how RTOs assess resilience; and (3) evaluate whether additional Commission action is appropriate.[2] While initially soliciting comments from RTOs, the Commission acknowledged that, "NERC and the regional entities tasked with implementation of mandatory reliability standards have a critical role to play in this area…. we will provide interested entities an opportunity to submit reply comments….."[3]

As the Commission certified Electric Reliability Organization ("ERO"),[4] the North American Electric Reliability Corporation ("NERC") must develop and enforce Reliability Standards that provide an adequate level of reliability for Reliable Operation of the BPS and must assess the reliability and adequacy of the BPS.[5] As discussed herein, resilience is a

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1 *Order Terminating Rulemaking Proceeding, Initiating New Proceeding, and Establishing Additional Procedures, Grid Resilience in Regional Transmission Organizations and Independent System Operators*, 162 FERC ¶ 61,012 (2018) ("Order").
2 *Id.* at P 18.
3 *Id.* at P 19.
4 *Order Certifying North American Electric Reliability Corporation as the Electric Reliability Organization and Ordering Compliance Filing*, 116 FERC ¶ 61,062 (2006) ("Certification Order").
5 As defined in section 215 of the Federal Power Act ("FPA"). 16 USC 824o.

component of reliability in relation to an event and thus an implicit feature of NERC's activities. NERC hereby submits reply comments in this proceeding to summarize the manner in which resilience is a component of reliability, to highlight NERC Reliability Standards and other activities that support resilience, and to underscore the importance of reexamining resilience in light of the changing generation resource mix and evolving cyber and physical threats.[6]

I. COMMUNICATIONS

Notices and communications with respect to these comments may be addressed to the following:[7]

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6 RTO comments were filed on March 9, 2018 by: Midcontinent Independent System Operator, Inc. ("MISO"), ISO New England Inc. ("ISO-NE"), Electric Reliability Council of Texas, Inc. ("ERCOT") and the Public Utility Commission of Texas ("PUCT"), Southwest Power Pool, Inc. ("SPP"), New York Independent System Operator, Inc. ("NYISO"), PJM Interconnection, L.L.C. ("PJM"), and the California Independent System Operator Corporation ("CAISO").

7 Persons to be included on the Commission's service list are identified by an asterisk. NERC respectfully requests a waiver of Rule 203 of the Commission's regulations, 18 C.F.R. § 385.203 (2018), to allow the inclusion of more than two persons on the service list in this proceeding.

II. EXECUTIVE SUMMARY

Reliability of the BPS requires the resilience to anticipate, withstand, recover, and adapt to events on the system. In accordance with section 215 of the FPA and Commission directive in the Certification Order, reliability encompasses aspects of resilience of the BPS. As discussed in these comments, NERC has defined the adequate level of reliability or "ALR" to include resilience as a time-based component of reliability. *See infra* Section III.A.

As recognized in RTO comments, NERC activities already address several aspects of resilience, including robustness, resourcefulness, rapid recovery, and adaptability of the grid. At the direction of the NERC Board of Trustees ("Board"), the Reliability Issues Steering Committee ("RISC") has also proposed a resilience framework to reexamine resilience and whether NERC should take additional action. The RISC resilience framework is based on the ALR and the National Infrastructure Advisory Council ("NIAC") Framework for Establishing Critical Infrastructure Goals (relied upon by the Commission for its proposed definition of resilience).[8] NERC will continue to assess whether further activities are appropriate to support a resilient grid, consistent with the overarching scope of ALR, the RISC resilience framework, and any applicable Commission orders. *See infra*, Section III.B.

NERC supports the Commission's renewed dialogue around resilience. The changing resource mix demands reevaluation of resilience and consideration of policies recognizing essential reliability services ("ERS") and the value of a balanced portfolio of generation and infrastructure that provide fuel assurance, particularly under extreme weather conditions. As detailed in prior NERC comments and reflected in RTO comments, the changing resource mix

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[8] A Framework for Establishing Critical Infrastructure Resilience Goals, National Infrastructure Advisory Council (October 19, 2010), *available at*, https://www.dhs.gov/xlibrary/assets/niac/niac-a-framework-for-establishing-critical-infrastructure-resilience-goals-2010-10-19.pdf.

has implications for reliability. In addition, evolving cyber and physical threats aimed at critical energy infrastructure may challenge resilience in the future. These reliability implications support policies recognizing the value of ERS and a diverse energy portfolio with sufficient fuel assurance to promote resilience. Policies supporting ERS, fuel assurance, and security as key elements of resilience would help ensure that the BPS continues to evolve in a manner that supports Reliable Operation of a resilient grid. *See infra* Section III.C.

