# Reliability Forum

## FERC Order 901– Data and Model Validation and Related Topics


Facilitators:

**Gerry Dunbar**

Director, Communications and Stakeholder Outreach

**Faisal Nahian**

Communications and Solutions Manager


August 7, 2025

NPCC, Inc.

# Forum Agenda

| | | |
|---|---|---|
| 9:00 a.m. | **Welcome and Safety Message** | Gerry Dunbar – NPCC – Director, Communications and Stakeholder Outreach |
| 9:05 a.m. | **Forum Disclaimer and Antitrust Compliance Guidelines** | Faisal Nahian – NPCC – Communications and Solutions Manager |
| 9:10 a.m. | **NPCC Reliability Forum Outreach Efforts** | Gerry Dunbar – NPCC – Director, Communications and Stakeholder Outreach |
| 9:15 a.m. | **IBR Category 2 Registration and Initial Compliance Expectations** | Tracy D. MacNicoll – NPCC – Senior Entity Risk Assessment Analyst |
| 9:35 a.m. | **FERC Order 901 Milestone 3 Standards Update** | JP Skeath – NERC – Manager, Engineering & Security Integration |
| 10:10 a.m. | **Modernization of Standards Processes and Procedures Task Force Whitepaper** | Todd E. Lucas – Southern Company – Vice President, Transmission Operations & Policy<br>Brett A. Kruse – Calpine Corporation – Vice President, Market Design |
| 10:45 a.m. | **BREAK** | |
| 10:50 a.m. | **Practical Impacts and Recommendations for Order 901 Milestone 3 Activities** | Ryan Quint – Elevate Energy Consulting – President and CEO |
| 11:20 a.m. | **Electronic Modeling Lessons Learned & Challenges for Inverter-Based Resources (IBRs)** | Todd Chwialkowski – EDF Power Solutions North America – Director, Transmission Regulatory & Compliance |
| 11:50 a.m. | **Forum Survey and Closing Remarks** | Gerry Dunbar – NPCC – Director, Communications and Stakeholder Outreach |

# Safety Message

- Public transportation safety awareness

# Reliability Forum Disclaimer

**Webinar Logistics**

- Participants are muted.
- Use the “Q&A” feature to submit questions.
- Questions will be addressed at the end of each presentation.
- The forum will be recorded.
- Presentation materials will be posted on the NPCC website.

**Public Advisory**

- This is a public webinar.
- Audience may include press and government representatives.
- Speakers should be mindful of the diverse audience.

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- Views expressed do not necessarily reflect NPCC’s position.

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- NPCC does not promote specific technologies, products, or vendors.
- Questions about vendor offerings should be directed to the vendors.
- Users of vendor services assume full responsibility.
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- Their company's prices for products or services, or prices charged by their competitors;
- Costs, discounts, terms of sale, profit margins or anything else that might affect prices;
- The resale prices their customers should charge for products they sell them;
- Allocating markets, customers, territories or products with their competitors;
- Limiting production;
- Whether or not to deal with any company; and
- Any competitively sensitive information concerning their company or a competitor.

# Antitrust Compliance Guidelines

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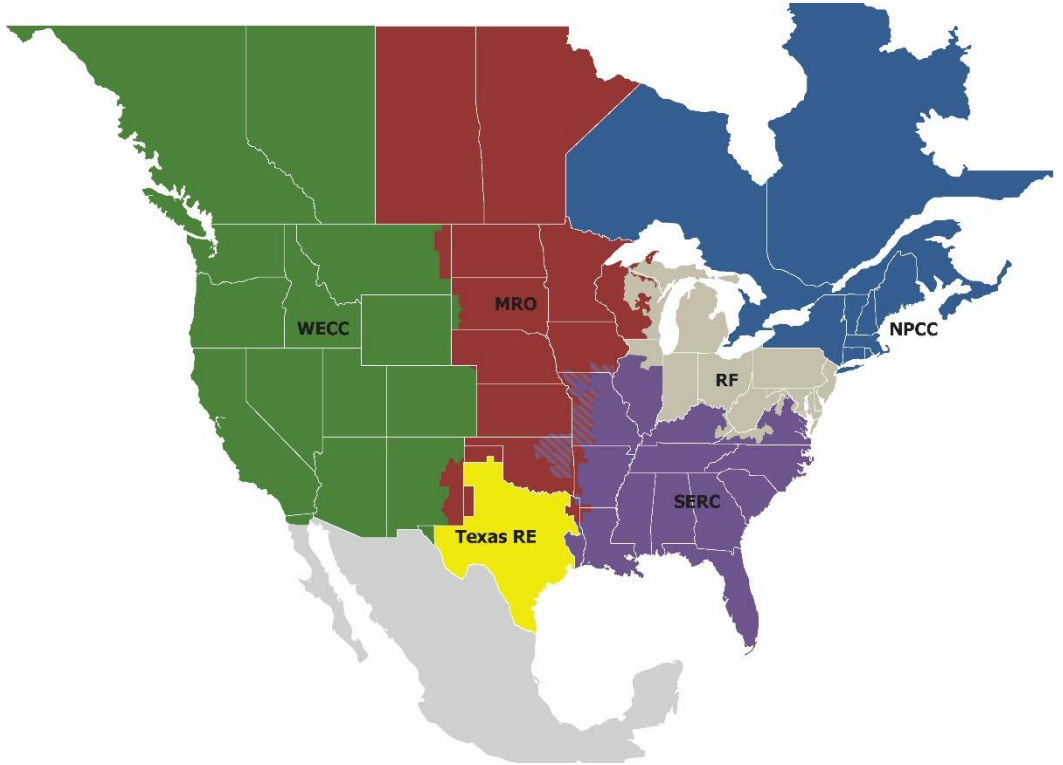
- Any NPCC meeting participant or employee who is uncertain about the legal ramifications of a particular course of conduct or who has doubts or concerns about whether NPCC's antitrust compliance policy is implicated in any situation should call NPCC's General Counsel and Corporate Secretary, Mr. Damase Hebert at (646) 737-2335 or dhebert@npcc.org.

# NPCC Long Term Strategy

To assure effective and efficient reduction of risks to the reliability and security of the grid

## 2025 Outreach Activities

- **Reliability Forums - March, May, Aug., Oct.**
  - Various Reliability Topics
  - Electric Vehicles, Energy Storage, Large Loads, FERC Order 901– Data and Model Validation
- **State and Provincial Outreach Topics**
  - NERC and NPCC Seasonal Reliability Assessments
  - State of Reliability
  - Interregional Transfer Capability Study (ITCS)
  - FERC Order 901 (September 2025)
- **Regional Webinars/Workshops**
  - Physical and Cyber Security
  - Extreme Weather Preparedness
- **2024 NPCC Northeast Gas-Electric Study**




NERC Regions Map

NPCC, Inc.

# IBR Category 2 Registration and Initial Compliance Expectations

**Tracy MacNicoll**

Senior Entity Risk Assessment Analyst

August 7, 2025

# Agenda

- Reliability Gap
- Registration
- Category 2 Reliability Standards
  - Project 2024-01 Rules of Procedure Definitions Alignment
  - Category 2 GO/GOP Standards

# The Reliability Gap

ERO Enterprise assessments identified a reliability gap arising due to the increasing penetration of inverter-based resources (IBR) on the grid and the need for updated registration rules under the NERC Rules of Procedure (ROP).

FERC ordered NERC to prepare a work plan to accomplish the above by May 2026.

# The Solution

NERC seeks to register Generator Owners (GO) and Generator Operators (GOP) of non-Bulk Electric System IBRs with an aggregate nameplate capacity ≥20 MVA connected at a voltage ≥60 kV.

Under this proposal, 97.5% of BPS-impactful IBRs would become subject to NERC Reliability Standards, commensurate to the 97% of BPS-impactful synchronous resources currently subject to these standards by nameplate capacity.

# Registration


Source: Unsplash

# IBR Registration Milestones

NERC is currently in **Phase 3** of the registration milestones identified in the FERC-approved work plan.


Source: Quick Reference Guide: IBR Registration Initiative

# Category 2 Candidate Identification

**Request for Information 1 (due September 2024)**

- Balancing Authorities
- Transmission Owners

**Request for Information 2 (initiated December 2024)**

- Registration Candidates

| REGIONAL ENTITY | NUMBER OF IBRS | MVA |
|---|---|---|
| MRO | 118 | 5,130 |
| NPCC | 57 | 1,862 |
| ReliabilityFirst | 77 | 3,513 |
| SERC | 171 | 9,881 |
| Texas RE | 39 | 1,998 |
| WECC | 319 | 12,800 |
| **TOTAL** | **781** | **35,184** |

*The numbers in this table are subject to change based on further validation.

Source: IBR Registration Workplan May Update_Signed.pdf

# NPCC IBR Candidate Expectations

## RFI was distributed in December 2024

- Asset Verification Form
- Interconnection Agreement
- Third-Party Operating Agreement

## NPCC Registration Outreach

- One-on-One with each Candidate
- Establish Expectations
- Answer Questions

# Centralized Organization Registration ERO System (CORES)

- Category 2 expanded existing GO/GOP Functional Registration
- All existing registered GO/GOP should meet the BES Definition
- Modification are in progress to accommodate Category 2
  - Expected: Q3 2025

# Standards

Source: Unsplash

# Glossary/ROP Alignment

## Project 2024-01: Rules of Procedure Definitions Alignment

| Generator Owner (GO): | Generator Operator (GOP): |
| --- | --- |
| • The entity that: 1) owns and maintains generating Facility(ies) (Category 1 GO); or 2)owns and maintains non-BES Inverter-Based Resource(s) that either have or contribute to an aggregate nameplate capacity of greater than or equal to 20 MVA, connected through a system designed primarily for delivering such capacity to a common point of connection at a voltage greater than or equal to 60 kV (Category 2 GO). | • The entity that: 1) operates generating Facility(ies) and performs the functions of supplying energy and Interconnected Operations Services (Category 1 GOP); or 2) operates non-BES Inverter-Based Resources(s) that either have or contribute to an aggregate nameplate capacity of greater than or equal to 20 MVA, connected through a system designed primarily for delivering such capacity to a common point of connection at a voltage greater than or equal to 60 kV (Category 2 GOP). |

Source: 2024-01 GO GOP Definitions_Clean_IB_032425.pdf

# Category 2 GO/GOP Standards


Source: Reliability Standards Compliance Dates for Generation Owners & Generator Operators

# Category 2 GO/GOP Standards

## Standards that only require FERC approval of GO/GOP Definitions

| Reliability Standard | Standards Project # For Inclusion of Cat 2 | Status | Effective Date of Standard | Category 2 IBR Compliance Date |
|---|---|---|---|---|
| BAL-001-TRE | Project 2024-01 | Approved | 7/1/2020 | Pending FERC Approval of GO/GOP Definitions |
| IRO-010-5 | Project 2024-01 | Approved | 7/1/2025 | Pending FERC Approval of GO/GOP Definitions |
| MOD-032-1 | Project 2024-01 | Approved | 7/1/2015 | Pending FERC Approval of GO/GOP Definitions |
| PRC-012-2 | Project 2024-01 | Approved | 1/1/2021 | Pending FERC Approval of GO/GOP Definitions |
| PRC-017-1 | Project 2024-01 | Approved | 4/1/2017 | Pending FERC Approval of GO/GOP Definitions |
| TOP-003-6.1 | Project 2024-01 | Approved | 7/1/2025 | Pending FERC Approval of GO/GOP Definitions |
| VAR-001-5 | Project 2024-01 | Approved | 1/1/2019 | Pending FERC Approval of GO/GOP Definitions |
| VAR-002-4.1 | Project 2024-01 | Approved | 9/26/2017 | Pending FERC Approval of GO/GOP Definitions |

Source: Reliability Standards Compliance Dates for Generation Owners & Generator Operators

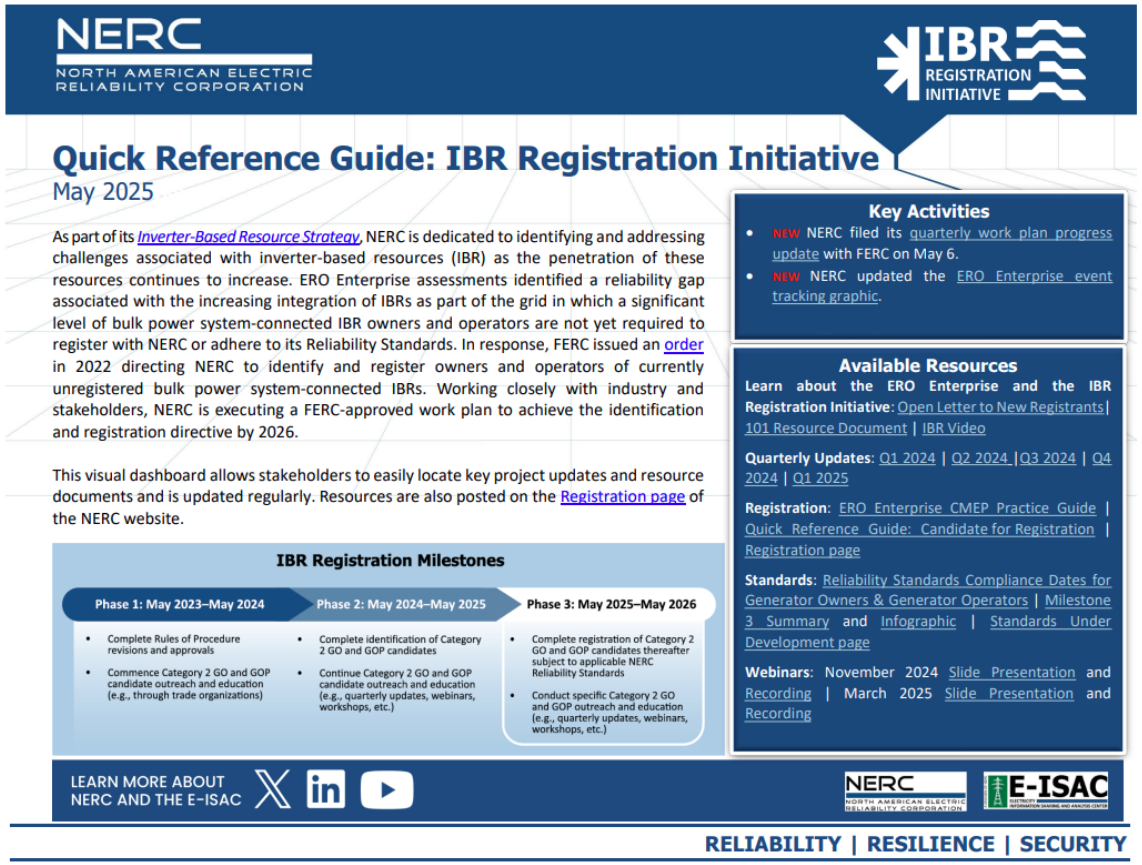
# Category 2 GO/GOP Standard Modifications

## Modifications required for Additional Standards

| Reliability Standard | Standards Project # For Inclusion of Cat 2 | Status | Effective Date of Standard | Category 2 IBR Compliance Date |
|---|---|---|---|---|
| PRC-019 | - | Requires Modification | - | - |
| PRC-023 | - | Requires Modification | - | - |
| PRC-024 | - | Requires Modification | - | - |
| PRC-025 | - | Requires Modification | - | - |
| PRC-026 | - | Requires Modification | - | - |
| PRC-027 | - | Requires Modification | - | - |
| PRC-028-1 | Project 2021-04 | Approved | 4/1/2025 | 7/1/2026 |
| PRC-029-1 | Project 2020-02 | Pending FERC Approval | Pending FERC Approval | Pending FERC Approval |
| PRC-030-1 | Project 2023-02 | Approved | TBD | TBD |
| TOP-001 | - | Requires Modification | - | - |
| TPL-007 | - | Requires Modification | - | - |

Source: Reliability Standards Compliance Dates for Generation Owners & Generator Operators

# Resources




Source: Quick Reference Guide: IBR Registration Initiative

## Currently Available

- Quarterly Updates: Q2 2025
- Quick Reference Guides and FAQs:
  - IBR Registration Initiative
  - IBR Activities
  - Candidate for Registration
  - IBR Webinar Series
  - ERO Enterprise CMEP Practice Guide
  - Inverter-Based Resources (IBR) Registration Initiative—101

# Questions

Contact Us (npcc.org)

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

# FERC Order 901 Milestones

JP Skeath, Manager, Engineering & Security Integration
August 2025

RELIABILITY | RESILIENCE | SECURITY




# FERC Order 901 Summary

IBR REGISTRATION INITIATIVE

## STANDARDS MILESTONES: ORDER 901

**1 — COMPLETED JANUARY 2024**

Order No. 901 Work Plan submission

**2 — DUE NOVEMBER 4, 2024**

Standards development and filing to address performance requirements and post-performance validations for Registered IBRs

