Grid Resilience in RTOs and ISOs

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Special Markets & Reliability Committee
February 23, 2018

FERC Order – January 8, 2018

Unanimous decision with three concurrences (Chatterjee, LaFleur & Glick)

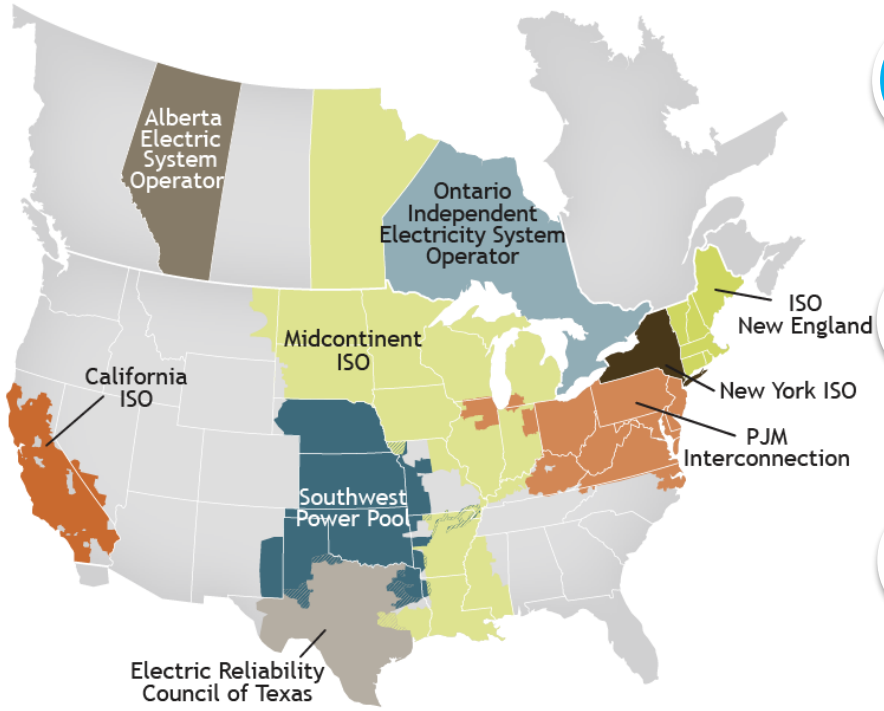
Terminated the DOE NOPR proceeding: Proposed Rule on Grid Reliability and Resilience Pricing

T H E N

Initiated a new proceeding: Grid Resilience in Regional Transmission Organizations and Independent System Operators

N O W

FERC's Goals of the Grid Resilience Proceeding



FERC's Goals…

1. To develop a common understanding among FERC, industry and others of resilience
2. To understand how each RTO/ISO assesses resilience in its geographic footprint
3. To use this information to evaluate whether additional FERC action regarding resilience is appropriate

Key Points in the FERC Order

A L L E N C O M P A S S I N G

RTOs/ISOs: Well-suited to understand the needs of their respective regions and to assess how to address resilience given their geographic needs

Proper evaluation of grid resilience should include:

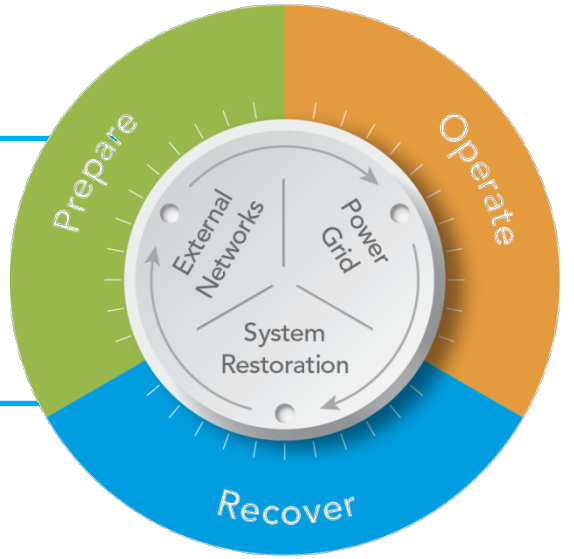
- wholesale electric market rules
- planning and coordination
- NERC standards

A Common Understanding of Resilience

FERC's Proposed Definition: The 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 recover from such an event.

PJM's Working Definition: The ability to withstand or quickly recover from events that pose operational risks.

Prepare + Operate + Recover



FERC on Risk Assessment: At the most basic level, ensuring resilience requires that we

(1) determine which risks to the grid we are going to protect against, and

(2) identify the steps, if any, needed to ensure those risks are addressed.

Proposed Resilience Definition

FERC should adopt a definition of Resilience:

The ability to withstand ~~and~~ or reduce the magnitude and/or duration of disruptive events, which includes the capability to ~~anticipate,~~ identify and mitigate vulnerabilities and threats, and plan for, prepare for, absorb, adapt to, and/or ~~rapidly~~ recover from such an event.