III. COMMENTS

A. Resilience is an Element of Reliable Operation of the BPS.

Pursuant to section 215 of the FPA, NERC develops Reliability Standards based on what is necessary to achieve an adequate level of reliability for Reliable Operation of the BPS.[9] NERC must also conduct Reliability Assessments that evaluate BPS performance and identify emerging risks to reliability. Reliable Operation of the BPS includes the ability to withstand probable contingencies and the ability to manage adverse reliability impacts of disturbances in a coordinated and controlled manner.[10] As a result, the Commission's order certifying NERC as the ERO, "direct[ed] NERC to consider and propose methods for ensuring that Reliability Standards provide for an adequate level of reliability and defin[e] 'an adequate level of

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[9] 16 U.S.C. 824o(c)(1) (stating, "The Commission may certify one such ERO if the Commission determines that such ERO—(1) has the ability to develop and enforce, subject to subsection (e)(2) of this section, reliability standards that provide for an adequate level of reliability of the bulk-power system;"); *and* 16 U.S.C. 824o(a)(3)(providing, The term 'reliability standard' means a requirement, approved by the Commission under this section, to provide for reliable operation of the bulk-power system. The term includes requirements for the operation of existing bulk-power system facilities, including cybersecurity protection, and the design of planned additions or modifications to such facilities to the extent necessary to provide for reliable operation of the bulk-power system, but the term does not include any requirement to enlarge such facilities or to construct new transmission capacity or generation capacity.").

[10] 16 USC 824o(a)(4) (stating, "The term 'reliable operation' means operating the elements of the bulk-power system within equipment and electric system thermal, voltage, and stability limits so that instability, uncontrolled separation, or cascading failures of such system will not occur as a result of a sudden disturbance, including a cybersecurity incident, or unanticipated failure of system elements.").

reliability.'"[11] The Commission explained that, "unless NERC further explores what it means to provide an adequate level of reliability, targeting a valuable reliability goal may not be enough to prevent a Reliability Standard from reflecting the lowest common denominator…."[12]

Accordingly, NERC developed and filed a definition of the ALR to guide Reliability Standards development, Reliability Assessments, and technical committee work. In particular, NERC defines the ALR as the state that design, planning, and operation of the Bulk Electric System ("BES") will achieve when five performance objectives are met.[13] The ALR also lists two assessment objectives for purposes of assessing risks to reliability.[14] Each objective addresses Reliable Operation of the BES over four time frames: (1) steady state (the period before a disturbance and after restoration has achieved normal operating conditions); (2) transient (the transitional period after a disturbance and during high-speed automatic actions in response); (3) operations response (the period after the disturbance where some automatic actions occur and operators act to respond); and (4) recovery and system restoration (the time period after a widespread outage through initial restoration to a sustainable operating state and

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11 Certification Order, at P 240.

12 *Id.*

13 The ALR Performance Objectives are as follows (see ALR for detail):

1. The BES does not experience instability, uncontrolled separation, Cascading, or voltage collapse under normal operating conditions and when subject to predefined Disturbances.
2. BES frequency is maintained within defined parameters under normal operating conditions and when subject to predefined Disturbances.
3. BES voltage is maintained within defined parameters under normal operating conditions and when subject to predefined Disturbances.
4. Adverse Reliability Impacts on the BES following low probability Disturbances (e.g., multiple contingences, unplanned and uncontrolled equipment outages, cyber security events, and malicious acts) are managed.
5. Restoration of the BES after major system Disturbances that result in blackouts and widespread outages of BES elements is performed in a coordinated and controlled manner.

14 The ALR Assessment Objectives are as follows (see ALR for detail):

1. BES Transmission capability is assessed to determine availability to meet anticipated BES demands during normal operating conditions and when subject to predefined Disturbances.
2. Resource capability is assessed to determine availability to the BES to meet anticipated BES demands during normal operating conditions and when subject to predefined Disturbances.

recovery to a new steady state).[15] These periods of time correspond to the four outcome-based abilities of both the NIAC resilience framework and the Commission proposed definition of resilience: (1) robustness; (2) resourcefulness; (3) rapid recovery; and (4) adaptability.[16]