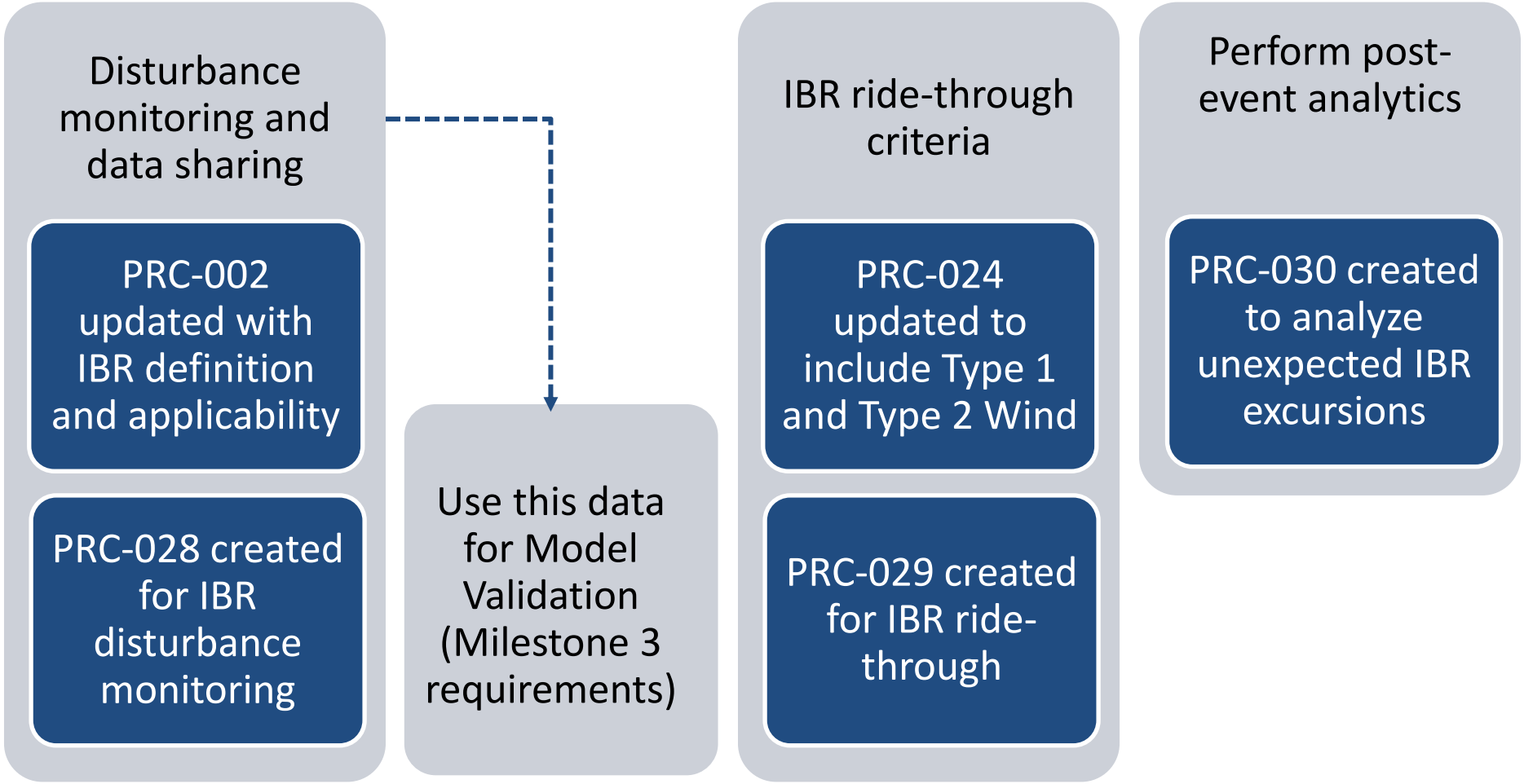
**3 — DUE NOVEMBER 4, 2025**

Development and filing of Reliability Standards to address data sharing and model validation for all IBRs

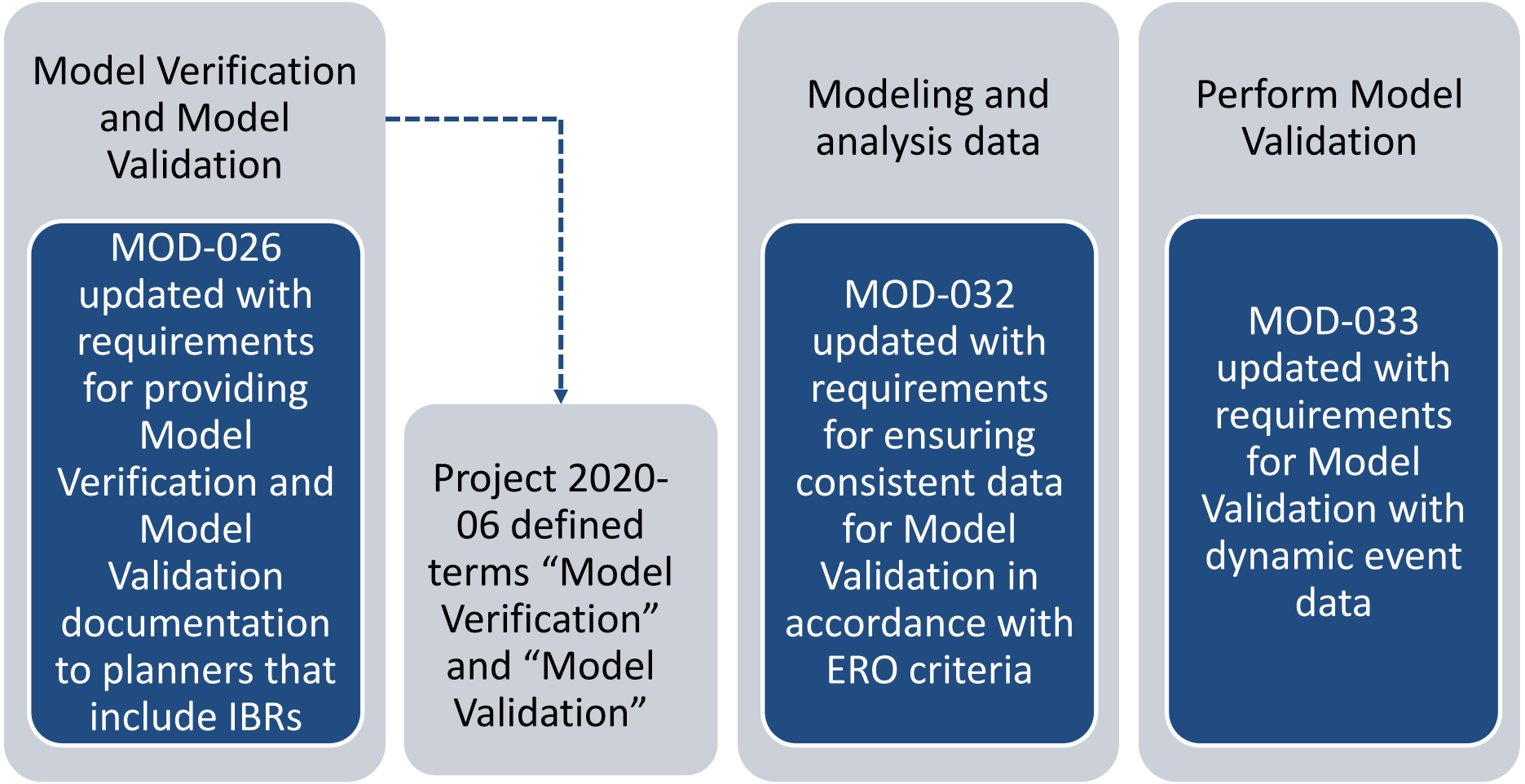
**4 — DUE NOVEMBER 4, 2026**

Development and filing of Reliability Standards to address use of performance data in Operational and Planning studies

# Milestone 2 Summary



# Milestone 3 Summary



# Milestone 3 Timeline

- All project initial ballots complete.
- Project 2021-01 and Project 2022-02 standards and associated documents to be posted for additional ballot on August 8.
- Project 2020-06 to be posted for additional ballot on August 14.
- All project ballots to close around second week of September.
- Milestone 3 Standards to be submitted to FERC by November 4, 2025.

# Project 2022-02 MOD-032 Updates

Purpose:

To establish consistent modeling data requirements and reporting procedures for development of planning horizon cases.

Requirement:

Each Planning Coordinator (PC) and its Transmission Planner(s) (TP) develop steady-state, dynamic, and short circuit data requirements:

**1.4.** Specifications of the following items for dynamic model submissions:

**1.4.1.** Required submission of:

- standard library models incorporated within the software(s) utilized to create the interconnection-wide case(s);
- user-written models; or
- both standard library models and user-written models.

**1.4.2.** Where user-written models are accepted, usability requirements for any submitted user-written models including, at a minimum, requirements to provide model documentation and instructions for model set up and use.

**1.4.2.1.** Each Planning Coordinator and Transmission Planner shall provide their user-written model criteria within 90 calendar days of receiving a written request for such data from other Planning Coordinators and Transmission Planners within the Interconnection.

# Project 2022-02 MOD-032 Updates

- FERC Order 901 P104, P105, P106:

Transmission Owners (TO), Distribution Providers (DP), and other registered entities, if they are unable to gather aggregate IBR-DER data, to…

> provide instead to the Bulk-Power System planners and operators in their areas: (1) an estimate of the modeling data and parameters of IBR-DERs in the aggregate,[202] (2) an explanation of the limitations of the availability of data, (3) an explanation of the limitations of the data provided by IBR-DERs, and (4) the method used for estimation. In support of above, we further direct NERC to consider commenters' suggestions to implement a process or mechanism by which distribution providers would receive modeling data and parameters.[203]

- Requirement:

> **2.1.** If ~~the responsible~~a functional entity~~, as identified in Requirement R1 Part 1.1,~~ is required to provide data for one or more of the following and is unable to gather ~~unregistered Inverter-based Resource (IBR)[1] data or aggregate Distributed~~such data ~~and parameters and include~~, the functional entity shall provide an ~~explanation of the limitations~~estimate of the ~~availability of~~ data, an explanation of the limitations of ~~any~~the estimated data ~~provided~~, and the method used for estimation.
>
> - Aggregate DER data; or
> - Data for an IBR that is not a DER and does not meet the criteria that would require the owner to register with NERC for mandatory Reliability Standards compliance purposes.

# Project 2022-02 MOD-032 Updates

- Attachment 1 contains data reporting requirements to effectively model interconnected transmission system, and typical functional entity responsible for reporting respective data.

| steady-state<br>*(Items marked with an asterisk indicate data that vary with system operating state or conditions. Those items may have different data provided for different modeling scenarios)* | dynamics | short circuit |
|---|---|---|
| 1. Each bus [TO]<br>a. nominal voltage<br>b. area, zone and owner<br>2. Aggregate Demand[3] [DP]<br>a. real and reactive power*<br>b. in-service status*<br>3. Generating and storage units[4] [GO, TO[5], RP (for future planned resources only)]<br>a. real power capabilities - gross maximum and minimum values<br>b. reactive power capabilities - maximum and minimum values at real power capabilities in 3a above<br>c. station service auxiliary load for normal plant configuration (provide data in the same manner as that required for aggregate Demand under item 2, above).<br>d. regulated bus* and voltage set point* (as typically provided by the TOP)<br>e. machine MVA base | 1. Generator [GO, RP (for future planned resources only)]<br>2. Excitation System [GO, RP (for future planned resources only)]<br>3. Governor [GO, RP (for future planned resources only)]<br>4. Power System Stabilizer [GO, RP (for future planned resources only)]<br>5. Aggregate Demand[3] [DP]<br>6. Wind plant model (for plants with type 1 and type 2 wind turbines) [GO]<br>7. Inverter-Based Resource [GO, TO[5]]<br>a. IBR capabilities related to momentary cessation, tripping, Ride-through, voltage control, and frequency control<br>8. Static Var Systems and FACTS [GO, TO, DP]<br>9. DC system models [TO]<br>10. Aggregate Distributed Energy Resource (DER) data[7] [DP, TO][6] | 1. Provide for all applicable elements in column "steady-state" [GO, RP, TO, DP]<br>a. Positive Sequence Data<br>b. Negative Sequence Data<br>c. Zero Sequence Data<br>2. Mutual Line Impedance Data [TO]<br>3. Other information requested by the Planning Coordinator or Transmission Planner necessary for modeling purposes. [BA, GO, DP, TO, TSP] |

# Project 2022-02 Other Updates

- IRO-010 ensures reliability by preventing instability, uncontrolled separation, or Cascading outages. This is done by ensuring each Reliability Coordinator has data and information to plan, monitor, and assess its area.
- TOP-003 ensures each Transmission Operator (TO) and Balancing Authority (BA) has data and information needed to plan, monitor, and assess its area.

- These standards updated with:
  - Including IBR-specific data and parameters.

**1.1.** A list of data and information needed by the Reliability Coordinator to support its Operational Planning Analyses, Real-time monitoring, and Real- time Assessments including non-BES data and information, external network data and information, Inverter-based Resource (IBR)-specific data and parameters, and identification of the entities responsible for responding to the specification as deemed necessary by the Reliability Coordinator.

  - Clarifying model submission requirementss.

**1.5.3** Requirements for model submissions to be consistent with the model submitted for planning purposes~~in accordance with the Criteria for Acceptable Models maintained by the Electric Reliability Organization~~, as applicable;

# Project 2020-06 Definition Updates

Project 2020-06 defined the following terms, which have passed industry ballot:

**Model Verification**

The process of confirming that model structure and parameter values represent the equipment or facility design and settings by reviewing equipment or facility design and settings documentation.

**Model Validation**

The process of comparing measurements with simulation results to assess how closely a model's behavior matches the measured behavior.

# Project 2020-06 MOD-026 Updates

Purpose:

To verify and validate dynamic models used to assess Bulk Electric System (BES) reliability represent in-service equipment.

- Updated standard will incorporate MOD-027 requirements; MOD-027 will be retired.
- This standards applies to the following facilities
  - Synchronous generators
  - Dynamic reactive resources greater than 20 MVA
  - HVDC systems
  - Inverter-Based Resources

- **I2** – Generating resource(s) including the generator terminals through the high-side of the step-up transformer(s) connected at a voltage of 100 kV or above with:
  a) Gross individual nameplate rating greater than 20 MVA. Or,
  b) Gross plant/facility aggregate nameplate rating greater than 75 MVA.

- **I5** –Static or dynamic devices (excluding generators) dedicated to supplying or absorbing Reactive Power that are connected at 100 kV or higher, or through a dedicated transformer with a high-side voltage of 100 kV or higher, or through a transformer that is designated in Inclusion I1 unless excluded by application of Exclusion E4

# Project 2020-06 MOD-026 Updates

Requirements:

- Each Transmission Planner (TP) and Planning Coordinator (PC) to develop dynamic model requirements, including those for acceptable Electromagnetic Transient (EMT) models and provide these to Generator Owner (GO) and Transmission Owner (TO). These requirements will be used to assess acceptability of submitted models. (Exemptions for legacy GOs)

- Generator Owner (GO) and Transmission Owner (TO) shall provide this information, including Model Verification and Model Validation information for any new or updated facilities to its Transmission Planner (TP).

- Transmission Planner (TP) shall review, and communicate whether it accepts or declines the dynamic model information. If declined, entities will work together to resolve model issues.

# Project 2020-06 MOD-026 Updates

Attachment 1 provides requirements for dynamic models and associated functions

| Generator Model | Excitation Control | Governor Control | Additional Limiting and Protective Functions |
|---|---|---|---|
| 1. Manufacturer, model number (if available), and type of generator/synchronous condenser;<br>2. Models representing the generator/synchronous condenser. | 1. Manufacturer, model number (if available), and type of excitation system hardware;<br>2. Model(s) representing the excitation system including voltage regulator, impedance compensation (such as droop, line drop, differential compensation), power system stabilizer, and outer-loop controls which impact dynamic volt/volt-ampere reactive (VAR) performance. | 1. Manufacturer, model number (if available), and type of prime mover, governor, and control;<br>2. Model(s) representing the prime mover, governor control system, and any other controls which impact the dynamic active power or frequency performance due to a system disturbance (e.g., load controller), but excluding Automatic Generation Control. | If required by its Transmission Planner under Requirement R1, Part 1.1.1, Generator Owner(s) or Transmission Owner(s) shall submit:<br>1. Model(s) representing enabled excitation limiters;<br>2. Model(s) representing AC over-voltage, AC under-voltage, enabled over-frequency, under-frequency, over-speed, under-speed, Volts per Hertz protective functions, out of step protection that trip the excitation system, the prime mover, or generator/synchronous condenser either directly or via lockout or auxiliary tripping relays. |

# Project 2021-01 MOD-033 Updates

Purpose:

To establish a process for system model validation to achieve and maintain model accuracy.