Resilience is an Extension of Reliability

The Commission should affirm that resilience is an extension of reliability. Section 215 of the FPA (16 U.S. Code § 824o(a)(4)) states: 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*.

The Commission should affirm that Resilience is an extension of the required Planning characteristics of an RTO (18 CFR 35.34(k)(7)).

Key Themes of PJM's Response

- RTOs should have an affirmative role in planning for resilience.
- Resilience of wholesale supply is best addressed through RTO markets.
- RTO authority during extended periods of degraded operations and/or unanticipated restoration scenarios should be clarified.
- Additional federal leadership to improve communication and coordination with interdependent infrastructure systems is needed.

RTO Leadership on Resilience Risk Assessment

Elements of Risk = Vulnerability + Cause/Threat + Probability/Possibility + Impact

High-Impact, Low-Frequency (HILF) events are not amenable to quantitative probability-based cost-benefit analyses commonly used for risk assessment.

PJM's independence and expertise uniquely positions it to perform the HILF risk assessment and qualitative analyses *for the region*. PJM is well positioned to:

- identify regional vulnerabilities,
- identify the mitigating solutions, and
- assess the efficiency, effectiveness/impact, and feasibility of such solutions.

PJM will request additional federal guidance/support/process on the identification of risks to be mitigated.

FERC Action on Planning

FERC should direct that each RTO submit additional filings setting forth any necessary changes to its tariff to address resilience planning, including providing information regarding any criteria changes (manuals or Form 715) and any related processes/rules.

Each RTO should identify the type of vulnerabilities/threats that it intends to mitigate (or engage in planning to resolve). Examples of items to be addressed through criteria:

i. NERC CIP-014 – critical infrastructure

ii. NERC TPL-001 – Extreme Events or “maximum credible disturbance”

Planning goes beyond transmission planning and includes a larger RTO role in system protection and restoration planning.

Resource Resilience through Markets

- The first principal of ensuring reliability and resilience is ensuring that the markets are sending the correct price signals.
- The second principal is compensating generation based upon the desired operational attributes.
- Out-of-market or cost-based compensation should be used only under limited circumstances.

FERC Action on Markets

FERC should direct that each RTO submit additional filings on market reforms and any related compensation mechanisms that are necessary or appropriate to advance resilience efforts.

a. Improved shortage pricing, fast start pricing, operating reserve markets;

b. Black start fuel requirements; critical load fuel requirements;

c. Provisions for non-market operations and cost compensation; and

d. Continued focus on capacity and energy market pricing.

FERC Action on RTO Authority

- Confirmation of RTO authority during extended periods of degraded operations and/or unanticipated restoration scenarios.
- PJM has broad emergency powers under its governing documents and Manual 13.
- Some of PJM's rules regarding out-of-market actions assume that there is in fact a market.
- Additional clarity is needed regarding:
    - right to suspend market operation,
    - right to direct generator operations, and
    - providing cost-based compensation.

FERC Action on Interdependent Systems

RTOs need better information from interdependent systems – principally interstate gas pipelines, local distribution companies, and telecom providers, as well as water utilities.

Gas pipeline coordination improvements:

a. Real-time communications of disruptions and anticipated flow restrictions;
b. Prospective identification and communication of system contingencies, vulnerabilities, and resilience plans;
c. Modeling the impact of adverse events;
d. Improved coordination of restoration plans;
e. Revisions to planning, operations, and service categories to better accommodate generation customer needs:
    (i) Interconnection coordination; and
    (ii) New generation-friendly offerings including flexible products/services.
f. Cyber and physical security standards.

Other Topics

- Review of minimum interconnection standards
  - RTO role in mandating dual fuel and/or black start
  - RTO role in mitigating any increases of critical infrastructure or resilience risks
- Exploring the role of new technologies in resilience
  - Storage as transmission or black start; role of Distributed Energy Resources (DERs)
- RTOs need better transparency of DERs
- NERC/NAESB efforts

Appendix – Questions Posed by FERC on Grid Resilience in Regional Transmission Organizations and Independent System Operators

AD18-7-000

How RTOs/ISOs *Assess* Threats to Resilience

a) What are the primary risks to resilience in your region from both naturally occurring and man-made threats? How do you identify them? Are they short-, mid-, or long-term challenges?

b) How do you assess the impact and likelihood of resilience risks?

c) Please explain how you identify and plan for risks associated with high-impact, low-frequency events (e.g., physical and cyber attacks, accidents, extended fuel supply disruptions, or extreme weather events). Please discuss the challenges you face in trying to assess the impact and likelihood of high-impact, low-frequency risks. In addition, please describe what additional information, if any, would be helpful in assessing the impact and likelihood of such risks.