The ALR, NIAC framework, and Commission proposed definition of resilience demonstrate the manner in which resilience is an element of Reliable Operation over time in anticipation of and in response to an event. As NIAC states, "[i]nfrastructure resilience is the ability to reduce the magnitude and/or duration of disruptive events. The effectiveness of a resilient infrastructure or enterprise depends upon its ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event."[17] NERC interprets the Commission's proposed definition of resilience as intended to include both shorter-term elements of resilience and longer-term adaptability, consistent with the NIAC framework and NERC-filed ALR. Hence, resilience pertains to reliability before, during, immediately after, and in the longer-term after an event. In this way, the ALR avoids the "lowest common denominator" concern that the Commission expressed in the Certification Order, avoids making electric consumers insurers of the BES, and allows for regional approaches tailored to regional risks. NERC filed the latest definition of the ALR on May 10, 2013, after notice, comment, and NERC Board approval.

B. NERC Reliability Standards, Reliability Assessments, Event Analysis, Situational Awareness, and Other Activities Address Resilience.

A BPS that provides an adequate level of reliability is a resilient one. By defining specific performance and assessment objectives for the BES that include elements of resilience,

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15 *See*, "*Informational Filing on the Definition of Adequate Level of Reliability,*" Docket No. RR06-1-000 (filed May 10, 2013), *available at*, https://www.nerc.com/pa/Stand/Resources/Documents/Adequate_Level_of_Reliability_Definition_(Informational_Filing).pdf (including the definition of the ALR and supporting technical report).

16 *See*, NIAC Framework, at p. 13.

17 This definition is cited in a NERC report, "*Severe Impact Resilience: Considerations and Recommendations*" (May 9, 2012).

the NERC ALR supports a highly reliable and resilient grid. As expressed in the technical report attached to the ALR:

> ALR is an outcome of a multi-dimensional effort to identify Reliability Performance and Assessment Objectives and then achieve outcomes that will support reliable operations. This multi-dimensional effort is reflected in NERC's current and evolving body of reliability standards, which work together to establish a portfolio of performance outcomes, risk reduction, and capability-based reliability standards that are designed to achieve a defense in depth against an inadequate level of reliability. Other NERC programs, such as industry alerts, reliability assessments, event analysis, education, and the compliance with and enforcement of reliability standards, are designed to work in concert with reliability standards to support reliable operation. Each of these activities should be driven by the goal of consistently achieving an adequate level of reliability.

In accordance with this intent, NERC activities across the ERO Enterprise are driven towards supporting the ALR and a resilient system. As referenced in the RTO Comments,[18] these activities include, for example, Reliability Standards, GridEx, and Electric-Information Sharing Analysis Center ("E-ISAC") work. This section describes some of the ways in which NERC Reliability Standards, Reliability Assessments, Event Analysis, and other activities address resilience, while also highlighting the RISC resilience framework reexamining what is required for ALR and resilience in today's environment.

1. Reliability Standards.

As discussed in Section III.A above, NERC must develop Reliability Standards that provide for an adequate level of reliability for Reliable Operations of the BPS. Reliability Standards are defined to:

> include requirements for the operation of existing bulk-power system facilities, including cybersecurity protection, and the design of planned additions or modifications to such facilities to the extent necessary to provide for reliable

[18] *See, e.g.*, MISO Comments, at pp. 19, 21, 25, and 38; CAISO Comments, at pp. 7-8, 21-22, 26, 31, 41-42, and 113-119; PJM Comments, at pp. 4, 19-20, 30-31, 53-54, and pp. 72-73; ERCOT Comments, at pp. 3, 7, 18; SPP Comments, at pp. 5-8, 11, and 18-19; NYISO Comments, at pp. 5 and 25-27; and ISO-NE Comments, at pp. 16, 18, 40, 49-50, and 53-54. Please see RTO Comments for full discussion and further examples.

> operation of the bulk-power system, but the term does not include any requirement to enlarge such facilities or to construct new transmission capacity or generation capacity.[19]

NERC Reliability Standards work together to establish a portfolio of performance-based outcome, risk reduction, and capability standards applicable to entities within NERC's jurisdiction and designed to support Reliable Operations.[20] As recognized in the RTO comments,[21] several Reliability Standards relate to the BPS's capability to withstand disturbances in anticipation of potential events, manage the system after an event, and/or prepare to restore or rebound after an event.