Requirement:

- Each Planning Coordinator to validate steady-state and dynamic planning System model developed in accordance with MOD-032.
- Validation performed by comparing planning System model to:
  - State estimator case(s) or other Real-time data sources for steady-state models.
  - Actual System behavior obtained from dynamic local event data for dynamic models.
- Planning Coordinator to determine any unacceptable performance differences and resolve these differences.

[1] Such planning System models will thus include registered IBRs and aggregated DERs, as well as IBRs that are not DERs and that do not meet the criteria that would require the owner(s) to register with NERC for mandatory Reliability Standards compliance purposes, that are present in the existing system.

# Milestone 4 SARs

Operational Studies Potential Updates:

- Revise definitions (Real-time Assessment, Operational Planning Analysis, Balancing Contingency Event) to include IBR performance and sudden IBR output reduction.

- TOP Standards:
  - Require entities to utilize IBR performance as captured via updated modeling standards. IBR performance to inform generation-load-interchanges as well as Operating Plans.

- IRO, FAC, PRC Standards:
  - Require Reliability Coordinators to utilize IBR performance information to identify Operating Limit exceedances as well as Transmission and Generation outages.
  - Require Reliability Coordinators to utilize IBR performance information to determine stability limits, Contingency events, and responses to Remedial Action Schemes

# Milestone 4 SARs

Planning Studies Potential Updates:

- Revise TPL-001 Standard or create new Standard to update Planning Models. These updated Planning Models will include IBRs as required in updated Standards from Milestone 3.
- Ensure grid stress performance conditions are updated where necessary.
- Planning assessments to capture IBR performance under these conditions, and to include ride-through performance.

**Table 1 – Steady State & Stability Performance Planning Events**

**Steady State & Stability:**

a. The System shall remain stable. Cascading and uncontrolled islanding shall not occur.

b. Consequential Load Loss as well as generation loss is acceptable as a consequence of any event excluding P0.

c. Simulate the removal of all elements that Protection Systems and other controls are expected to automatically disconnect for each event.

d. Simulate Normal Clearing unless otherwise specified.

e. Planned System adjustments such as Transmission configuration changes and re-dispatch of generation are allowed if such adjustments are executable within the time duration applicable to the Facility Ratings.

| Category | Initial Condition | Event [1] | Fault Type [2] | BES Level [3] | Interruption of Firm Transmission Service Allowed [4] | Non-Consequential Load Loss Allowed |
|---|---|---|---|---|---|---|
| **P0** No Contingency | Normal System | None | N/A | EHV, HV | No | No |
| **P1** Single Contingency | Normal System | Loss of one of the following:<br>1. Generator<br>2. Transmission Circuit<br>3. Transformer[5]<br>4. Shunt Device[6] | 3Ø | EHV, HV | No[9] | No[12] |
| | | | SLG | | | |
| **P2** Single Contingency | Normal System | 1. Opening of a line section w/o a fault[7] | N/A | EHV, HV | No[9] | No[12] |
| | | 2. Bus Section Fault | SLG | EHV | No[9] | No |
| | | | | HV | Yes | Yes |
| | | 3. Internal Breaker Fault (non-Bus-Section) | SLG | EHV | No[9] | No |
| | | | | HV | Yes | Yes |
| | | 4. Internal Breaker Fault (Bus-Section) | SLG | EHV, HV | Yes | Yes |

# Milestone 4 Timeline

- New projects to be developed for Milestone 4 Standards updates.
- Milestone 4 SARs to be posted mid-August for industry comment.
- Call for nominations for Milestone 4 Drafting Teams!
- Looking for individuals from utilities, Regions, and vendors with expertise in planning and operational studies with IBRs.

# Resources

- NERC 2020-06 Project Page (link)
- NERC 2021-01 Project Page (link)
- NERC 2022-02 Project Page (link)
- Dynamic Modeling Recommendations (link)
- FERC Order 901 (link)
- Standards Development Work Plan in Response to FERC Order No. 901 (link)
- Project 2022-02 Uniform Modeling Framework for IBR and Project 2021-01 System Model Validation with IBRs Industry Joint Webinar Recording (link)
- Industry Engagement Workshop for Reliable IBR Integration and Milestone 3 of FERC Order 901 Slides and Recording (link)

# Announcement

**Registration Process for Category 2 Generator Owner and Generator Operator Inverter-Based Resources Webinar Resources Now Available**

Click here for: Slide Presentation| Webinar Recording| IBR Initiative Quick Reference Guide | Candidate for Registration Quick Reference Guide | Joining the ERO Enterprise |Expanding Your Registration

On July 14, 2025, NERC hosted an informational webinar on the Registration Process for Category 2 Generator Owner (GO) and Generator Operator (GOP) Inverter-Based Resources (IBRs). This webinar introduced the registration process for owners and operators of non-Bulk Electric System IBRs with aggregate nameplate capacity ≥20 MVA connected at a voltage ≥60 kV that are required to register with NERC and adhere to its Reliability Standards. NERC has developed a process to register these Category 2 GOs and GOPs by May 15, 2026.

The informational webinar was designed to focus on the registration process for Category 2 GOs and GOPs, including the new functionality in the Centralized Organization and Registration ERO System (CORES), and included an update on the IBR Initiative Milestones and Resources, and an overview of the Electricity Information Sharing Analysis Center (E-ISAC).

The webinar agenda included:

- IBR Initiative Milestones and Work Plan Overview
- E-ISAC Overview
- Registration Process
- Centralized Organization Registration ERO System (CORES)
- Question and Answers

NERC also released new infographics to support entities in IBR Registration Initiative. For newly identified entities, the Joining the ERO Enterprise infographic provides background on the ERO Enterprise and its mission and provides a step-by-step overview of the registration process. For currently registered entities, the Expanding Your Registration infographic explains how to update existing registrations in CORES to reflect new Category 2 Generator Owner/Generator Operator responsibilities.

These resources are part of a broader effort to welcome new participants into the ERO Enterprise and provide the tools and guidance needed to support reliability and compliance from the start.

# Questions and Answers

# Modernization of Standards Processes and Procedures (MSPP) Task Force

Brett Kruse
Todd Lucas
NPCC
August 7, 2025

# Guiding Principles

### *Transform and Modernize the Process*

Re-envision a modernized standard development process to address evolving risks.

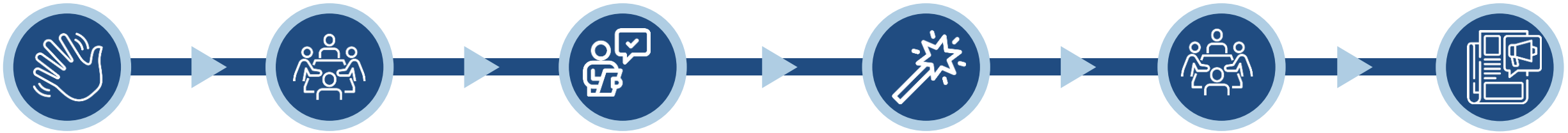
### *Create Efficiencies*

Identify areas of opportunity and recommendations to save time and remove redundant steps in the current process.

### *Develop a Trusted Process*

Provide clear opportunities for stakeholder input, due process, openness, and balance of interests.

# Activities to Date



***March***

**Stood Up Task Force**

***April***

**April Workshop**

***May - June***

**Industry Feedback Survey**

***May - July***

**Opportunities Developed**

***June***

**June Workshop**

***July***

**White Paper Posted for Comment**

# Potential Improvement Opportunities

## Standards Initiation

- Implement a biannual review and prioritization process
- Centralize the process through the Reliability and Security Technical Committee

## Standards Development

- Form a new group or panel to coordinate standards drafting with AI assistance
- Outsource standards drafting
- Implement incremental process changes

## Balloting

- Create a standing ballot body
- Implement a notice and comment process for proposed standards
- Implement incremental changes to Registered Ballot Body framework

# White Paper Roll-out and Engagement

***July 21***

*Industry Webinar*

***Week of August 4***

*"Drop-in" Q&A Sessions*

***July 22***

*Public Comment Period Open*

***August 27***

*Public Comment Period Closes*

***July-August***

*Industry Outreach (Regional Entity events, NERC Standing Committees, MRC, Board, task force outreach etc.)*

# MSPPTF Timeline

## Q2 2025

- Developed scope document
- Identified areas for improvement
- Solicit stakeholder input

## Q3 2025

- Develop white paper of potential improvement opportunities
- Solicit stakeholder input
- Develop draft recommendations

## Q4 2025

- Solicit stakeholder input
- Finalize recommendations

## Q1 2026

- Present recommendations to NERC Board

## Communications and Engagement

- Individual task force engagement
- General communications to and broad engagement with industry and stakeholders
- Updates to NERC's Board, MRC, Standing Committees, and Industry Groups

# Key Resources

- Resources and forthcoming engagements are posted on the MSPPTF webpage (under the Initiatives tab NERC homepage).
- Link to the whitepaper Standard Process Improvements White Paper and the feedback form MSPPTF Potential Improvement Opportunities Industry Feedback Questionnaire
- Several resources are available to keep industry and stakeholders informed throughout this critical project:
  - MSPP FAQs
  - MSPPTF External Engagements
- The MSPPTF publishes a monthly update at the beginning of each month to provide an overview of recent activity and upcoming work.

## Monthly Update

MSPP Task Force

Modernization of Standards Processes & Procedures

The speed at which risks to the reliability, security, and resilience of the bulk power system are emerging during the transformation to a decentralized, digitized, and decarbonized grid is outpacing industry's ability to develop, enhance, and implement Reliability Standards under the existing processes and procedures. At its February 2025 meeting, the NERC Board of Trustees passed a resolution forming an industry-led Modernization of Standards Processes and Procedures Task Force (MSPPTF) to undertake a strategic review of NERC's Reliability Standards development process. The task force will present proposed recommendations to the NERC Board in February 2026.

**2025 June Update**

**This is the second in a series of updates that summarize ongoing activities related to the MSPP initiative.**

**Background**

The MSPPTF is focusing on transforming current processes and procedures to ensure that standards can be developed more efficiently and effectively to better address the complex and rapidly evolving risk landscape. It is considering the spectrum of the current standards program, including processes, balloting, drafting, and the roles of team and committee members. The MSPPTF is also reviewing prior standard improvement efforts and recent Section 321 actions for lessons learned.

**Key Activities**

Since the last update, the MSPPTF has identified and prioritized three areas of opportunity for improvement in the standards process and is conducting a deep dive into: 1) standards initiation/standard authorization requests, 2) standards development/drafting, and 3) balloting. The task force is meeting this month to develop an initial outline of recommended changes.

**Stakeholder Outreach**

The MSPPTF also released a survey that provides stakeholders with the opportunity to offer ideas for consideration to transform current standards processes and procedures. The survey (which is due on **June 5**) is anonymous, and while the task force will not directly respond to comments, survey feedback will be considered as the initial outline of recommended changes is developed. The initial outline will be posted this summer for additional stakeholder input.

The task force continues its comprehensive program to engage and provide updates to stakeholders through public announcements and various open meetings. MSPPTF Chair Greg Ford and Vice Chair Todd Lucas updated the NERC Board of Trustees on MSPPTF activities on May 8, and Todd Bennett updated the Standards Committee (SC) on May 21. Todd Lucas will provide an update at the Joint Reliability and Security Technical Committee/SC/Reliability Issues Steering Committee meeting on June 11. In addition, task force members are conducting outreach to various industry groups to gather informal input as indicated in the timeline below.

**Key Resources**

Several resources are available to keep industry and stakeholders informed throughout this critical project, including the MSPP webpage (located under the Initiatives tab on the NERC homepage), the MSPPTF Scope, the MSPP Roster, and MSPP FAQs.

Questions? Please email mspp@nerc.net.

# Questions and Answers

**Questions?**
Email mspp@nerc.net

# BREAK

Resume at 10:55 AM

# NERC Milestone 3 Updates

## IBR Modeling, Model Verification, and Model Validation

**Ryan D. Quint, PhD, PE**
President and CEO, Elevate Energy Consulting
President and Chief Engineer, GridStrong

August 2025

# The Elevate Team













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# Disclaimers

- These views reflect the insights of Elevate and do not necessarily reflect the views of our partners and clients.
- These views reflect learnings from working on *many* IBR plant models across multiple Regions and entities, and do not reflect any one site or entity.
- These views should not be interpreted as compliance advice; they are solely for the purpose of discussion and *elevating* industry.

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# NERC Activities

*Order 901 Milestone 3 Updates and Related Efforts*

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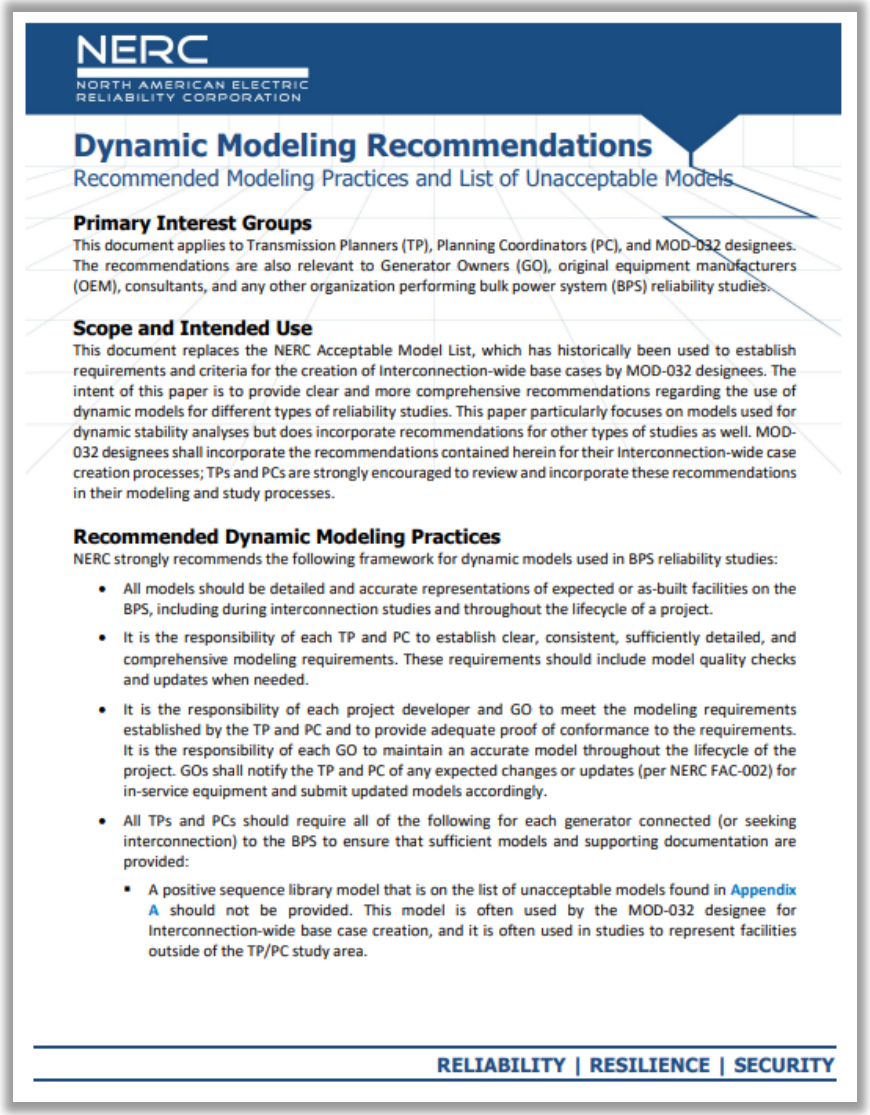
# NERC Dynamic Modeling Recommendations

- Detailed and accurate modeling
- Reflecting as-left facility settings
- Comprehensive IBR modeling req's
- Adequate proof of conformance
- Positive sequence library model
- Positive sequence user-defined model (UDM)
- Electromagnetic transient (EMT) model
- Site-specific models, verified by OEM
- Benchmarking across models
- List of unacceptable models



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**Dynamic Modeling Recommendations**

Recommended Modeling Practices and List of Unacceptable Models

**Primary Interest Groups**

This document applies to Transmission Planners (TP), Planning Coordinators (PC), and MOD-032 designees. The recommendations are also relevant to Generator Owners (GO), original equipment manufacturers (OEM), consultants, and any other organization performing bulk power system (BPS) reliability studies.