How RTOs/ISOs *Assess* Threats to Resilience

d) Should each RTO/ISO be required to identify resilience needs by assessing its portfolio of resources against contingencies that could result in the loss or unavailability of key infrastructure and systems? For example, should RTOs/ISOs identify as a resilience threat the potential for multiple outages that are correlated with each other, such as if a group of generators share a common mode of failure (e.g., , a correlated generator outage event, such as a wide-scale disruption to fuel supply that could result in outages of a greater number of generating facilities)? The RTOs/ISOs should also discuss resilience threats other than through a correlated outage approach. Do RTOs/ISOs currently consider these types of possibilities, and if so, how is this information used?

How RTOs/ISOs *Assess* Threats to Resilience

e) Identify any studies that have been conducted, are currently in progress, or are planned to be performed in the future to identify the ability of the bulk power system to withstand a high-impact, low-frequency event (e.g., physical and cyber-attacks, accidents, extended fuel supply disruptions, or extreme weather events). Please describe whether any such studies are conducted as part of a periodic review process or conducted on an as-needed basis.

f) In these studies, what specific events and contingencies are selected, modeled, and assessed? How are these events and contingencies selected?

g) What criteria (e.g., load loss (MW)), duration of load loss, vulnerability of generator outages, duration of generator outages, etc.) are used in these studies to determine if the bulk power system will reasonably be able to withstand a high-impact, low-frequency event? Are the studies based on probabilistic analyses or deterministic analyses?

How RTOs/ISOs *Assess* Threats to Resilience

h) Do any studies that you have conducted indicate whether the bulk power system is able to reasonably withstand a high-impact, low frequency event? If so, please describe any actions you have taken or are planning as mitigation, and whether additional actions are needed.

i) How do you determine whether the threats from severe disturbances, such as those from low probability, high impact events require mitigation? Please describe any approaches or criteria you currently use or otherwise believe are useful in determining whether certain threats require mitigation.

j) How do you evaluate whether further steps are needed to ensure that the system is capable of withstanding or reducing the magnitude of these high-impact, low frequency events?

k) What attributes of the bulk power system contribute to resilience? How do you evaluate whether specific components of the bulk power system contribute to system resilience? What component-level characteristic, such as useful life or emergency ratings, support resilience at the system level?

How RTOs/ISOs *Assess* Threats to Resilience

l) If applicable, how do you determine the quantity and type of bulk power system physical asset attributes needed to support resilience? Please include, if applicable, what engineering and design requirements, and equipment standards you currently have in place to support resilience? Are those engineering and design requirements designed to address high-impact, low-frequency events? Do these requirements change by location or other factors?

m) To what extent do you consider whether specific challenges to resilience, such as extreme weather, drought, and physical or cyber threats, affect various generation technologies differently? If applicable, please explain how the different generation technologies used in your system perform in the face of these challenges.

n) To what extent are the challenges to the resilience of the bulk power system associated with the transmission system or distribution systems, rather than electric generation, and what could be done to further protect the transmission system from these challenges?

How RTOs/ISOs *Assess* Threats to Resilience

o) Over what time horizon should the resilience assessments discussed above be conducted, and how frequently should RTOs/ISOs conduct such an analysis? How could these studies inform planning or operations?

p) How do you coordinate with other RTOs/ISOs, Planning Coordinators, and other relevant stakeholders to identify potential resilience threats and mitigation needs?

q) Are there obstacles to obtaining the information necessary to assess threats to resilience? Is there a role for the Commission in addressing those obstacles?

r) Have you performed after-the-fact analyses of any high-impact, low-frequency events experienced in the past on your system? If so, please describe any recommendations in your analyses and whether they have or have not been implemented.

s) Please provide any other information that you believe the Commission would find helpful in its evaluation of the resilience of the RTO/ISO systems.

How RTOs/ISOs *Mitigate* Threats to Resilience

a) Describe any existing operational policies or procedures you have in place to address specific identified threats to bulk power system resilience within your region. Identify each resilience threat (e.g., the potential for correlated generator outage events) and any operational policies and procedures to address the threat. Describe how these policies or procedures were developed in order to ensure their effectiveness in mitigating the identified risks and also describe any historical circumstances where you implemented these policies or procedures.

b) How do existing market-based mechanisms (e.g., capacity markets, scarcity pricing, or ancillary services) currently address these risks and support resilience?

c) Are there other generation or transmission services that support resilience? If yes, please describe the service, how it supports resilience, and how it is procured.

How RTOs/ISOs *Mitigate* Threats to Resilience

d) How do existing operating procedures, reliability standards (e.g., N-1 NERC TPL contingencies), and RTO/ISO planning processes (e.g., resource adequacy programs or regional transmission planning) currently consider and address resilience?

e) Are there any market-based constructs, operating procedures, NERC reliability standards, or planning processes that should be modified to better address resilience? If so, please describe the potential modifications.