For example, NERC has developed the following:

- Reliability Standard TPL-001-4 (*Transmission System Planning Performance Requirements*): providing planning performance requirements in anticipation of potential events;
- Reliability Standard EOP-004-3 (*Event Reporting*): requiring that entities report disturbances and events threatening reliability;
- Reliability Standard EOP-005-2 (*System Restoration from Blackstart Resources*): including requirements pertaining to preparation for system restoration from Blackstart resources after an event;
- Reliability Standard EOP-006-2 (*System Restoration Coordination*): requiring that plans and personnel be prepared to support system restoration after an event;
- Reliability Standard EOP-011-1(*Emergency Operations*): requiring operating plans to mitigate emergencies;
- Reliability Standard CIP-008-5 (*Cyber Security - Incident Reporting and Response Planning*): requiring plans to address reportable cyber security incidents;

[19] 16 USC §824o(a)(3).

[20] In response to CAISO's question regarding inverter-based resources, NERC clarifies that Reliability Standards apply to all resources within NERC jurisdiction.

[21] *See, e.g.*, MISO Comments, at pp. 19, 21, 25, and 38; CAISO Comments, at pp. 7-8, 21-22, 26, 31, 41-42, and 113-119; PJM Comments, at pp. 4, 19-20, 30-31, 53-54, and pp. 72-73; ERCOT Comments, at pp. 3, 7, 18; SPP Comments, at pp. 5-8, 11, and 18-19; NYISO Comments, at pp. 5 and 25-27; and ISO-NE Comments, at pp. 16, 18, 40, 49-50, and 53-54. *See also* the RTO Comments for full discussion and further examples.

- Reliability Standard CIP-014-2 (*Physical Security*): including physical security requirements; and

- Reliability Standard TPL-007-1 (*Transmission System Planned Performance for Geomagnetic Disturbance Events*): providing requirements related to geomagnetic disturbances.[22]

In addition, certain Reliability Standards codify obligations to implement lessons learned and thereby adapt after an event. See, for example:

- Reliability Standard TPL-007-1 (*Transmission System Planned Performance for Geomagnetic Disturbance Events*): requiring corrective action plans if a geomagnetic disturbance vulnerability assessment concludes that the system does not meet certain performance requirements;

- Reliability Standard PRC-004-5 (*Protection System Misoperation Identification and Correction*): requiring a corrective action plan after Protection System Misoperations or declaration explaining why corrective action plans are beyond the entity's control or would not improve BES reliability;

- Reliability Standard PRC-006-3 (*Automatic Underfrequency Load Shedding*): requiring a corrective action plan where the automatic underfrequency load shedding ("UFLS") design assessment determines that the UFLS program does not meet certain performance characteristics; and

- Reliability Standard PRC-016-1 (*Remedial Action Scheme Misoperations*): requiring that responsible entities take corrective actions to avoid future remedial action scheme misoperations.[23]

These examples demonstrate how Reliability Standards support resilience, without requiring the construction of facilities or otherwise exceeding the scope of section 215 of the FPA.

2. Reliability Assessments.

In recognition of NERC's commitment to assess industry performance, analyze trends, and learn from performance successes and failures, NERC performs Reliability Assessments on potential risks to the BPS. This allows the ERO Enterprise to focus on and align activities in

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[22] *See*, NERC Complete Set of Reliability Standards, *available at*, https://www.nerc.com/pa/Stand/Reliability%20Standards%20Complete%20Set/RSCompleteSet.pdf (last updated Feb. 15, 2018) (providing the full set of NERC Reliability Standards).

[23] *Id.*

support of Reliable Operations of the BPS. NERC Reliability Assessments must evaluate the adequacy and operating reliability of the BPS. Resource adequacy reflects the ability of the system to supply electricity to meet consumer demand at all times.[24] Operating reliability is the ability of the system to withstand sudden disturbances to system stability or unanticipated loss of components.[25] Both of these concepts reflect an assessment of the resilience of the system as a whole.

The NERC Reliability Assessments program is in and of itself a component of resilience, as it serves as a credible source of information for policy makers and stakeholders. At a high level, Reliability Assessments evaluate the: 1) adequacy of resources to meet demand and energy requirements; 2) sufficiency of ERS; 3) capability of the transmission system to accommodate projected resources and demand; 4) vulnerabilities to fuel supply, transportation, and delivery; and 5) ability to manage extreme conditions. For example, NERC's Long-Term Reliability Assessment ("LTRA") provides an annual update of a ten-year outlook identifying key issues and reliability challenges facing the BPS. NERC Reliability Assessments serve as an independent resource and technical platform for important policy discussions.