**Scope and Intended Use**

This document replaces the NERC Acceptable Model List, which has historically been used to establish requirements and criteria for the creation of Interconnection-wide base cases by MOD-032 designees. The intent of this paper is to provide clear and more comprehensive recommendations regarding the use of dynamic models for different types of reliability studies. This paper particularly focuses on models used for dynamic stability analyses but does incorporate recommendations for other types of studies as well. MOD-032 designees shall incorporate the recommendations contained herein for their Interconnection-wide case creation processes; TPs and PCs are strongly encouraged to review and incorporate these recommendations in their modeling and study processes.

**Recommended Dynamic Modeling Practices**

NERC strongly recommends the following framework for dynamic models used in BPS reliability studies:

- All models should be detailed and accurate representations of expected or as-built facilities on the BPS, including during interconnection studies and throughout the lifecycle of a project.
- It is the responsibility of each TP and PC to establish clear, consistent, sufficiently detailed, and comprehensive modeling requirements. These requirements should include model quality checks and updates when needed.
- It is the responsibility of each project developer and GO to meet the modeling requirements established by the TP and PC and to provide adequate proof of conformance to the requirements. It is the responsibility of each GO to maintain an accurate model throughout the lifecycle of the project. GOs shall notify the TP and PC of any expected changes or updates (per NERC FAC-002) for in-service equipment and submit updated models accordingly.
- All TPs and PCs should require all of the following for each generator connected (or seeking interconnection) to the BPS to ensure that sufficient models and supporting documentation are provided:
  - A positive sequence library model that is on the list of unacceptable models found in Appendix A should not be provided. This model is often used by the MOD-032 designee for Interconnection-wide base case creation, and it is often used in studies to represent facilities outside of the TP/PC study area.

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Source: NERC Recommendations

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# Order 901 Milestone 3 Standards Projects

## FERC Order 901 Milestone 3 Projects

**Project 2020-06 – Verifications of Models and Data for Generators:** *Addressing the verification and validation of models for registered inverter-based resources (IBR), unregistered and aggregated IBR, and aggregated distributed energy resources.*

**Additional Focus:**

- Define terms, such as Model Verification and Model Validation
- Develop process for post-interconnection model validation based on performance data
- Set validation expectations using performance data

**Standards Include: MOD-026, MOD-027**

**Project 2021-01 – System Model Validation with IBRs:** *Addressing system-level model verification and validation against actual system operational behavior during disturbances as well as aligning steady state and dynamic representation, where appropriate.*

**Additional Focus:**

- Develop criteria for performing validation
- Determine minimum study conditions for conducting validation studies
- Develop process to communicate system interconnection-wide model defects to Transmission Planners and other associated entities

**Standards Include: MOD-033**

**Project 2022-02 – Uniform Framework Model Framework for IBR:** *Addressing development of a NERC-maintained library consisting of generic IBR model types.*

**Additional Focus:**

- Establish a uniform framework for data sharing and model development
- Ensure other standards use performance data and library using this framework

**Standards Include: MOD-032, TOP-003, IRO-010**

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# Order 901 Milestone 3 Standards Projects

| Project 2020-06 | Verifications of Models and Data for Generators |
|---|---|
| *MOD-026*<br>*MOD-027* | • Combining MOD-026-1 and MOD-027-1<br>• Created NERC definitions for IBR, Model Verification, and Model Validation<br>• Addresses registered IBRs and synchronous generators<br>• Adds EMT modeling requirements (commissioned IBRs after effective date; TPs identify legacy assets)<br>• GO/TO conduct model verification, model benchmarking<br>• Validation of models with actual disturbance monitoring data from PRC-002 and PRC-028 |
| **Project 2022-02** | **Uniform Framework Model for IBRs** |
| *MOD-032*<br>*TOP-003*<br>*IRO-010* | • ERO-approved criteria for acceptable models; uniform model framework for data sharing and model development<br>• Developed DER definition<br>• MOD-032: replace LSE with DP, ERO criteria for acceptable models, includes unregistered IBR and DER data exchange, modifications to Attachment 1<br>• TOP-003 and IRO-010: IBR-specific data and parameters, acceptable models, |
| **Project 2021-01** | **System Model Validation with IBRs** |
| *MOD-033* | • Not a lot of MOD-033 requirements changing<br>• Enhancing guidance, technical rationale, etc., for the “how”<br>• Incorporates data sources from PRC-002 and PRC-028 for real-time data access |

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# Milestone 3 Initial Ballots

*Initial Ballots for NERC Milestone 3 Standards Projects*

| Project | Standard | Standard Ballot Results | Implementation Plan Ballot Results |
|---|---|---|---|
| **Project 2020-06** | MOD-026-2 | 32.47% (*Fail*) | 40.22% (*Fail*) |
| **Project 2021-01** | MOD-033-2 | 57.06% (*Fail*) | 59.43% (*Fail*) |
| **Project 2022-02** | MOD-032-2 | 39.05% (*Fail*) | 39.46% (*Fail*) |
| | IRO-010-6 | 41.62% (*Fail*) | |
| | TOP-003-8 | 34.70% (*Fail*) | |

- Initial ballots failed (not uncommon)
- Drafting teams currently working on subsequent revisions
- November deadline approaching – will NERC ROP 321 process be needed?

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# Model Verification and Validation Definitions

**Model Verification**: The process of confirming that model structure and parameter values are representative of the equipment or facility design and settings by reviewing equipment or facility design and settings documentation.

**Model Validation**: The process of comparing simulation results with measurements to assess how closely a model's behavior matches the measured behavior.

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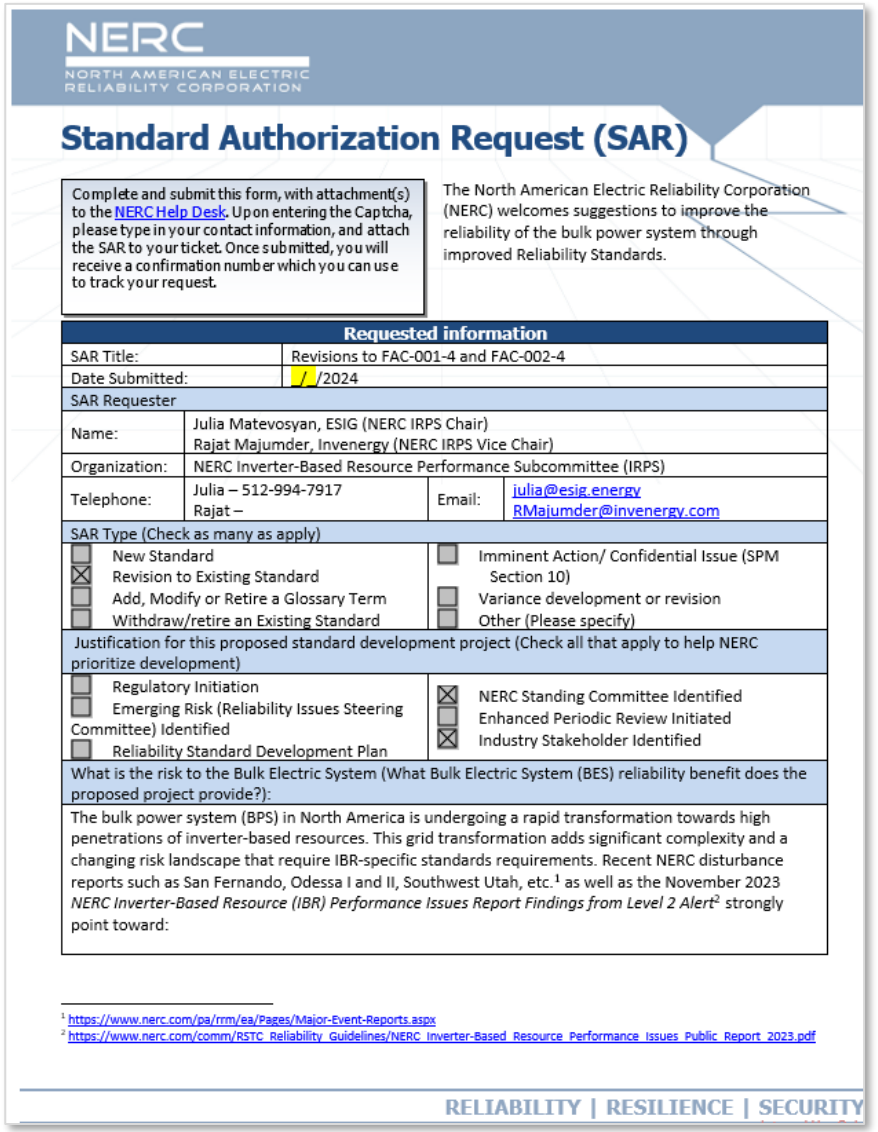
# NERC IRPS SAR: FAC-001 and FAC-002

- SAR endorsed by NERC RSTC
- Approved by NERC SC and assigned to EMT project
- “Medium Priority” project
- Modify FAC-001 and FAC-002 for IBR Risks
  - Enhancements to interconnection requirements (*TOs*)
  - IBR conformity assessments via studies (*TPs and PCs*)
  - IBR facility commissioning requirements (*GOs*)



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**Standard Authorization Request (SAR)**

Complete and submit this form, with attachment(s) to the NERC Help Desk. Upon entering the Captcha, please type in your contact information, and attach the SAR to your ticket. Once submitted, you will receive a confirmation number which you can use to track your request.

The North American Electric Reliability Corporation (NERC) welcomes suggestions to improve the reliability of the bulk power system through improved Reliability Standards.

| Requested information | | | |
|---|---|---|---|
| SAR Title: | Revisions to FAC-001-4 and FAC-002-4 | | |
| Date Submitted: | _ /2024 | | |
| SAR Requester | | | |
| Name: | Julia Matevosyan, ESIG (NERC IRPS Chair)<br>Rajat Majumder, Invenergy (NERC IRPS Vice Chair) | | |
| Organization: | NERC Inverter-Based Resource Performance Subcommittee (IRPS) | | |
| Telephone: | Julia – 512-994-7917<br>Rajat – | Email: | julia@esig.energy<br>RMajumder@invenergy.com |

SAR Type (Check as many as apply)

- ☐ New Standard
- ☒ Revision to Existing Standard
- ☐ Add, Modify or Retire a Glossary Term
- ☐ Withdraw/retire an Existing Standard
- ☐ Imminent Action/ Confidential Issue (SPM Section 10)
- ☐ Variance development or revision
- ☐ Other (Please specify)

Justification for this proposed standard development project (Check all that apply to help NERC prioritize development)

- ☐ Regulatory Initiation
- ☐ Emerging Risk (Reliability Issues Steering Committee) Identified
- ☐ Reliability Standard Development Plan
- ☒ NERC Standing Committee Identified
- ☐ Enhanced Periodic Review Initiated
- ☒ Industry Stakeholder Identified

What is the risk to the Bulk Electric System (What Bulk Electric System (BES) reliability benefit does the proposed project provide?):

The bulk power system (BPS) in North America is undergoing a rapid transformation towards high penetrations of inverter-based resources. This grid transformation adds significant complexity and a changing risk landscape that require IBR-specific standards requirements. Recent NERC disturbance reports such as San Fernando, Odessa I and II, Southwest Utah, etc.[1] as well as the November 2023 *NERC Inverter-Based Resource (IBR) Performance Issues Report Findings from Level 2 Alert*[2] strongly point toward:

[1] https://www.nerc.com/pa/rrm/ea/Pages/Major-Event-Reports.aspx
[2] https://www.nerc.com/comm/RSTC_Reliability_Guidelines/NERC_Inverter-Based_Resource_Performance_Issues_Public_Report_2023.pdf

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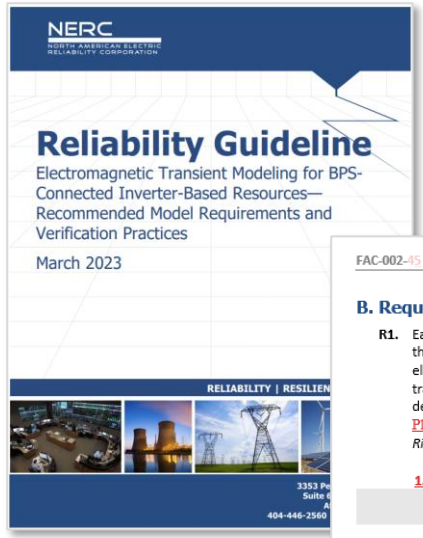
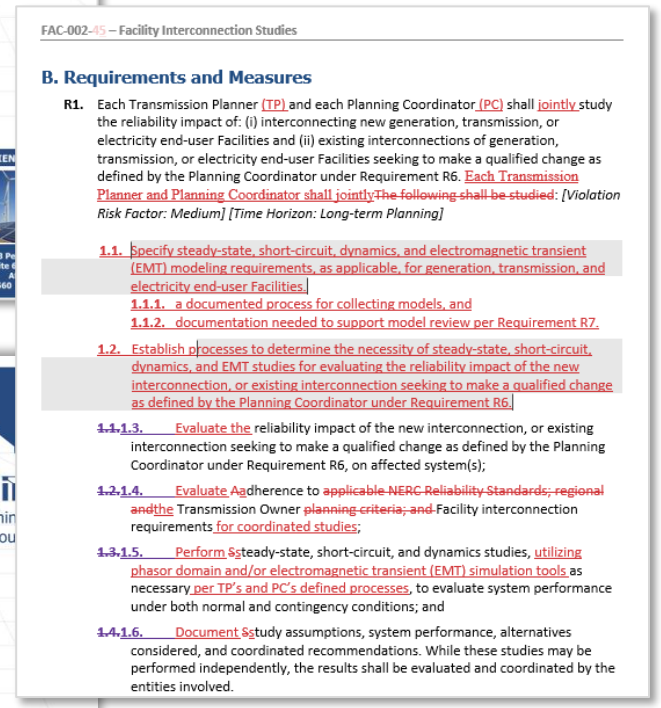
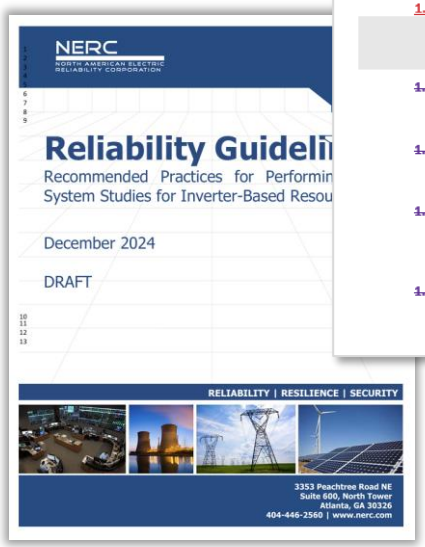
https://www.nerc.com/pa/Stand/Project202204EMTModelingDL/2022-04%20FAC-001%20and%20-002%20SAR_121124.pdf

# NERC Project 2022-04 EMT Modeling

- Modifying **NERC FAC-002**, **MOD-032**, and **TPL-001** to include EMT modeling and study requirements
- FAC-002 revisions underway
  - EMT model requirements
  - Process for collecting models, independent of studies
  - EMT model review process
  - Process for determining if EMT studies are needed ("screening")



# Modeling-Related Alerts and Reports

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**Industry Recommendation**
Inverter-Based Resource Model Quality Deficiencies

Initial Distribution: June 4, 2024

NERC has analyzed 10 large-scale disturbances on the bulk power system (BPS) that involved the widespread and unexpected reduction in output of inverter-based resources (IBR) since 2016. These 10 disturbances totaled nearly 15,000 MW of unexpected IBR output reduction with approximately 10,000 MW occurring between 2020 and 2024. The increase of IBR-related events coincides with an increase in IBR penetration across the BPS. Two contributing causes to these events are poor modeling and study practices to assess the performance of these resources.

Performing dynamic simulations of the BPS allows Transmission Planners (TP), in cooperation with Generator Owners (GO), to mitigate reliability risks before they occur. Accurate dynamic models of resources are critical to this analysis and to BPS reliability. Several of NERC's published disturbance reports included analyses of the models for the affected facilities, which revealed systemic dynamic model inaccuracies. These analyses also revealed that the models provided for conducting generator interconnection studies or other system studies failed to accurately reflect the dynamic performance of the plants. Accurate modeling of IBR facilities is critical in performing system studies to assess the reliable operation of the BPS.

This alert is being distributed to all GOs of Bulk Electric System (BES)-connected IBRs as modeling deficiencies, best practices, and recommendations are applicable across all IBR technologies. NERC encourages owners and operators of non-BES and BPS-connected IBRs to review this alert as well.

The significantly higher complexity and software-based nature of IBR modeling when compared to synchronous machine modeling necessitates an improvement in the fundamental principles of dynamic modeling to accurately capture the performance of IBR plants. This alert is also being distributed to TPs and Planning Coordinators (PC) to provide recommendations that can be implemented to strengthen current modeling practices. TPs and PCs are required to answer a set of questions in the alert system; however, only GOs of IBRs will need to complete the Data Submission Worksheet.

