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NORTH AMERICAN ELECTRIC  
RELIABILITY CORPORATION

# NERC Milestone 3 Standards Industry Webinar

May 2025

Presenters:

Bradley Marszalkowski – Chair, Project 2020-06 Drafting Team

Hayden Maples – Member, Project 2022-02 Drafting Team

Trevor Schultz – Vice Chair, Project 2021-01 Drafting Team

RELIABILITY | RESILIENCE | SECURITY

Please post your questions using the  
Webex Q&A function.

## Project 2020-06 Verifications of Models and Data for Generators

- MOD-026

## Project 2022-02 Uniform Framework Model for IBRs

- MOD-032
- TOP-003
- IRO-010

## Project 2021-01 System Model Validation with IBRs

- MOD-033

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# Verifications of Models and Data for Generators

NERC Project 2020-06

Bradley Marszalkowski – Chair, Project 2020-06 Drafting Team  
May 2025

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- Combine MOD-026-1 (Volt/Var Control) and MOD-027-1 (Active Power/Frequency Control)
- Define terms Model Verification and Model Validation
- Address modeling for registered IBRs as well as synchronous generators
- Adds EMT modeling requirements
- Provides a process for improving model fidelity
  - Requirements on GO/TO for model verification
  - Validation of models with actual disturbance monitoring data from PRC-002 and PRC-028

# Model Verification vs Model Validation definitions



**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.

*\*Aligns with IEEE P2800.2 proposed definitions*



EMT models will be required for IBRs commissioned after the effect date of MOD-026-2



Transmission Planner must identify which legacy facilities also need to provide EMT models



Standard addresses issues with legacy facilities that may be impacted by OEM no longer in business or supporting in-service equipment

- MOD-26 will address a number of FERC 901 directives:
  - P126 satisfied through model benchmarking requirements of R3
  - P140 satisfied through Model Verification and Model Validation requirements under R2 and R3
  - P141 satisfied through submission and verification requirements of R2 and R3 requiring dynamic model submissions that represent in-service equipment.
  - P143 satisfied through the development of MOD-26-2 which requires a uniform approach to model verification
  - P149 satisfied through all requirements, and ensuring no conflicts with FERC Order 2023
  - P226 satisfied through the implementation plan to be in place prior to 2030



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# Uniform Modeling Framework for IBR

NERC Project 2022-02

Hayden Maples – Member, Project 2022-02 Drafting Team  
May 2025

## Uniform Framework Model Framework for IBR (Project 2022-02)



### ERO Approved Criteria for Acceptable Models



### Establish uniform model framework for data sharing and model development

**Distributed Energy Resources (DER):** Generators and energy storage technologies connected to a distribution system that are capable of providing Real Power in non-isolated parallel operation with the Bulk-Power System, including those connected behind the meter of an end-use customer that is supplied from a distribution system.

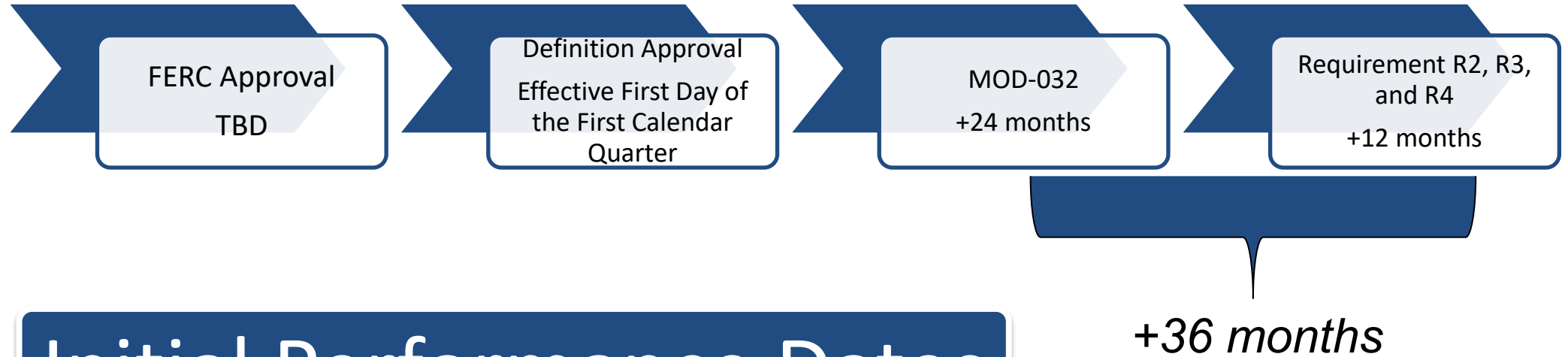
- Functional Entity
  - Replaced Load Serving Entity with Distribution Provider
- Requirement Language
  - ERO Criteria for Acceptable Models
  - Replaced Load Serving Entity with Distribution Provider
  - Unregistered IBR data or DER data/estimate of modeling data and parameters
    - Including explanation and method used
- Attachment 1
  - Added
    - IBR
    - Aggregate Demand
    - Aggregate Distributed Resource Energy
  - Footnote Section