In addition to NERC's annual Reliability Assessments, NERC conducts Special Reliability Assessments on topic-specific issues that require a closer examination. A recent example of this is NERC's 2017 *Special Reliability Assessment: Potential Bulk Power System Impacts Due to Severe Disruptions on the Natural Gas System.*[26] The assessment was primarily prepared in response to the continuing trend of increasing reliance on natural gas capacity, as

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[24] October 2017 Filing, at Exhibit B, at p. 1 (stating, "NERC defines the reliability of the interconnected BPS in terms of two basic and functional aspects).

[25] *See supra* text accompanying note 17 (regarding NIAC's definition of resilience).

[26] *Special Reliability Assessment: Potential Bulk Power System Impacts Due to Severe Disruptions on the Natural Gas System*, NERC (Nov. 2017), *available at*, https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_SPOD_11142017_Final.pdf

highlighted in several of NERC's LTRAs and by the temporary closure of the Aliso Canyon natural gas storage facility in Southern California. Prior NERC assessments concluded that the growing interdependence of the natural gas and electric infrastructure resulted in new operational and planning reliability challenges that policy makers and industry should consider when making decisions. For example, the Aliso Canyon natural gas storage facility leak underscored not only the reliance on natural gas to meet electric demand, but also how the disruption of a single key natural gas infrastructure component can affect BPS reliability. The primary take-away of the 2017 assessment was that more planning studies are needed to inform policy makers, system planners, and market operators, and to support actions addressing the unique risks each system may have. ISO-NE's "Operational Fuel-Security Analysis," reviewing New England's unique reliability risks concerning increasing dependency on natural gas generation coupled with limited natural gas pipeline, fuel storage, and transportation options, provides a good example of how NERC assessments have contributed to further analysis of regional risks.[27]

The *State of Reliability 2017 Report* ("2017 SOR") provides additional detail on how NERC uses reliability indicators to tie the performance of the BES to the reliability performance objectives in the ALR. NERC's reliability indicators address risks to the BES, recovery after events, and ERS by examining, for example:

- Metric M-2: BPS Transmission-Related Events Resulting in Loss of Load;
- Metric M-4: Interconnection Frequency Response;
- Metric M-6: Average Percent Nonrecovery Disturbance Control Standard Events;
- Metric M-7: Disturbance Control Events Greater than Most Severe Single Contingency;

[27] ISO-NE Comments, at p. 1 (discussing the Operational Fuel-Security Analysis published Jan. 17, 2018).

- Metric M-8: Interconnected Reliability Operating Limit/System Operating Limit (IROL/SOL) Exceedances;
- Metric M-9: Correct Protection System Operations; and
- Metric M-11: Energy Emergency Alerts.[28]

As demonstrated by the 2017 SOR, NERC then evaluates performance in comparison to these reliability indicators to determine whether the BES meets the ALR and whether reliability is improving.

3. Event Analysis Program.

The NERC Event Analysis Program also serves an integral component of NERC's efforts in favor of resilience by supporting continuous improvement and learning from past events. In particular, Event Analysis provides insight and guidance by identifying and disseminating valuable information to owners, operators, and users of the BPS to enable improved and more reliable operations. Through this program, NERC evaluates BPS events by undertaking appropriate levels of analysis to determine the causes of the events, promptly assuring tracking of corrective actions designed to prevent recurrence, and providing lessons learned to the industry. NERC's August 2017 *Hurricane Harvey Event Analysis Report*, for example, provided analysis of Hurricane Harvey's impact on the BPS to ensure a complete, coherent, review and documentation of the event and restoration efforts.[29]

Event Analysis has augmented its activities to take into consideration issues affecting resilience under the changing resource mix. For example, in June 2017, the NERC Planning and Operating Committees created the Inverter-based Resource Performance Task Force ("IRPTF")

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[28] *See*, 2017 SOR, at Chapter 4 and Appendix E (providing a full list of reliability indicators and discussing conclusions for the 2017 SOR), *available at*, https://www.nerc.com/pa/RAPA/PA/Performance%20Analysis%20DL/SOR_2017_MASTER_20170613.pdf.