This alert will gather dynamic modeling information from BES-connected IBR GOs, TPs, and PCs to understand the extent of condition of dynamic modeling for IBR, which will inform what additional actions are necessary to mitigate observed deficiencies. These GOs are strongly encouraged to coordinate with their inverter- and plant-level controller manufacturers and third-party consultants to review the parameters and controls installed in the field, review and mitigate modeling deficiencies, and implement the recommendations described in this alert. The information gathered throughout this alert should also be shared and reviewed with the associated GOPs as applicable.

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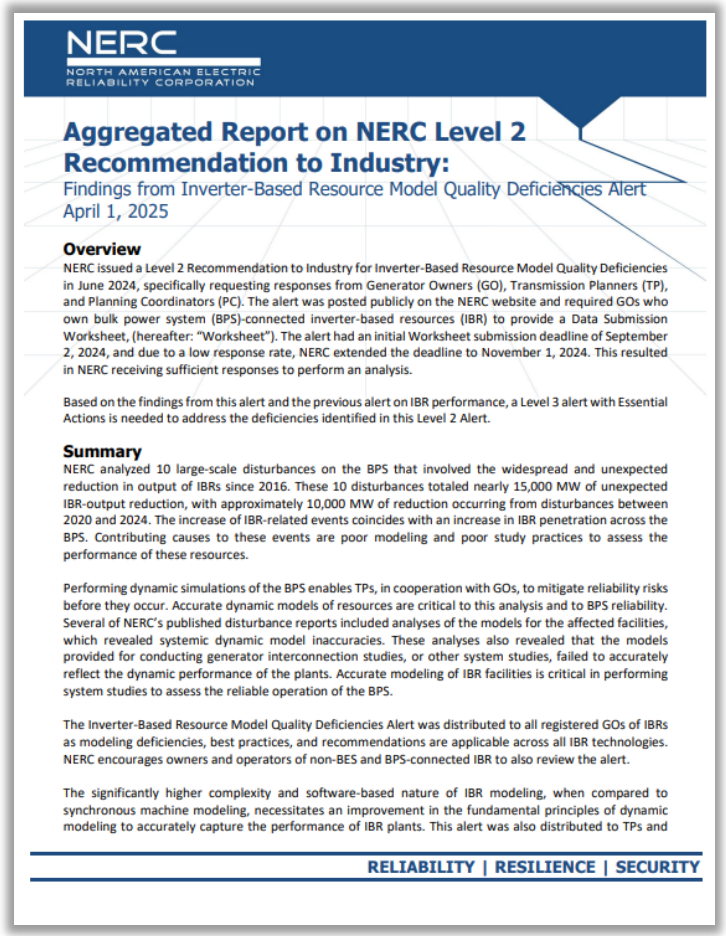
Level 2 Alert on IBR Model Quality Deficiencies (June 2024)
here



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**Aggregated Report on NERC Level 2 Recommendation to Industry:**
Findings from Inverter-Based Resource Model Quality Deficiencies Alert
April 1, 2025

**Overview**

NERC issued a Level 2 Recommendation to Industry for Inverter-Based Resource Model Quality Deficiencies in June 2024, specifically requesting responses from Generator Owners (GO), Transmission Planners (TP), and Planning Coordinators (PC). The alert was posted publicly on the NERC website and required GOs who own bulk power system (BPS)-connected inverter-based resources (IBR) to provide a Data Submission Worksheet, (hereafter: "Worksheet"). The alert had an initial Worksheet submission deadline of September 2, 2024, and due to a low response rate, NERC extended the deadline to November 1, 2024. This resulted in NERC receiving sufficient responses to perform an analysis.

Based on the findings from this alert and the previous alert on IBR performance, a Level 3 alert with Essential Actions is needed to address the deficiencies identified in this Level 2 Alert.

**Summary**

NERC analyzed 10 large-scale disturbances on the BPS that involved the widespread and unexpected reduction in output of IBRs since 2016. These 10 disturbances totaled nearly 15,000 MW of unexpected IBR-output reduction, with approximately 10,000 MW of reduction occurring from disturbances between 2020 and 2024. The increase of IBR-related events coincides with an increase in IBR penetration across the BPS. Contributing causes to these events are poor modeling and poor study practices to assess the performance of these resources.

Performing dynamic simulations of the BPS enables TPs, in cooperation with GOs, to mitigate reliability risks before they occur. Accurate dynamic models of resources are critical to this analysis and to BPS reliability. Several of NERC's published disturbance reports included analyses of the models for the affected facilities, which revealed systemic dynamic model inaccuracies. These analyses also revealed that the models provided for conducting generator interconnection studies, or other system studies, failed to accurately reflect the dynamic performance of the plants. Accurate modeling of IBR facilities is critical in performing system studies to assess the reliable operation of the BPS.

The Inverter-Based Resource Model Quality Deficiencies Alert was distributed to all registered GOs of IBRs as modeling deficiencies, best practices, and recommendations are applicable across all IBR technologies. NERC encourages owners and operators of non-BES and BPS-connected IBR to also review the alert.

The significantly higher complexity and software-based nature of IBR modeling, when compared to synchronous machine modeling, necessitates an improvement in the fundamental principles of dynamic modeling to accurately capture the performance of IBR plants. This alert was also distributed to TPs and

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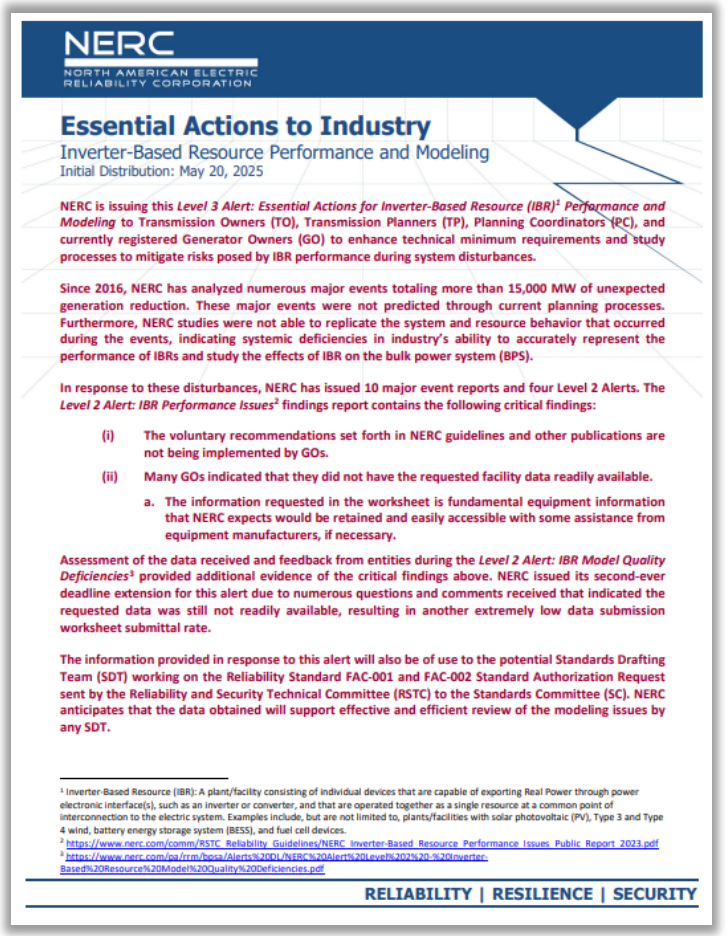
Report on Level 2 Alert on IBR Model Quality Deficiencies (April 2025)
here



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**Essential Actions to Industry**
Inverter-Based Resource Performance and Modeling
Initial Distribution: May 20, 2025

NERC is issuing this *Level 3 Alert: Essential Actions for Inverter-Based Resource (IBR)*[1] *Performance and Modeling* to Transmission Owners (TO), Transmission Planners (TP), Planning Coordinators (PC), and currently registered Generator Owners (GO) to enhance technical minimum requirements and study processes to mitigate risks posed by IBR performance during system disturbances.

Since 2016, NERC has analyzed numerous major events totaling more than 15,000 MW of unexpected generation reduction. These major events were not predicted through current planning processes. Furthermore, NERC studies were not able to replicate the system and resource behavior that occurred during the events, indicating systemic deficiencies in industry's ability to accurately represent the performance of IBRs and study the effects of IBR on the bulk power system (BPS).

In response to these disturbances, NERC has issued 10 major event reports and four Level 2 Alerts. The *Level 2 Alert: IBR Performance Issues*[2] findings report contains the following critical findings:

(i) The voluntary recommendations set forth in NERC guidelines and other publications are not being implemented by GOs.

(ii) Many GOs indicated that they did not have the requested facility data readily available.

a. The information requested in the worksheet is fundamental equipment information that NERC expects would be retained and easily accessible with some assistance from equipment manufacturers, if necessary.

Assessment of the data received and feedback from entities during the *Level 2 Alert: IBR Model Quality Deficiencies*[3] provided additional evidence of the critical findings above. NERC issued its second-ever deadline extension for this alert due to numerous questions and comments received that indicated the requested data was still not readily available, resulting in another extremely low data submission worksheet submittal rate.

The information provided in response to this alert will also be of use to the potential Standards Drafting Team (SDT) working on the Reliability Standard FAC-001 and FAC-002 Standard Authorization Request sent by the Reliability and Security Technical Committee (RSTC) to the Standards Committee (SC). NERC anticipates that the data obtained will support effective and efficient review of the modeling issues by any SDT.

[1] Inverter-Based Resource (IBR): A plant/facility consisting of individual devices that are capable of exporting Real Power through power electronic interface(s), such as an inverter or converter, and that are operated together as a single resource at a common point of interconnection to the electric system. Examples include, but are not limited to, plants/facilities with solar photovoltaic (PV), Type 3 and Type 4 wind, battery energy storage system (BESS), and fuel cell devices.
[2] https://www.nerc.com/comm/RSTC_Reliability_Guidelines/NERC_Inverter-Based_Resource_Performance_Issues_Public_Report_2023.pdf
[3] https://www.nerc.com/pa/rrm/bpsa/Alerts%20DL/NERC%20Alert%20Level%202%20-%20Inverter-Based%20Resource%20Model%20Quality%20Deficiencies.pdf

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Level 3 Alert on IBR Performance and Modeling (May 2025)
here

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# Level 2 Alert Recommendations

- Models should be accurate, detailed, and represent or expected or as-built facilities.
- Industry-approved standard library positive sequence models are sufficient for use in Interconnection-wide base case creation.
- Equipment-specific, user-defined models should be used for detailed reliability studies (e.g., interconnection studies, local reliability studies); should be accepted by TP or PC if usability requirements are met.
- TPs and PCs should stablish clear, consistent, detailed, and comprehensive modeling requirements aligned with NERC recommendations and FERC GIP; include model quality check.
- TPs and PCs should require standard library model, equipment-specific UDM, electromagnetic transient (EMT) model, and supporting documentation from each generator.
- GOs should coordinate with inverter and PPC manufacturers, TPs, and PCs to meet model requirements; provide proof of conformance with requirements.
- GOs should maintain an accurate and representative model throughout the lifecycle of the project.
- An updated set of dynamic models should be included in the next TP and PC annual model updates.

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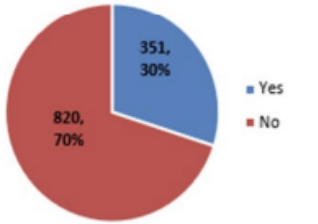
# NERC Report on Model Deficiencies (April 2025)

| Down Droop Gain (DDN) | | | |
|---|---|---|---|
| Data Source | GO Field Manual Entry | GO Model Manual Entry | GO Model Dynamic Model File |
| GO Model Manual Entry | 44% | | |
| GO Model Dynamic Model File | 40% | 69% | |
| Interconnection-Wide Model Dynamic Model File | 30% | 31% | 45% |

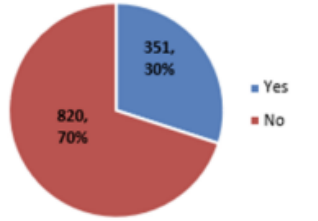
| Low Voltage Ride-through Enter (Vdip) | | | |
|---|---|---|---|
| Data Source | GO Field Manual Entry | GO Model Manual Entry | GO Model Dynamic Model File |
| GO Model Manual Entry | 35% | | |
| GO Model Dynamic Model File | 38% | 93% | |
| Interconnection-Wide Model Dynamic Model File | 27% | 67% | 69% |

Source: NERC Report

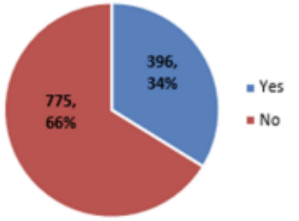
| LVRT Settings at Max Capability | # of Facilities | % |
|---|---|---|
| Yes | 351 | 30% |
| No | 820 | 70% |
| Total | 1,171 | 100% |



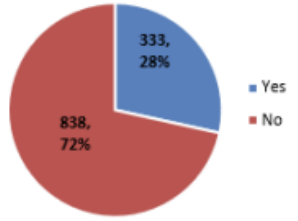

| Overvoltage Settings at Max Capability | # of Facilities | % |
|---|---|---|
| Yes | 351 | 30% |
| No | 820 | 70% |
| Total | 1,171 | 100% |



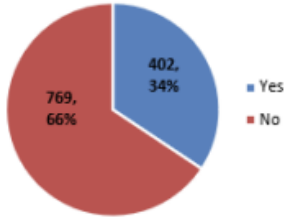

| Undervoltage Settings at Max Capability | # of Facilities | % |
|---|---|---|
| Yes | 396 | 34% |
| No | 775 | 66% |
| Total | 1,171 | 100% |




| HFRT Settings at Max Capability | # of Facilities | % |
|---|---|---|
| Yes | 409 | 35% |
| No | 762 | 65% |
| Total | 1,171 | 100% |




| LFRT Settings at Max Capability | # of Facilities | % |
|---|---|---|
| Yes | 402 | 34% |
| No | 769 | 66% |
| Total | 1,171 | 100% |

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# Level 2 Alert Key Findings from NERC

- GOs indicated that requested data was ***not*** readily available
- NERC expressed concerns with “lack of knowledge” of IBR plant setup and operating characteristics and “failure to improve data acquisition and management processes”
- Systemic deficiencies indicate insufficient interconnection requirements are insufficient
- Protection settings not maximized to inverter capability
- Limitations of reactive power capability
- Inconsistent data across sources – as-left settings, reported data, submitted models, interconnection-wide base cases
- Recommendations
  - TPs and PCs should enhance model requirements and quality check processes to mitigate deficiencies
  - Level 3 Alert on IBR performance and modeling

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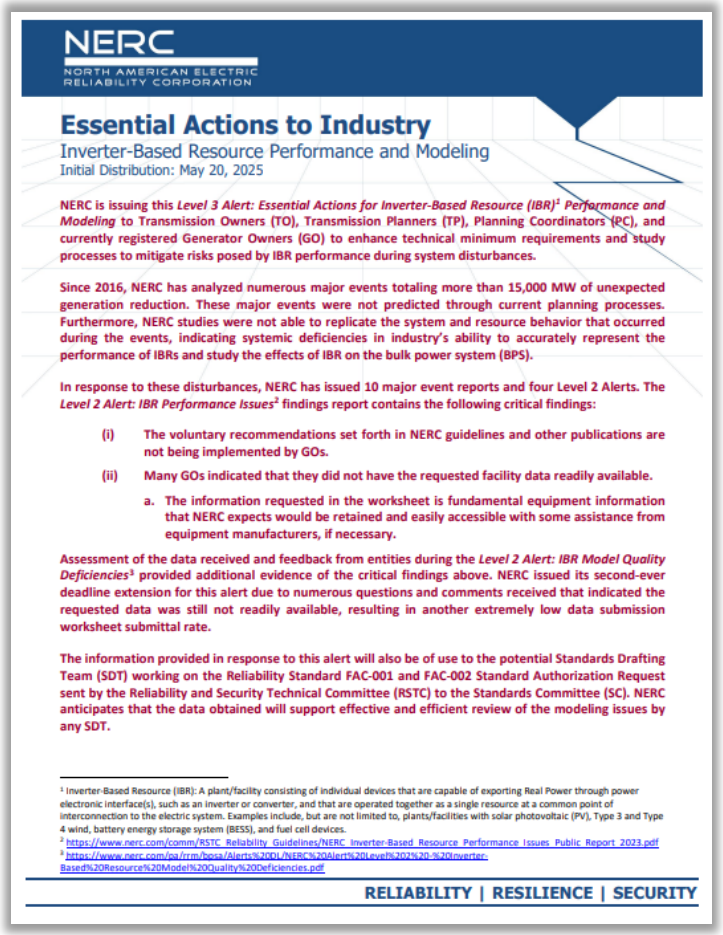
# Level 3 Alert on IBR Performance and Modeling

- Reporting required by ***August 18, 2025***
- Essential Actions*
  - TOs, TPs, and PCs:
    - Enhance criteria and policies with additional technical details and IBR-specific performance criteria
    - Enhance modeling and study practices; include model quality verifications
    - Perform detailed review of currently operating IBRs to understand performance and model accuracy issues
  - GOs:
    - Ensure models used for design are submitted to TPs and PCs; accurate and high-fidelity



NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

**Essential Actions to Industry**

Inverter-Based Resource Performance and Modeling

Initial Distribution: May 20, 2025

NERC is issuing this *Level 3 Alert: Essential Actions for Inverter-Based Resource (IBR)[1] Performance and Modeling* to Transmission Owners (TO), Transmission Planners (TP), Planning Coordinators (PC), and currently registered Generator Owners (GO) to enhance technical minimum requirements and study processes to mitigate risks posed by IBR performance during system disturbances.

