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Independent System Operator

Overview of Industry Activities Related to Inverter-Based Resources and IEEE 2800

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Overview

- **The purpose of this presentation is to provide a high-level overview of various industry activities related to Inverter-Based Resources (IBR) and IEEE 2800**
  - This presentation is not a comprehensive review of all industry activities but is meant to highlight important issues and information related to reliability
- **The IEEE 2800 standard establishes uniform technical minimum requirements for the interconnection, capability, and lifetime performance of IBRs connecting to the transmission (and sub-transmission) system**
  - Standard includes performance requirements for the reliable integration of IBRs to the transmission system including:
    - Voltage and frequency ride through, active power control, reactive power control, dynamic active power support under abnormal voltage and frequency conditions and other aspects
  - Standard was published in April 2022
  - IEEE 2800 is a voluntary standard and requires adoption by the appropriate authorities to become mandatory

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FERC Order RM22-12

- **FERC Notice of Proposed Rule Making (Docket No. RM22-12-000) issued November 17, 2022 proposes to direct NERC to develop new or modified Reliability Standards that address reliability gaps related to IBRs including data sharing, model validation, planning and operation studies, and performance requirements**
  - The need for these reforms are rooted in actual system events that showed IBR related adverse reliability impacts on the transmission system
  - Within this NOPR, FERC recognizes that at least 12 events have demonstrated common mode failures of IBRs in that the IBRs have acted "unexpectedly and adversely in response to normally cleared faults"
    - These 12 events plus another event in Odessa Texas (bringing the total to 13) are described in detail in the published NERC major event reports (found here)
  - FERC recognizes that as the resource mix trends towards increased penetrations of IBRs, the risks that these resources pose to reliable operation underscore the need for mandatory reliability standards to address these issues on a nationwide basis
- **Industry comments on this NOPR were due to FERC on February 6**

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NERC Actions to Address IBR Reliability Risks

- As highlighted in FERC Order RM22-12, NERC has begun to address some of the reliability risks posed by IBRs such as:
  - Published 8 reports on 13 disturbance events,
  - Issued two NERC alerts loss of solar PV IBRs,
  - Issued four reliability guidelines,
  - Formed the Inverter-Based Resource Subcommittee (IRPS) and System Planning Impacts on Distributed Energy Resources Working Group (SPIDERWG),
  - Issues various technical reports regarding IBR data collection and performance, and
  - Issued an IBR strategy document
- NERC has also posted the NERC Quick Reference Guide: Inverter-Based Resource Activities (found here), which provides a high-level overview regarding IBR strategy, disturbance reports, alerts, reliability guidelines, white papers, technical reports, SAR activities, and other IBR related items

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NERC IBR Strategy

- NERC developed the IBR strategy document to ensure industry awareness and alignment
- Risk analysis, interconnection process improvements, best practices and education, and regulatory enhancements are the four key areas
  - Each focus area includes specific items that are described in more detail in the NERC IBR strategy document
- The following slides provide a few high-level details of some aspects within these key areas

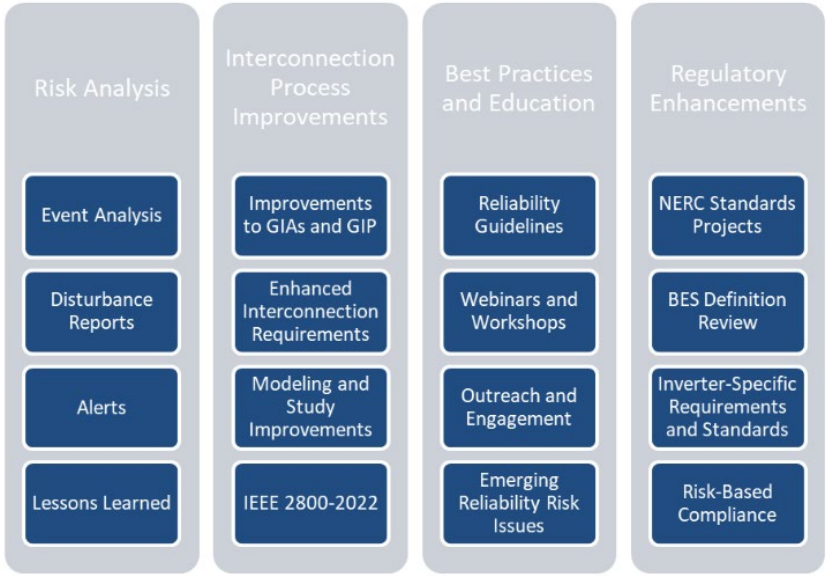

Figure 1: NERC Inverter-Based Resource Strategy

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NERC Reliability Guidelines

- NERC reliability guidelines, security guidelines, technical reference documents, and whitepapers are posted on the NERC website (here)
- The NERC IBR quick reference guide includes the following four reliability guidelines:

Title	Published
Integrating Inverter-Based Resources into Low Short Circuit Strength Systems	December 2017
BPS Connected Inverter-Based Resource Performance	September 2018
Improvements to Interconnection Requirements for BPS-Connected Inverter-Based Resources	September 2019
Performance, Modeling, and Simulations of BPS-Connected Battery Energy Storage Systems and Hybrid Power Plants	March 2021

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NERC Event Analysis & Disturbance Reports

- **NERC event analysis provides key findings and recommendations to industry stakeholders through information published in lessons learned and major event reports**
  - These efforts by NERC involve working with NERC registered entities along with manufacturers, developers, national laboratories, the U.S. Department of Energy, research institutes, and other international colleagues in an effort to enhance the performance of IBRs for existing and proposed interconnection projects
  - These reports provide findings from the disturbance analysis, an assessment of modeling and studies, along with recommendation and actions needed