[29] *August 2017 Hurricane Harvey Event Analysis Report*, NERC (Aug. 2017), *available at*, https://www.nerc.com/pa/rrm/ea/Pages/August-2017-Hurricane-Harvey-Event-Analysis-Report.aspx.

to consider some of the new challenges associated with the changing resource mix, specifically, the proliferation of inverter based resources. The task force is producing a guideline for inverter-based resource performance to support BPS reliability. While none of the inverter-based resource events examined to date meet the threshold of a NERC reportable event, NERC has continually reviewed and reported on the small occurrences, before they can become bigger events. In 2016, NERC issued the *1200 MW Fault Induced Solar Photovoltaic Resource Interruption Disturbance Report* regarding the Blue Cut Fire in Southern California, detailing issues created by solar inverter settings and recommendations to help mitigate future interruptions. The October 2017 *Canyon 2 Fire Disturbance Report*, described the Canyon 2 Fire in the Southern California area, key findings regarding solar inverter issues, and recommendations thereafter to support reliable operation of the BPS. Further, in February 2018, NERC published the *900 MW Fault Induced Solar Photovoltaic Resource Interruption Disturbance Report.* The Event Analysis process provides valuable input for training and education, reliability trend analysis efforts, and Reliability Standards development, all of which support continued improvement of reliability. As a result, Event Analysis operates as one of the pillars of NERC's foundational activities in support of resilience.

NERC strives to develop a culture of reliability excellence that promotes and rewards aggressive self-critical review and analysis of operations, planning, and critical infrastructure protection processes. This helps avoid similar or repeated events through the timely identification and correction of event causes and the sharing of lessons learned. For example, based on analysis in the *1200 MW Fault Induced Solar Photovoltaic Resource Interruption Disturbance Report*, NERC recently issued recommendations for reliability through an Alert after NERC observed loss of solar resources during transmission disturbances due to the low-voltage ride through setting of photovoltaic inverters.[30] Other NERC Alerts have addressed topics such as supply chain risk, threats targeting the electric industry and other critical sectors, vegetation management, and frequency response.[31] These Alerts demonstrate how Event Analysis contributes to resilience by focusing on the robustness of the grid, adaption to lessons learned, risks to reliability, and the changing resource mix.

4. Situational Awareness and Information Sharing Through the E-ISAC and NERC Bulk Power System Awareness.

NERC's activities as part of the E-ISAC and Bulk Power System Awareness ("BPSA") also contribute to resilience. A major disruption in electric service due to an event on the system, such as cyber-security incident or physical attack, could have far-reaching effects. As a result, the ERO Enterprise has instituted several initiatives to ensure a more resilient system, better secured against cyber and physical threats to the grid.

The E-ISAC serves as the primary security communications channel for the electricity industry and enhances industry readiness and ability to respond to threats, vulnerabilities, and incidents that could affect the BPS. The E-ISAC's Cybersecurity Risk Information Sharing Program ("CRISP") also provides a voluntary program to facilitate real-time, computer-to-computer data exchange involving potential security threats identified through monitoring participating utility networks. Further, the E-ISAC holds a biannual GridEx conference to allow participants the opportunity to self-assess their emergency response and recovery plans through simulated security exercises featuring stresses on the system.

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30 *See*, *Loss of Solar Resources during Transmission Disturbances due to Inverter Settings*, NERC (June 20, 2017), *available at*, https://www.nerc.com/pa/rrm/bpsa/Alerts%20DL/NERC%20Alert%20Loss%20of%20Solar%20Resources%20during%20Transmission%20Disturbance.pdf.

31 *See*, NERC Alerts, *available at*, https://www.nerc.com/pa/rrm/bpsa/Pages/Alerts.aspx.

Similarly, the NERC BPSA collects and analyzes information on system disturbances and other incidents that affect the North American BPS. The BPSA then disseminates this information to internal departments, registered entities, regional organizations, and governmental agencies as necessary. In addition, the BPSA monitors ongoing storms, natural disasters, and geopolitical events that may affect or are currently affecting the BPS. The BPSA issues alerts to NERC registered entities and the electricity sector upon discovering, identifying or receiving information that is critical to ensuring the reliability of the BPS. These activities by the E-ISAC and BPSA help support a BPS better able to anticipate, withstand, respond to, recover from, and learn from events.

5. The RISC Resilience Framework.

Building on the efforts summarized above, and as shown in the following table, the RISC identified a variety of ongoing NERC activities for resilience that correspond to the NIAC framework and Commission proposed definition of resilience. The elements of the RISC resilience framework are very similar to the NIAC framework with certain clarifications shown below in red. For example, the Critical Infrastructure Protection Committee suggested that NERC could improve the resilience framework by incorporating detection as an explicit aspect of resourcefulness. The RISC is examining whether further NERC action on resilience is appropriate. At the May 2018 Member Representatives Committee Meeting, the RISC will summarize its analysis and any recommendations for the NERC Board.