Since 2016, NERC has analyzed numerous major events totaling more than 15,000 MW of unexpected generation reduction. These major events were not predicted through current planning processes. Furthermore, NERC studies were not able to replicate the system and resource behavior that occurred during the events, indicating systemic deficiencies in industry's ability to accurately represent the performance of IBRs and study the effects of IBR on the bulk power system (BPS).

In response to these disturbances, NERC has issued 10 major event reports and four Level 2 Alerts. The *Level 2 Alert: IBR Performance Issues*[2] findings report contains the following critical findings:

(i) The voluntary recommendations set forth in NERC guidelines and other publications are not being implemented by GOs.

(ii) Many GOs indicated that they did not have the requested facility data readily available.

a. The information requested in the worksheet is fundamental equipment information that NERC expects would be retained and easily accessible with some assistance from equipment manufacturers, if necessary.

Assessment of the data received and feedback from entities during the *Level 2 Alert: IBR Model Quality Deficiencies*[3] provided additional evidence of the critical findings above. NERC issued its second-ever deadline extension for this alert due to numerous questions and comments received that indicated the requested data was still not readily available, resulting in another extremely low data submission worksheet submittal rate.

The information provided in response to this alert will also be of use to the potential Standards Drafting Team (SDT) working on the Reliability Standard FAC-001 and FAC-002 Standard Authorization Request sent by the Reliability and Security Technical Committee (RSTC) to the Standards Committee (SC). NERC anticipates that the data obtained will support effective and efficient review of the modeling issues by any SDT.

[1] Inverter-Based Resource (IBR): A plant/facility consisting of individual devices that are capable of exporting Real Power through power electronic interface(s), such as an inverter or converter, and that are operated together as a single resource at a common point of interconnection to the electric system. Examples include, but are not limited to, plants/facilities with solar photovoltaic (PV), Type 3 and Type 4 wind, battery energy storage system (BESS), and fuel cell devices.

[2] https://www.nerc.com/comm/RSTC_Reliability_Guidelines/NERC_Inverter-Based_Resource_Performance_Issues_Public_Report_2023.pdf

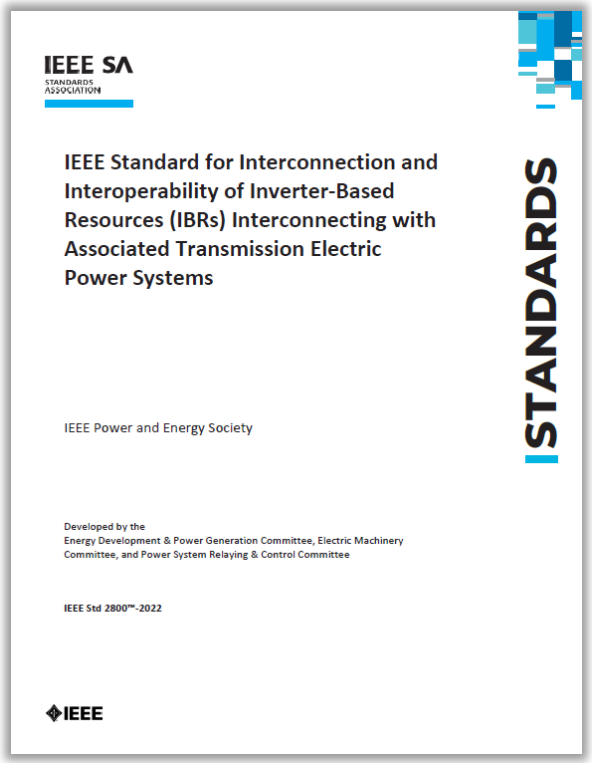
[3] https://www.nerc.com/pa/rrm/bpsa/Alerts%20DL/NERC%20Alert%20Level%202%20-%20Inverter-Based%20Resource%20Model%20Quality%20Deficiencies.pdf

RELIABILITY | RESILIENCE | SECURITY

Level 3 Alert on IBR Performance and Modeling (May 2025) here

** See Alert for more details regarding each Essential Action*

# IEEE 2800-2022 and IEEE P2800.2



IEEE SA
STANDARDS ASSOCIATION

IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems

STANDARDS

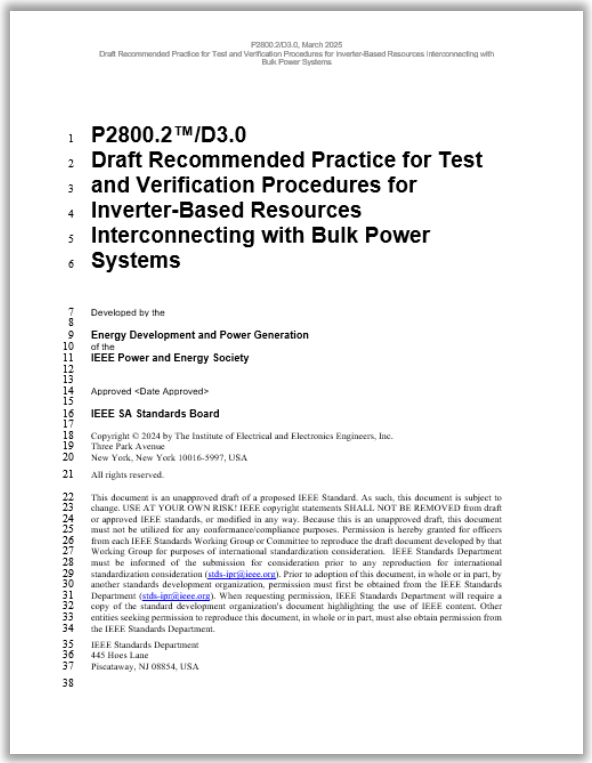
IEEE Power and Energy Society

Developed by the
Energy Development & Power Generation Committee, Electric Machinery Committee, and Power System Relaying & Control Committee

IEEE Std 2800™-2022

IEEE

**The What**



P2800.2/D3.0, March 2025
Draft Recommended Practice for Test and Verification Procedures for Inverter-Based Resources Interconnecting with Bulk Power Systems

P2800.2™/D3.0
Draft Recommended Practice for Test and Verification Procedures for Inverter-Based Resources Interconnecting with Bulk Power Systems

Developed by the

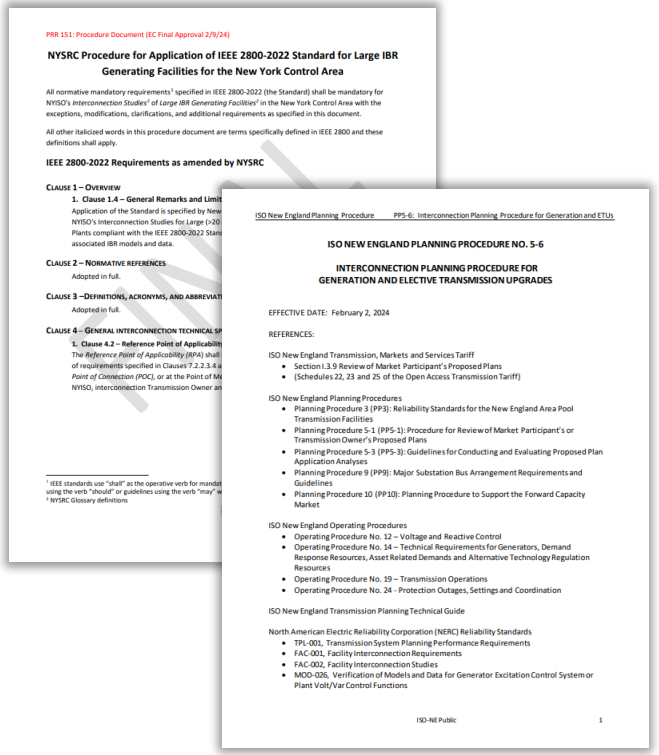
Energy Development and Power Generation
of the
IEEE Power and Energy Society

Approved <Date Approved>

IEEE SA Standards Board



**The How**



PRR 151: Procedure Document (EC Final Approval 2/9/24)

NYSRC Procedure for Application of IEEE 2800-2022 Standard for Large IBR Generating Facilities for the New York Control Area

All normative mandatory requirements[1] specified in IEEE 2800-2022 (the Standard) shall be mandatory for NYISO's *Interconnection Studies*[2] of *Large IBR Generating Facilities*[2] in the New York Control Area with the exceptions, modifications, clarifications, and additional requirements as specified in this document.

All other italicized words in this procedure document are terms specifically defined in IEEE 2800 and these definitions shall apply.

IEEE 2800-2022 Requirements as amended by NYSRC

CLAUSE 1 – OVERVIEW

1. Clause 1.4 – General Remarks and Limit

Application of the Standard is specified by New
NYISO's Interconnection Studies for Large (>20
Plants compliant with the IEEE 2800-2022 Stand
associated IBR models and data.

CLAUSE 2 – NORMATIVE REFERENCES

Adopted in full.

CLAUSE 3 –DEFINITIONS, ACRONYMS, AND ABBREVIAT

Adopted in full.

CLAUSE 4 – GENERAL INTERCONNECTION TECHNICAL SP

1. Clause 4.2 – Reference Point of Applicabilit

The *Reference Point of Applicability (RPA)* shall
of requirements specified in Clauses 7.2.2.3.4 a
*Point of Connection (POC)*, or at the Point of Me
NYISO, Interconnection Transmission Owner an

[1] IEEE standards use "shall" as the operative verb for mandat
using the verb "*should*" or guidelines using the verb "may" w
[2] NYSRC Glossary definitions

ISO New England Planning Procedure PP5-6: Interconnection Planning Procedure for Generation and ETUs

ISO NEW ENGLAND PLANNING PROCEDURE NO. 5-6

INTERCONNECTION PLANNING PROCEDURE FOR GENERATION AND ELECTIVE TRANSMISSION UPGRADES

EFFECTIVE DATE: February 2, 2024

REFERENCES:

ISO New England Transmission, Markets and Services Tariff
- Section I.3.9 Review of Market Participant's Proposed Plans
- (Schedules 22, 23 and 25 of the Open Access Transmission Tariff)

ISO New England Planning Procedures
- Planning Procedure 3 (PP3): Reliability Standards for the New England Area Pool Transmission Facilities
- Planning Procedure 5-1 (PP5-1): Procedure for Review of Market Participant's or Transmission Owner's Proposed Plans
- Planning Procedure 5-3 (PP5-3): Guidelines for Conducting and Evaluating Proposed Plan Application Analyses
- Planning Procedure 9 (PP9): Major Substation Bus Arrangement Requirements and Guidelines
- Planning Procedure 10 (PP10): Planning Procedure to Support the Forward Capacity Market

ISO New England Operating Procedures
- Operating Procedure No. 12 – Voltage and Reactive Control
- Operating Procedure No. 14 – Technical Requirements for Generators, Demand Response Resources, Asset Related Demands and Alternative Technology Regulation Resources
- Operating Procedure No. 19 – Transmission Operations
- Operating Procedure No. 24 - Protection Outages, Settings and Coordination

ISO New England Transmission Planning Technical Guide

North American Electric Reliability Corporation (NERC) Reliability Standards
- TPL-001, Transmission System Planning Performance Requirements
- FAC-001, Facility Interconnection Requirements
- FAC-002, Facility Interconnection Studies
- MOD-026, Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions

ISO-NE Public 1

**Implementation**

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# How This Impacts Industry

*Drivers and Activities*

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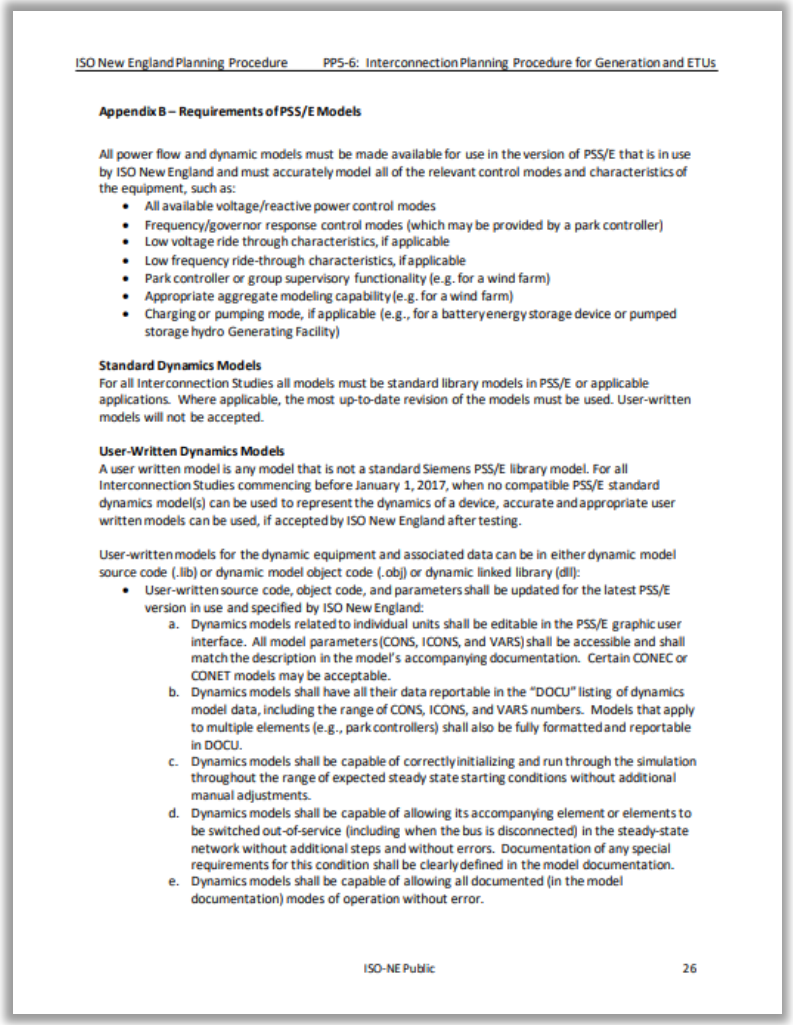
# Clear and Effective Requirements

- IEEE 2800-2022 Requirements
- Requirements for PSS/Models
- Requirements for PSCAD Models
- IBR Facility Study Considerations
- Procedures for Material Modifications
- Etc.

*Goal: Clear expectations for interconnection customers!*



ISO New England Planning Procedure PP5-6: Interconnection Planning Procedure for Generation and ETUs

**Appendix B – Requirements of PSS/E Models**

All power flow and dynamic models must be made available for use in the version of PSS/E that is in use by ISO New England and must accurately model all of the relevant control modes and characteristics of the equipment, such as:

- All available voltage/reactive power control modes
- Frequency/governor response control modes (which may be provided by a park controller)
- Low voltage ride through characteristics, if applicable
- Low frequency ride-through characteristics, if applicable
- Park controller or group supervisory functionality (e.g. for a wind farm)
- Appropriate aggregate modeling capability (e.g. for a wind farm)
- Charging or pumping mode, if applicable (e.g., for a battery energy storage device or pumped storage hydro Generating Facility)

**Standard Dynamics Models**

For all Interconnection Studies all models must be standard library models in PSS/E or applicable applications. Where applicable, the most up-to-date revision of the models must be used. User-written models will not be accepted.

**User-Written Dynamics Models**

A user written model is any model that is not a standard Siemens PSS/E library model. For all Interconnection Studies commencing before January 1, 2017, when no compatible PSS/E standard dynamics model(s) can be used to represent the dynamics of a device, accurate and appropriate user written models can be used, if accepted by ISO New England after testing.