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Recent NERC Major Event Report

- The 2022 Odessa Disturbance is the most recent disturbance report and was published in December 2022
  - Event was a phase-to-ground fault which cleared in 3 cycles
  - A similar issue occurred at the same facility in 2021 and is documented in the 2021 Odessa Disturbance Report
- The 2022 Odessa disturbance resulted in the loss of 844 MW of synchronous generation (only 333 MW were consequential with the fault) and 1,711 MW of solar PV, bringing the total generation lost to 2,555 MW
  - No solar PV resources were de-energized as a direct consequence of protective relaying removing the faulted element from service – rather, controls and protection within each solar plant caused the reduction in output
- The report documents the mitigating actions to address the loss of synchronous generation as well as over 1,600 MW of solar PV
  - The resolutions primarily include the disabling of specific inverter protection features, adjustment of control settings, and/or other software or firmware upgrades
- The recommendations and actions needed documented in the 2022 Odessa Disturbance continue to build upon the recommendations from all prior disturbance reports involving IBRs and include topics such as NERC standards enhancements to address performance, modeling, and studies gaps for IBRs as well as additional industry activities (such as the adoption of NERC reliability guidelines) and actions in the Area where the disturbance occurred

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NERC Standards Projects Related to IBRs

- NERC has several reliability standards under development (found here)
- Several of these standards under development are related to IBRs
  - Project 2020-02: Modifications to PRC -024 Generator Ride-Through
  - Project 2020-06: Verifications of Models and Data for Generators
  - Project 2021-01: Modifications to MOD -026 and PRC-019
  - Project 2021-02: Modifications to VAR -002
  - Project 2021-04: Modifications to PRC -002
  - Project 2022-02: Modifications to TPL -001-5.1 and MOD-032-1
  - Project 2022-04: EMT Modeling
- Project 2018-04 and 2020-05 are related to IBRs, but are under the archived section of the NERC reliability standards under development (found here)
- The NERC IRPS workplan (found here) identifies several other reliability guidelines, standard authorization requests, and IBR-related follow-up activities

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NYSRC IBR Activities

- **NYSRC held a workshop on September 13, 2022 to introduce NYSRC's Proposed Reliability Requirement (PRR) for Interconnection of IBRs to NYCA's BPS based on IEEE 2800-2022 (materials available here)**
- **At the January 19, 2023 TPAS meeting the NYSRC presented the IEEE 2800 - IBR working group work plan (found here)**
  - The objective is to develop a potential reliability rule for IBR interconnects in NYCA based on critical IEEE 2800-2022 requirements before NYISO class year 2023
  - The key steps outlined by the NYSRC in this presentation include
    - Defining the critical IEEE 2800 performance and validation requirements for immediate adoption, and
    - Defining the application

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Industry Presentations on IBRs and IEEE 2800

- On May 3, 2022, there was a joint NERC/NATF/NAGF/EPRI webinar (found here) on IEEE 2800 covering, among other things:
  - Purpose, scope, and applicability of IEEE 2800,
  - High level review of selected requirements, and
  - Some thoughts on the potential adoption of the standard in North America
- On November 2, 2022, there was a workshop (found here) by NATF/NERC/EPRI which also covered various aspects of IEEE 2800 from various companies and groups across the industry such as:
  - American Electric Power, Hawaiian Electric Company, Southern California Edison, ERCOT, Entergy, EPRI, NERC, and others
- Recordings of the May 3 and November 2 webinars are found on the NERC website (here)

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EPRI-NAGF-NATF-NERC Expectations on IEEE 2800

- **As presented at the May 3, 2022 EPRI-NAGF-NATF-NERC joint webinar (found here), the expectations of IEEE 2800 at a high-level include:**
  - Provides value
    - Widely-accepted, unified technical minimum requirements for IBRs
    - Specifies and speeds-up technical interconnection negotiations
    - Flexibility for IBR developers and OEMs – not an equipment design standard
  - Specifies
    - Performance and functional capabilities and not utilization and services
    - Functional default settings and ranges of available settings
    - Performance monitoring and model validation
    - Types of tests, plant level evaluations and other verification means, but not detailed procedures
      - Detailed procedures are under development in IEEE 2800.2
  - Scope
    - Limited to all transmission and sub-transmission connected, wind, solar, energy storage, and HVDC-VSC
- **At a high level, the expectations of IEEE 2800 do not include:**
  - Exhaustive requirements for evolving IBR technology solutions,
  - A definition of an interconnection process,
  - Procedures to verify that IBRs comply with IEEE 2800
    - Procedures to verify IBRs compliance with IEEE 2800 are being developed in IEEE P2800.2

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Conclusion

- Significant efforts are underway at FERC, NERC and the NYSRC to promote reliability with increased IBR resources
- The NYISO will continue to engage with the NYSRC in the development or modification of reliability rules and requirements to promote reliable operation and interconnection of IBRs
- We encourage all market participants and developers that are or may be impacted by the adoption of IEEE 2800 along with NERC standards and guidelines for IBRs to become familiar with this documentation
- We encourage all IBR generator owners and developers to review the NERC major disturbance reports (and other resources) and, as appropriate, implement any changes to their facilities in accordance with the findings and recommendations in these reports
- While the requirements within the IEEE 2800 standard are currently voluntary, we encourage all IBR generator owners and developers to promote reliability by designing and operating facilities in accordance with the requirements in this standard

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Questions?

Our Mission & Vision

Mission

Ensure power system reliability and competitive markets for New York in a clean energy future

Vision

Working together with stakeholders to build the cleanest, most reliable electric system in the nation

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