NIAC Resilience Constructs[32]	Key Programs and Activities	Specific Efforts\Tools

Robustness—The ability to continue operations in the face of disaster. In some cases, it translates into designing structures or systems to be strong enough to take a foreseeable punch. In others, robustness requires devising substitute or redundant systems that can be brought to bear should something important break or stop working. Robustness also entails investing in and maintaining elements of critical infrastructure so that they can withstand low probability but high consequence events.	• Reliability and Emerging Risk Assessments
	• Risk, Event and Performance Monitoring
	• Technical Committee work, including special projects
	• Mandatory Reliability Standards
	• Reliability Guidelines and technical reference documents
	• System Operator Certification and Credential Maintenance
	• System Operator Training
	• E-ISAC information sharing programs
		• Alerts
		• State of Reliability Report
		  o GADS
		  o TADS
		  o DADS
		  o Protection system misoperations
		  o TEAMS
		  o FR Performance
		• Long-Term Reliability Assessment
		• Key Reliability Standards:
		  o TPL (Extreme)
		  o EOP
		  o Blackstart Restoration
		  o Personnel Credentials
		• GridEx
		• Security conferences and information sharing (e.g. GridSecCon)
		• Supply Chain Security
		• Security Practices

Resourcefulness—The ability to skillfully detect and manage a disaster as it unfolds. It includes identifying options, prioritizing what should be done both to control damage and to begin mitigating it, and communicating decisions to the people who will implement them. Resourcefulness depends primarily on people, not technology.	• Situational Awareness and Industry Coordination
	• Government Coordination
	• Cross-Sector Information Sharing
	• Mandatory Reliability Standards/Functional Model
	• Reliability Guidelines and technical reference documents
	• System Operator Certification and Credential Maintenance
	• System Operator Training
		• BPSA information sharing tools and processes
		• E-ISAC information sharing tools and processes
		• Formation of a Crisis Action Team to support industry and governmental coordination
		• GridEx
		• Standards requirements
		  o Reliability Coordinators
		  o Transmission Operators
		  o Communications

Rapid recovery—The capacity to get things back to normal as quickly as possible after a disaster in a coordinated and controlled manner. Carefully drafted contingency plans, competent emergency operations, and the means to get the right people and resources to the right places are crucial.	• Situational Awareness, Industry Coordination • Government Coordination • Cross-Sector Information Sharing • Reliability Guidelines and technical reference documents • System Operator Certification and Credential Maintenance • System Operator Training	• Support for Electric Sector Coordinating Council activities • BES simulation • System restoration coordination

Adaptability—The means to absorb new lessons that can be drawn from a catastrophe. It involves revising plans, modifying procedures, and introducing new tools and technologies needed to improve robustness, resourcefulness, and recovery capabilities before the next crisis.	• Reliability and Emerging Risk Assessments • Event Analysis • Event Forensics • Reliability Guidelines and technical reference documents • System Operator Certification and Credential Maintenance • System Operator Training • Periodic Review	• Technical Committee Recommendations • Reliability Guidelines • Lessons Learned • Event Analysis, Investigations • Audit Recommendations • Reliability Assessments • State of Reliability Report • Annual BES Security Assessment • BES Security Metrics • Training • BES simulation • Emergency operations

C. The Commission Should Continue Policy Reform Recognizing Attributes of a Reliable and Resilient BPS.

As detailed in NERC's Comments in Docket No. RM18-1-000, the changing resource mix is altering the operational characteristics of the BPS.[33] This warrants reexamination of what is necessary to maintain a reliable system, including its resilience. NERC Reliability Assessments demonstrate that resilience depends on the operating characteristics of the evolving resource mix and the capability of such resources to provide ERS. The Event Analysis reports referenced above and Alert on solar inverter settings further illustrate how the changing resource mix may affect ERS. As highlighted in SPP's Comments, ERS (such as capacity, voltage support, system inertia, and frequency response) "supports resilience by virtue of unique characteristics and abilities to respond to a significant disturbance."[34] NERC supports continued Commission action, such as the recent primary frequency response order, recognizing the value

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[32] Those items in red indicate NERC additions to the NIAC framework that includes the ability to detect (such as cyber incidences or equipment failure modes), or ensure rapid recovery includes that it is performed in a coordinated and controlled manner per the ALR.

[33] *Comments of the North American Electric Reliability Corporation in Response to Grid Reliability and Resilience Pricing Notice of Proposed Rulemaking*, Docket No. RM18-1-000 (filed Oct.23, 2017) ("October 2017 Filing").