User-written models for the dynamic equipment and associated data can be in either dynamic model source code (.lib) or dynamic model object code (.obj) or dynamic linked library (dll):

- User-written source code, object code, and parameters shall be updated for the latest PSS/E version in use and specified by ISO New England:
  a. Dynamics models related to individual units shall be editable in the PSS/E graphic user interface. All model parameters (CONS, ICONS, and VARS) shall be accessible and shall match the description in the model's accompanying documentation. Certain CONEC or CONET models may be acceptable.
  b. Dynamics models shall have all their data reportable in the "DOCU" listing of dynamics model data, including the range of CONS, ICONS, and VARS numbers. Models that apply to multiple elements (e.g., park controllers) shall also be fully formatted and reportable in DOCU.
  c. Dynamics models shall be capable of correctly initializing and run through the simulation throughout the range of expected steady state starting conditions without additional manual adjustments.
  d. Dynamics models shall be capable of allowing its accompanying element or elements to be switched out-of-service (including when the bus is disconnected) in the steady-state network without additional steps and without errors. Documentation of any special requirements for this condition shall be clearly defined in the model documentation.
  e. Dynamics models shall be capable of allowing all documented (in the model documentation) modes of operation without error.

ISO-NE Public 26

ISO NEW ENGLAND PLANNING PROCEDURE NO. 5-6

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# Steps to Ensure Accurate and Quality Models

*Steps for GOs to follow to ensure they meet NERC requirements and recommendations*

1. Start with the as-left settings – attestations from OEMs, actual field parameters extracted from HMI, pulled relay records, etc.
2. Gather and identify the latest "active" models across platforms (e.g., PSSE UDM, PSSE standard library, PSCAD, TSAT).
3. Perform model verification to verify that the model matches the as-left configuration, protection, and control settings.
4. Verify that models match across platforms structurally, control modes, settings, parameters, etc.
5. Perform rigorous model quality tests and model benchmarking across all applicable models.
6. Tune the IBR plant models if deficiencies are identified; iterate until accuracy matches are obtained.
7. Follow TP and PC processes for sharing models and/or making site modifications, if needed.

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# As-Lefts: Inconsistencies in Data

- Inconsistencies between data source:
  - Inverter documentation, as-left settings, specification sheets, narratives, etc.
  - OEM-supplied information
  - Relay .rdb files
  - Dynamic models (PSS®E, PSCAD™, TSAT™) discrepancies or omissions
  - Version control issues
- Inabilities to easily extract useful information from IBR units
  - Room for human error
  - Need machine readable files/forms, computer vision to identify inconsistencies
  - Standardized framework encouraged
- Errors exist in protection settings, imagine errors in inverter settings


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# Common Deficiencies and Modelling Issues

- Flat run issues across SCRs – unstable from the beginning
- Incorrect ride-through mode set
- Models do not include the same controls as the hardware
- Frequency response or voltage control parameters do not match as-lefts
- Model trips during expected ride-through events
- Inappropriate dynamic response during tests – poor response, unstable, etc.
- Many models with unclear labeling – uncertainty in what is “active model”
- Lack of documentation

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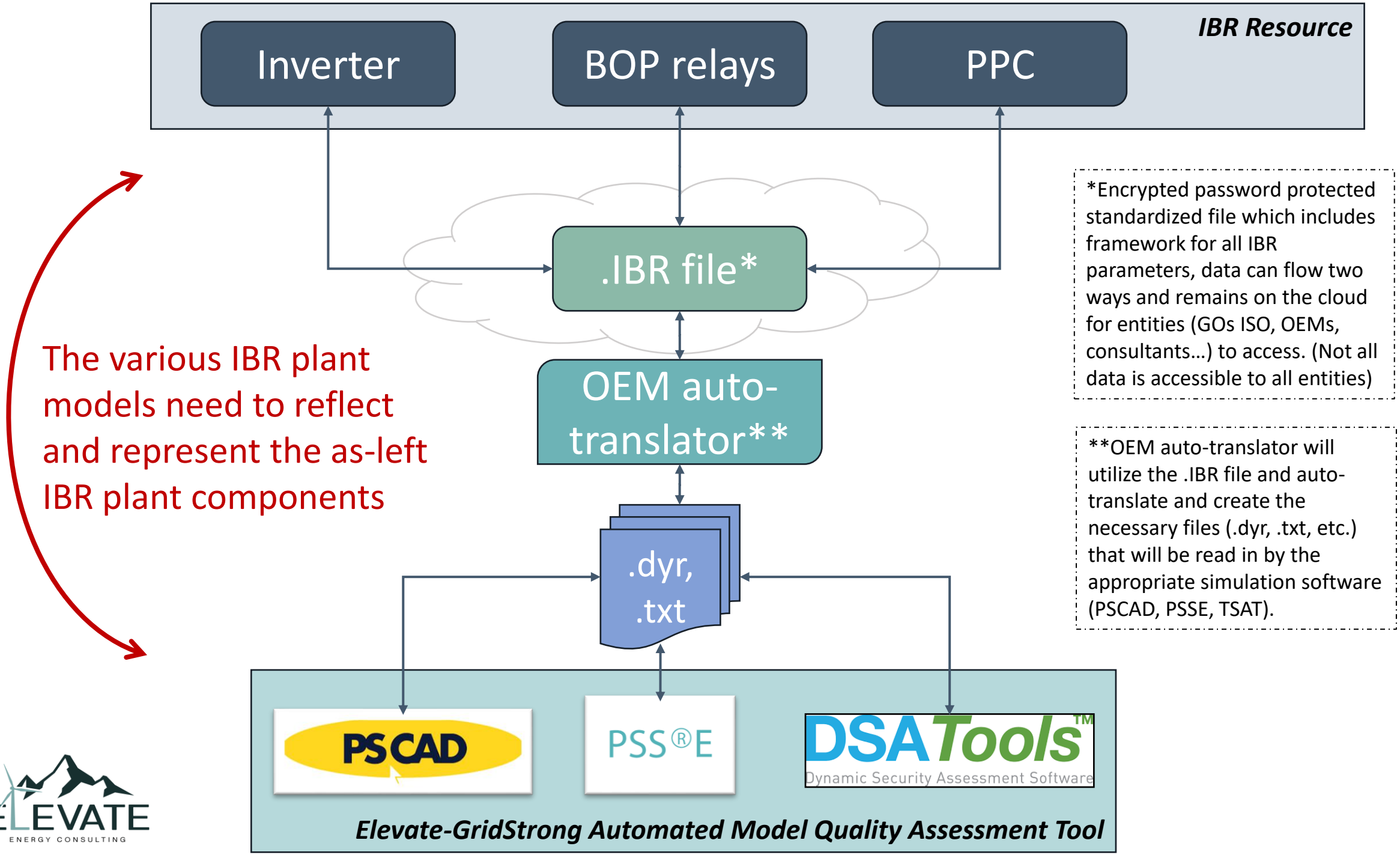


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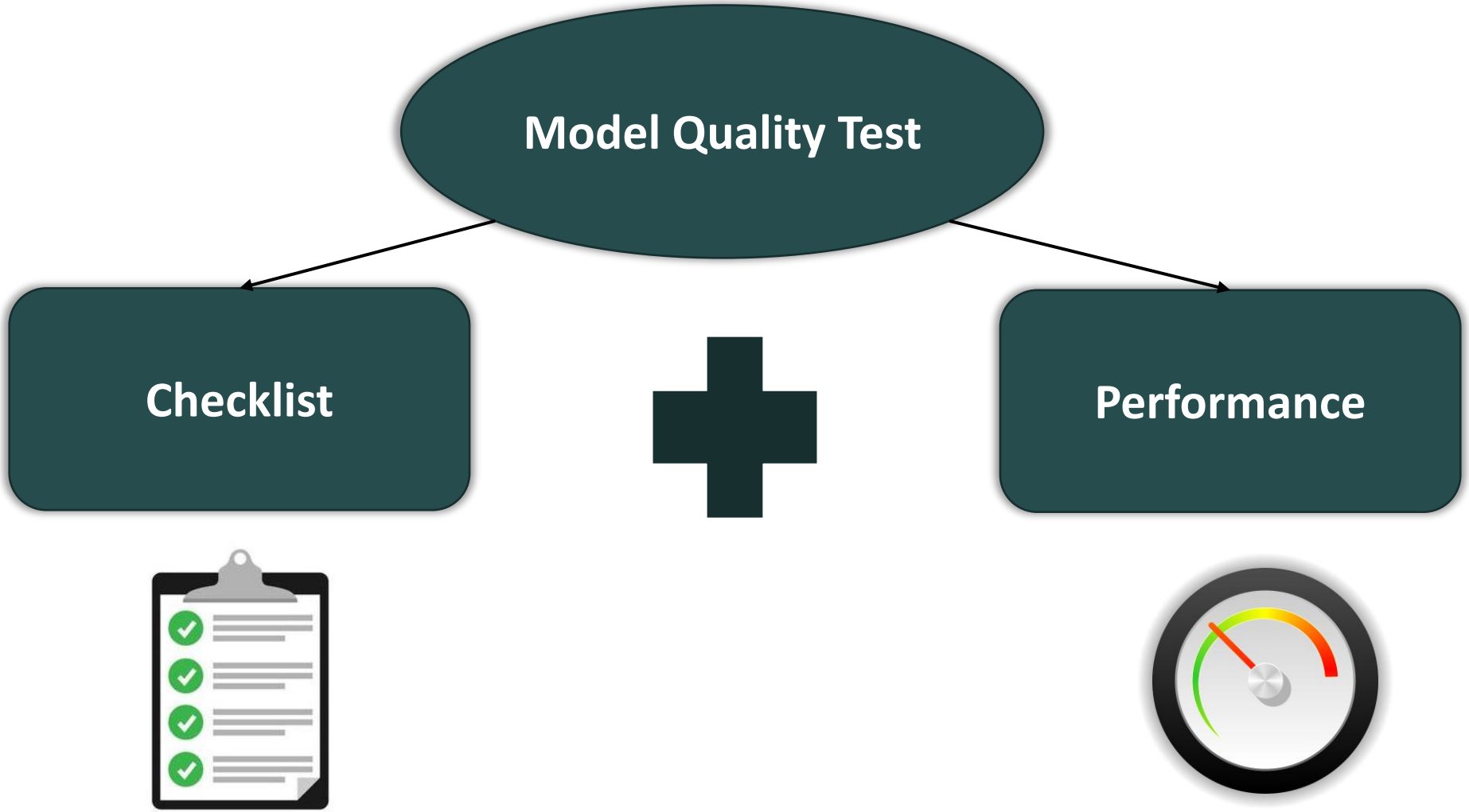
# Types of MQT



# Model Quality Automation

**Model Package**

**Choose a Region**

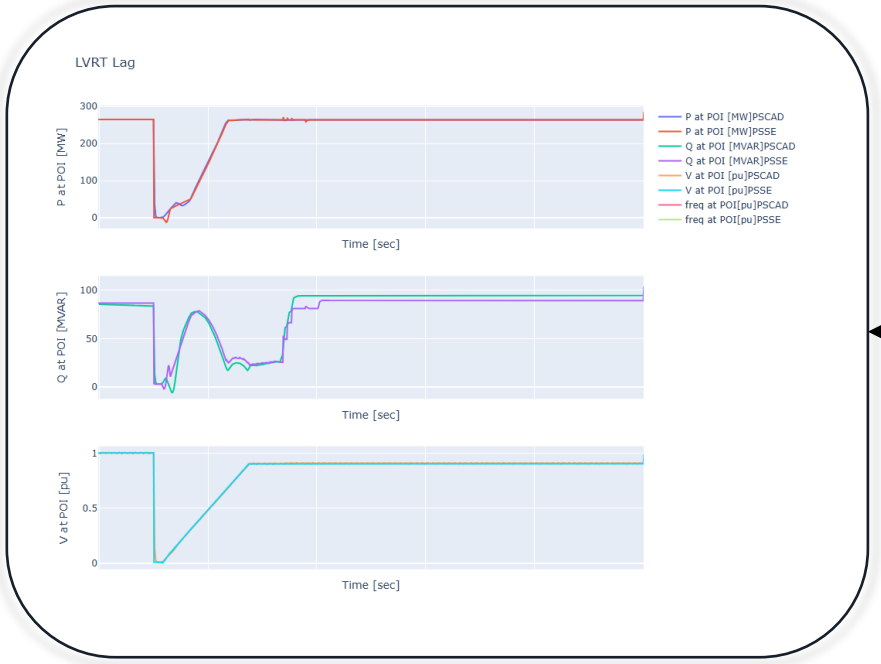
**Secure Virtual Computer Lab**

## Perform MQT tests
Run all tests via web interface on vitrual computers.
One click, minimize, and wait.

## Benchmark results
Overlay responses from each simulation model
(PSSE, PSCAD, TSAT) with auto-conformance checks.

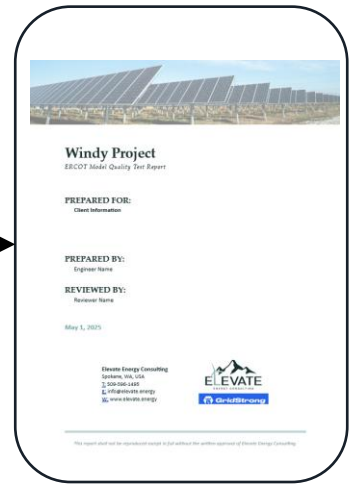
## Compare simulations
Check pre- vs. post-modification results.

## Compile MQT report
Capture findings from every test.




**Interactive plots with analytics built in**

**Report**



# Model Versus As-Left Equipment

- After performing the MQT Tests and system studies
- As-left settings should **REFLECT** the model parameters that were tuned to ensure stability
- Otherwise, what is the point? Avoid this:

Model Parameters in Simulation

MATCH?

As-Lefts in the Field

# Concluding Remarks

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# What's Next?

- IBR model requirements at ISO and NERC level evolving
- IBR model quality review processes also evolving
- Changes to IBR plant (controls, protections, settings, etc.) require model updates; have downstream NERC standards impacts as well (PRC, MOD, etc.)
- Model benchmarking requirements across models
- Careful IBR model development, verification, and validation
- Automation to expedite and reduce areas for error
- High trust and confidence in modelers – expertise across platforms matters

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# NERC References

- Level 2 Alert on IBR Model Quality Deficiencies (June 2024) – here
- Report on Level 2 Alert on IBR Model Quality Deficiencies (April 2025) – here
- Level 3 Alert on IBR Performance and Modeling (May 2025) – here
- NERC Standards Under Development – here
- FERC Order 901 Summary Graphic of Milestone 3 (as of July 2025) – here
- FERC Order 901 Summary Information of Milestone 3 (as of July 2025) – here
- Project 2020-06 Verification of Models and Data for Generators – here
- Project 2021-01 System Model Validation with IBRs – here
- Project 2022-02 Uniform Modeling Framework for IBR – here
- Project 2022-04 EMT Modeling – here

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Elevate Energy Consulting
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# Electronic Modeling Lessons Learned & Challenges for Inverter-Based Resources

**Todd Chwialkowski**
Director, Transmission Regulatory & Compliance
EDF power solutions North America

NPCC Reliability Forum | August 7, 2025

# Agenda

- Introduction to EDF power solutions North America
- Generator Requirements
- Improving Accuracy and Reliability
- Lessons Learned

# EDF power solutions

**EDF power solutions North America specializes in low-carbon power generation, storage, and energy management solutions that create value—from origination to operation—to help customers reduce long-term energy costs, increase resiliency, and achieve sustainability goals.**

As owner-operators of one of the largest clean energy portfolios on the continent, and with deep experience developing and operating low-carbon energy assets, we bring a **full-suite of solutions** for grid-scale, distribution-scale, asset optimization, and onsite power production.

Our outstanding capabilities allow us to utilize our in-house experts, providing **maximal efficiency and end-to-end oversight** of any size of energy project.

23 GW
developed

16 GW
service contracts

43 GW
pipeline

1,600
employees

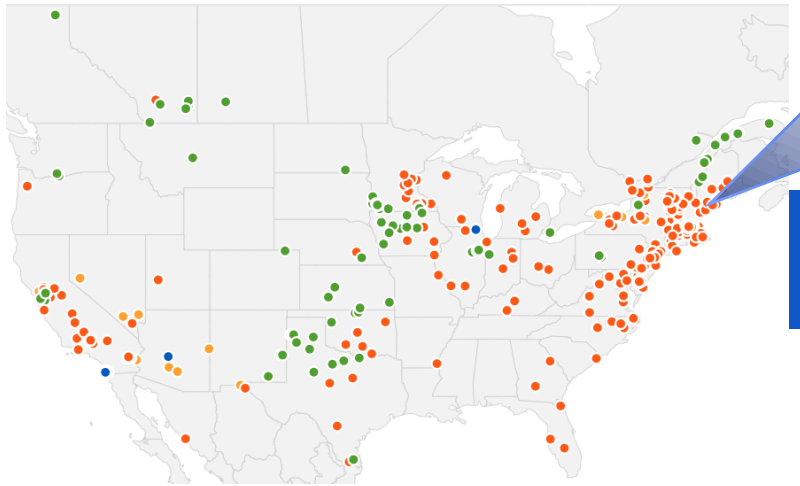
Est. 1987

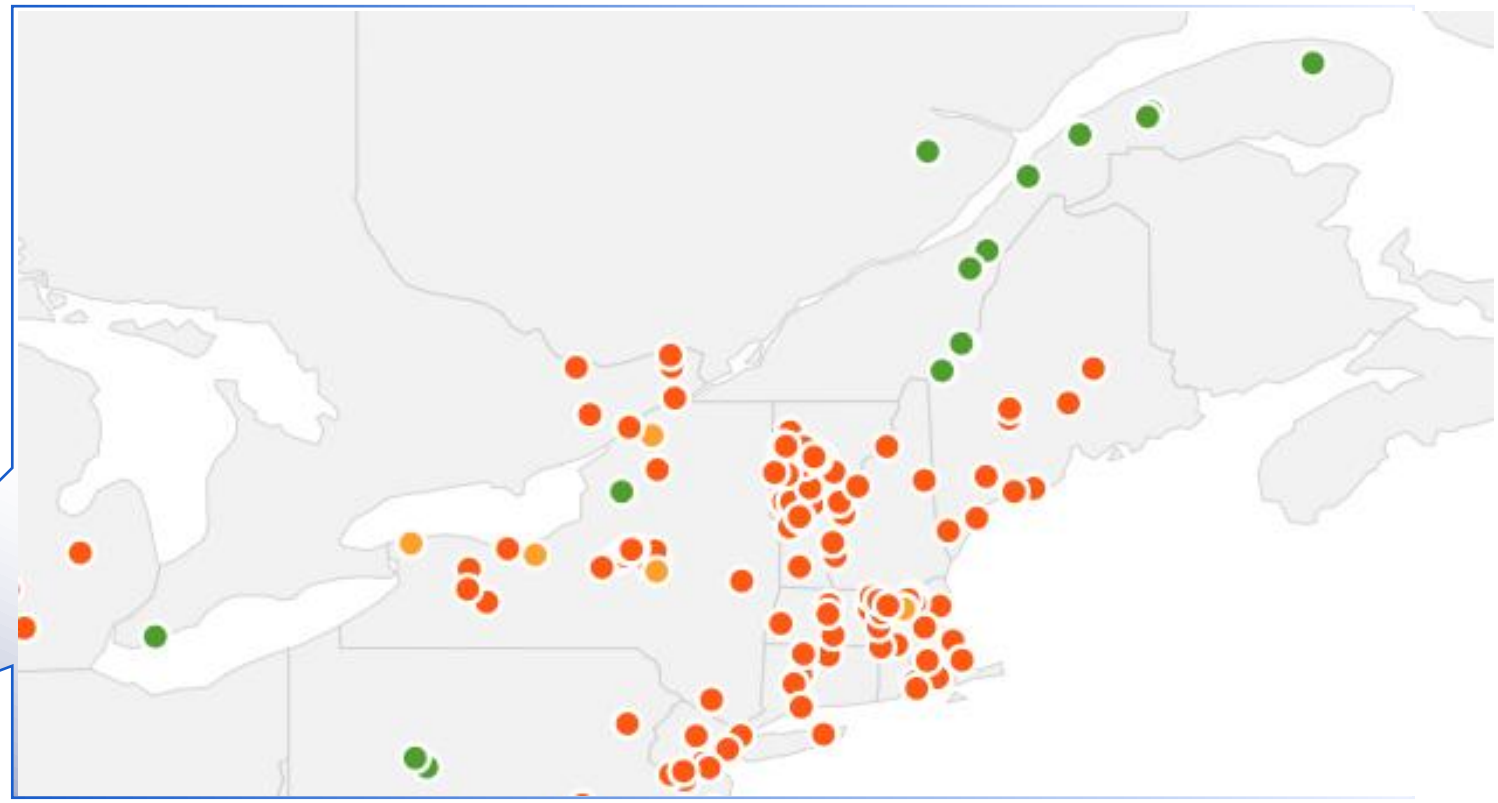
U.S., Canada, and Mexico

*as of 12/31/24*

# EDF power solutions in the Northeast

- Wind
- Solar
- Solar + Storage





**EDF power solutions' Grid-Scale and Distribution-Scale Generation Covers North America**

# IBR Model Technical Overview: Types of Models

In general, IBRs are required to submit two types of models to ISOs and TPs:
Positive Sequence Model and Electromagnetic Transient Model

## Positive Sequence (RMS) Model

Used for large system planning studies, e.g. FIS study, System Operating Limit (SOL) study, etc.

### PSSE PSLF

- Steady State power flow model **.raw**
- Dynamic model **.dyr**
- Short circuit model **.seq**

### TSAT

- Steady State power flow model **.raw**
- Dynamic model **.dyr**
- Short circuit model **.seq**
- On-line Dynamic Security Assessment **(On-line DSA)**

## Electromagnetic Transient Model (EMT)

More smaller area/site/equipment level studies, e.g. TOV study, SSR study, control interaction study

### PSCAD

- Plant model (steady state "power flow" model)
- Detailed device controller model
- Models all frequencies and all three phases

*Plant models may include OEM generator model, PPC model, Shunt Reactors & Capacitors, Transformer(s) (OLTC), etc.*

# Requirements for Inverter Based Resources (IBRs)

**Prior to FERC Order 901, NERC Milestone 3:**

FAC-002 / MOD-026 / MOD-027 / MOD-032: Positive Sequence Library and User-Defined Models

**Post NERC Milestone 3:**

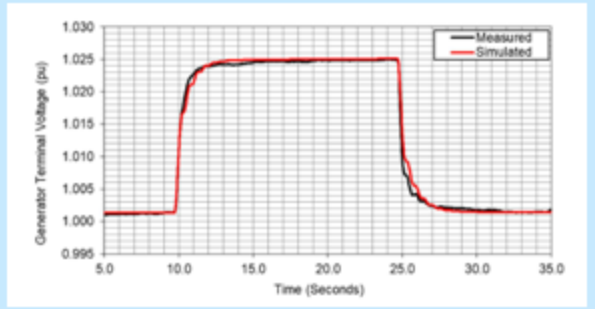
MOD-026-2 / MOD-032-2: Positive Sequence Library and User-Defined Models, EMT Models +++ (FAC-002-5: Project 2023-5)

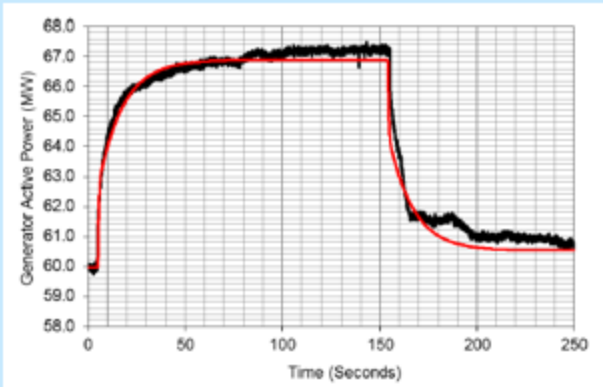
**WHY IS THIS IMPORTANT?** EMT models will provide better quality and accuracy—but are not always available!

"It is the responsibility of each project developer and GO to meet the modeling requirements established by the TP and PC and to provide adequate proof of conformance to the requirements. It is the responsibility of each GO to maintain an accurate model throughout the lifecycle of the project. GOs shall notify the TP and PC of any expected changes or updates (per NERC FAC-002) for in-service equipment and submit updated models accordingly."

# Requirements for IBRs: NERC & ISOs

| NERC & EROs | PSSE Generic | PSSE UDM | PSLF | PSCAD | TSAT | MQT |
|---|---|---|---|---|---|---|
| **NERC (MOD-026-2 / MOD-032-2)** | ✓ | ✓ | x | ✓ | x | ✓ |
| **Regions** | PSSE Generic | PSSE UDM | PSLF | PSCAD | TSAT | MQT |
| **NYISO** | ✓ | x | x | ✓ | x | same as ISO-NE, PJM |
| **ISO-NE** | ✓ | x | x | ✓ | ✓ | Tests as per PP5-6 |
| **CAISO** | x | x | ✓ (library models only) | ✓ | x | x |
| **ERCOT** | ✓ | ✓ | x | ✓ | ✓ | ✓ |
| **PJM** | ✓ | x | x | ? | x | Flat Start and Bump Test |
| **MISO** | ✓ | x | x | ✓ | ✓ | Flat Start and Bump Test |
| **SPP** | ✓ | ✓ | x | ✓ | ✓ | Flat Start and Bump Test |
| **Puerto Rico** | ✓ | ✓ | x | ✓ | x | |
| **Hawaii HECO** | ✓ | ✓ | x | ✓ | x | PSSE PSCAD Simulation testing |
| **TVA** | ✓ | x | x | ✓ | x | |
| **IESO** | ✓ | | x | ✓ | x | |
| **Hydro Quebec** | ✓ | ✓ | x | EMTP RV | x | |
| **AESO** | ✓ | x | * | Optional as of now | x | |
| **Other Entities** | | | | | | |
| **WECC** | x | x | ✓ (library models only) | ✓ | x | x |




**WHY IS THIS IMPORTANT?** NERC has high-level requirements; ISOs develop actual requirements for interconnection through generation & ***USE*** the models.

# IBR Plant Model Overview: Components of the Plant Model

**IBRs are required to submit plant models: *Tuned* IBR Unit Model, *Tuned* PPC Model, & BOP Model**

## OEM Provided (3rd Party Engineering)

### Tuned IBR Unit Model

- IBR Unit Model: model of the specific inverter / turbine (normally OEM provided)
- Protection / Control Settings: tuned specifically for the plant (updated during project stages)

### Tuned PPC Model

- PPC Unit Model: Model of the PPC representing the control design
- PPC Parameters: tuned specifically for the operation of the plant (updated during project stages

## Generator Owner Provided (3rd Party Engineering)

### Balance of Plant Model

- Transmission Line
- Collector System
- Transformers
- Reactive Compensation

# Modeling Requirements for IBRs
## Outsourcing vs. Bringing the Function In-house

### ACCOMPLISHING THE TASK

**Smaller GOs:** OEMs, 3rd-party engineering

**Mid-sized GOs:** Some in-house tasks, verification and validation, + OEMs, 3rd-party engineering

**Large GOs:** In-house management, 3rd-party engineering

### CHALLENGES

- Integration of diverse models to develop a plant model; lack of tools and resources [= cost]; time
- Modeling new technologies and characteristics; lack of expertise
- Verification and validation: data availability and quality
- Standardization of modeling practices

**WHY DOES THIS MATTER?** Balancing cost, time, and resources = success with accurate and quality models!

# Reliability & Reality: Opportunities

**Current IBRs (Legacy Generation Plants):**

- P & Q capability
- Frequency and voltage ride-through capability
- Improved data monitoring and reporting (e.g. ERCOT NOGRR-245, NERC PRC-028-1)

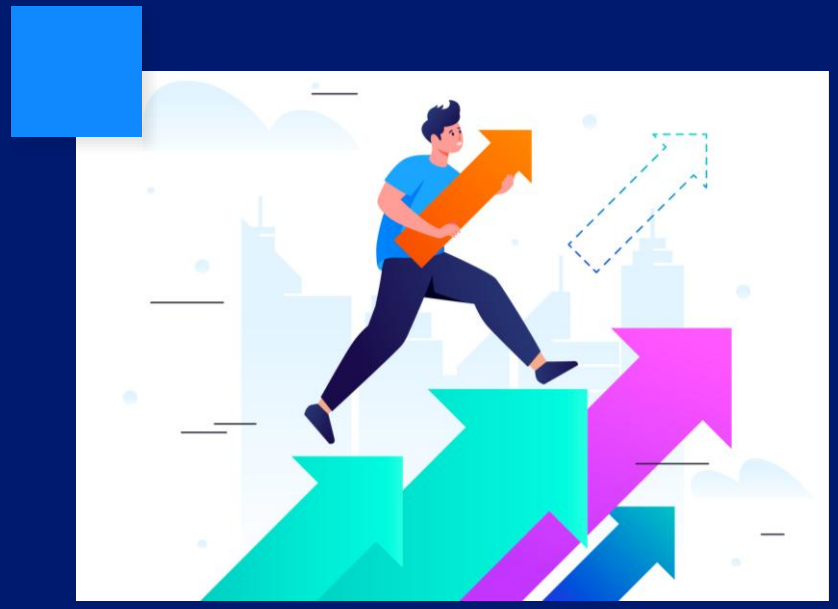
› **Basic modeling**

**IBRs in Development (Future Generation Plants):**

- Grid support services
- P & [increased] Q capability
- Faster response to events
- Enhanced frequency and voltage ride-through capability
- Continued response over longer periods of time before tripping
- Grid-forming vs. grid-following

› **Increased accuracy with modeling**

To date, NERC and ERCOT have proposed ***retroactive implementation*** (applies to both current generation and future projects).



ISOs / RTOs are utilizing various strategies in their implementation of the IEEE2800-2022 requirements.



EDF power solutions

EDF power solutions

# *Thank you*

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Energy Designed *for the Future.*

# Reliability Forum Survey

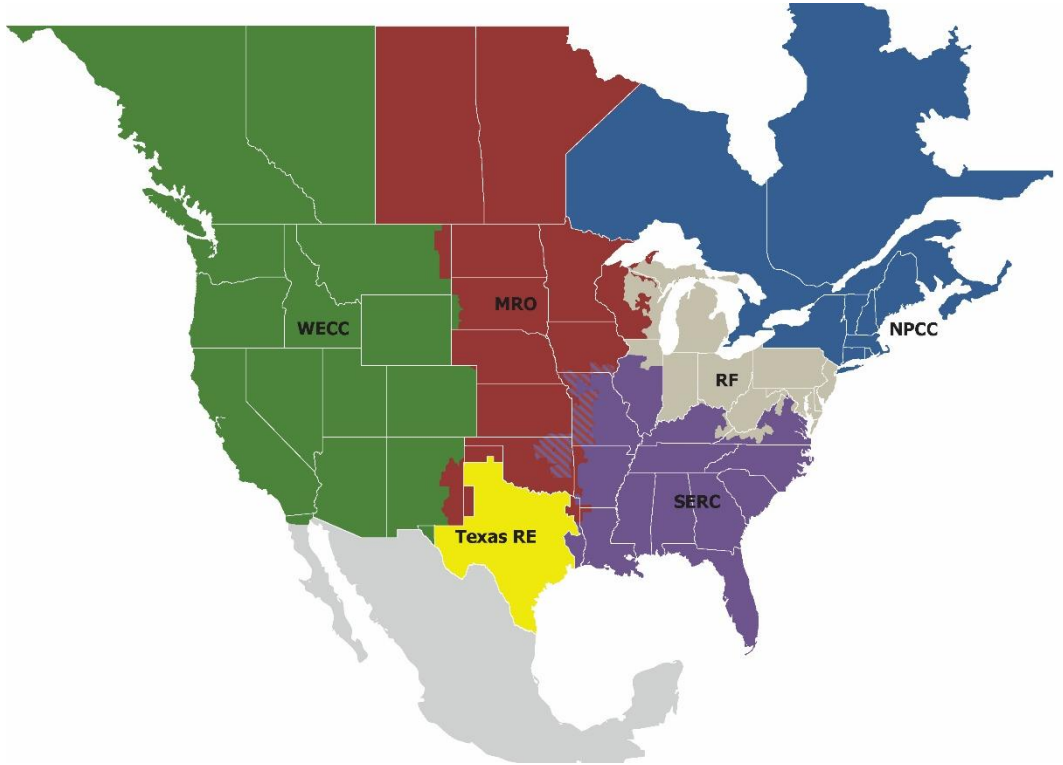
- Scan the QR or use link to join
  - Survey link will be provided in the Q&A section of Microsoft Teams

# NPCC Long Term Strategy

To assure effective and efficient reduction of risks to the reliability and security of the grid

## 2025 Outreach Activities

- **Reliability Forums - March, May, Aug., Oct.**
  - Various Reliability Topics
  - Electric Vehicles, Energy Storage, Large Loads, FERC Order 901– Data and Model Validation
- **State and Provincial Outreach Topics**
  - NERC and NPCC Seasonal Reliability Assessments
  - State of Reliability
  - Interregional Transfer Capability Study (ITCS)
  - FERC Order 901 (September 2025)
- **Regional Webinars/Workshops**
  - Physical and Cyber Security
  - Extreme Weather Preparedness
- **2024 NPCC Northeast Gas-Electric Study**




NERC Regions Map

# NPCC Long Term Strategy

To assure effective and efficient reduction of risks to the reliability and security of the grid

## Comments/Suggestions

Contact Us

NPCC Reliability Forums

NPCC Guidance Document