[34] SPP Comments, at p. 16.

of ERS and requiring integration of newly interconnecting resources in a manner that supports a reliable and resilient grid.[35]

In addition to ERS, fuel assurance and diversity are critical elements of a reliable and resilient system. A balanced portfolio of generation resources and transmission infrastructure ensures that the system has adequate capacity to meet consumer needs and is ready to respond to events.[36] As the resource mix changes, variable energy resources are expanding and the balancing resource often tends to be natural gas-fired generation. Natural gas-fired resources serve a key function in the generation fleet and depend upon a generally reliable fuel supply, for which fuel is transported on a "just-in-time" basis. Comments in this proceeding have underscored implications of this trend for reliability across regions.[37] NERC's October 2017 Filing also discussed how single source fuel dependency could have adverse impacts under common mode outages.[38] Recognizing that generating capacity alone does not guarantee dispatchable energy, it is also important to understand the difference in the potential outage rates of natural gas fired generating units with firm gas transportation compared to those units that lack firm transportation. As highlighted in NERC's 2014/2015 Winter Reliability Assessment, "increased reliance on gas-fired generation requires new approaches for assessing reliability."[39]

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[35] *Essential Reliability Services and the Evolving Bulk-Power System—Primary Frequency Response*, Order No. 842, 162 FERC ¶ 61,128 (2018).

[36] October 2017 Filing, Exhibit B, at p. 1.

[37] *See, e.g.*, MISO Comments, at pp. 23 and 37; CAISO Comments, at pp. 15 and 171; PJM Comments, at pp. 5-8 and 26; ERCOT Comments, at p. 19; ERCOT Comments, at p. 5; NYISO Comments at pp. 25 and 31; and ISO-NE Comments, at pp. 22 and 26. *See also* the RTO Comments for full discussion and further examples.

[38] October 2017 Filing, at Exhibit B, at p. 1. Natural gas fuel dependency may be particularly concerning in areas where: (i) generators rely on interruptible gas pipeline transportation; (ii) natural gas interstate pipelines are constrained to meet demand beyond what has been contracted and committed; and (iii) there is greater reliance on natural gas-fired generation as a "primary" generation resource

[39] 2014–2015 Winter Reliability Assessment, at p. 8.

Without unduly favoring any generation resource or infrastructure, the Commission should consider policies that build upon its prior examination of natural gas – electric coordination.[40] For example, the Commission could encourage firm transportation, multiple pipeline connections, and dual-fuel capability as measures to reduce the risk of common-mode failure and wider-spread reliability challenges from fuel supply disruptions. Further, the Commission could consider requiring that resource adequacy assessments account for potential reliability ramifications associated with the "just-in-time" natural gas fuel delivery model. Finally, the Commission could consider whether it would be beneficial to pursue market rules that would provide assurances that generators will perform in normal and extreme circumstances. The RTO comments similarly highlighted mechanisms that could help or were already helping their region address potential risks associated with natural gas supply contingencies.[41] As NERC recommended in Docket No. RM18-1-000, the Commission should consider further policies acknowledging the value of reliability attributes provided by all resources, and require integration of new resources in a manner that supports a reliable electric grid, resilient in the face of events on the system.

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[40] *See, e.g.*, *Request for Comments of Commissioner Moeller on Coordination between the Natural Gas and Electricity Markets*, Docket No. AD12-12-000 (Feb. 3, 2012).

[41] *See, e.g.*, NYISO Comments, at pp. 31-32; ERCOT Comments, at p. 19; ISO Comments, at pp. 7 and 11-12; *and* PJM Comments, at pp. 5-8. Please see RTO Comments for full discussion and further examples.

IV. CONCLUSION

NERC appreciates the Commission's attention to resilience. As discussed above, resilience is an element of reliability in relation to an event. NERC has defined the adequate level of reliability to encompass aspects of resilience. In accordance with the ALR and section 215 of the FPA, NERC Reliability Standards, Reliability Assessments, Event Analysis, and other activities address resilience, even as the RISC continues examining whether further action is appropriate. NERC recommends that the Commission continue to pursue policies supporting reliability, including resilience.

Respectfully submitted,

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Date: May 9, 2018

CERTIFICATE OF SERVICE

I hereby certify that I have served a copy of the foregoing document upon all parties listed on the official service lists compiled by the Secretary in Docket No. AD18-7-000.

Dated at Washington, DC this 9th day of May 2018.

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