- Requirement Language

- IBR-specified data and parameters
- ERO Criteria for Acceptable Models

**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.

**1.5.3** Requirements for model submissions in accordance with the Criteria for Acceptable Models maintained by the Electric Reliability Organization;



## Initial Performance Dates



Requirement R2, R3, and R4 Revisions  
+12 months after MOD-032-2 effective date



Current R2, R3, and R4 Requirements  
Must continue to comply during the phased-in compliance period



- **Criteria for Acceptable Models**
  - Usability requirements
  - Considerations for model use in planning versus operations
  - Process for updates to Criteria for Acceptable Models
- **Unacceptable Models List**
  - Process for updates to unacceptable models list

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## ERO Approved Criteria for Acceptable Models

For use by Project 2022-02 Team  
Last Updated February 2025

**Purpose**

The Criteria for Acceptable Models defines the minimum criteria for model usability and quality for model submissions under the MOD-032, TOP-003, and IRO-010 Reliability Standards, as well as other Reliability Standards that may be revised from time to time to incorporate these Criteria.

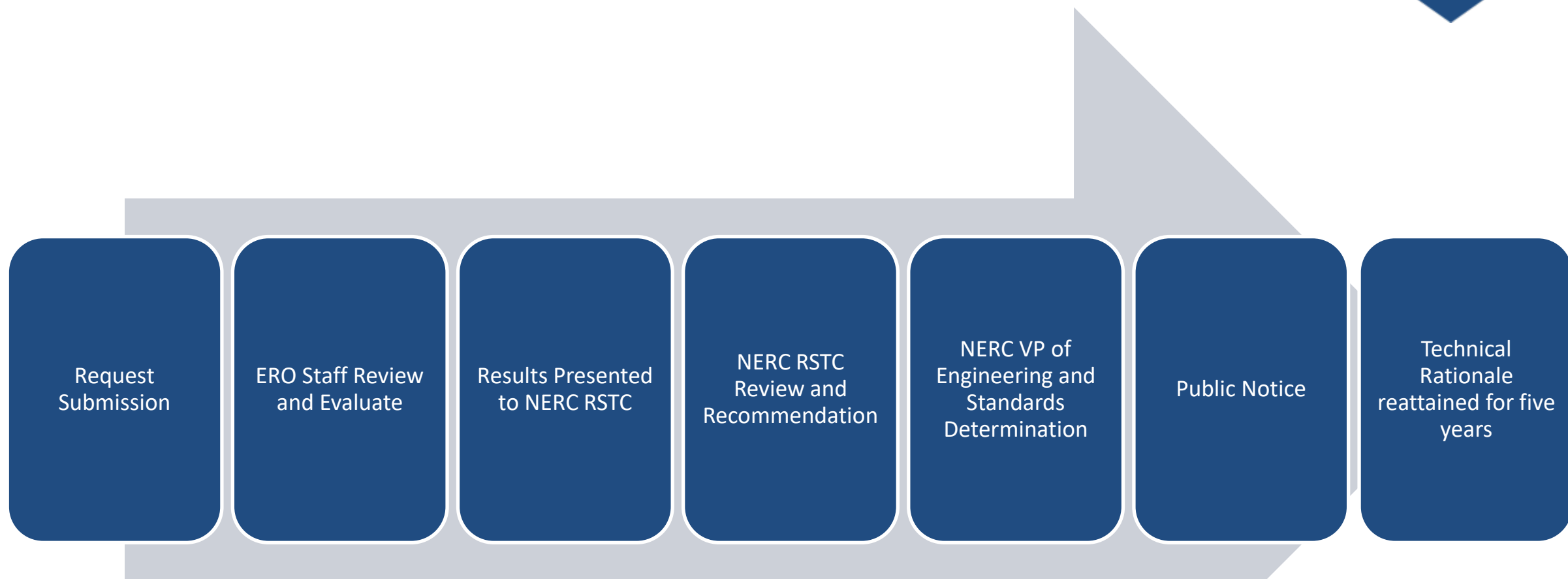
This document serves as the ERO-Approved Criteria for Acceptable Models List for the use of models representing generation and system components. This document fulfills the obligations required under FERC Order 901 outlining the need for such criteria to exist. This criteria is based on the *NERC Dynamic Modeling Recommendations*<sup>1</sup> but is standalone. Entities are encouraged to review those recommendations for further consideration and technical background for this Criteria for Acceptable Models.

**Use of this Criteria for Acceptable Models**

This Criteria for Acceptable Models will focus on the use and representation of positive sequence phasor domain (PSPD) models in Registered Entity footprints and in Interconnection-wide models. The use of the term “System Model” refers to the Registered Entity footprint or the Interconnection-wide representation of the Bulk Power System (BPS) and the term “model” refers to the individual component comprising these “System Models”. Thus, a given “model” is any generation, FACTS, load, or other representation of equipment. It is intended that appropriate NERC Reliability Standards will reference this Criteria for Acceptable Models to create compliance obligations ensuring the utilization of models in accordance with [this criteria](#) in transmission planning and operational analyses.







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# System Model Validation with IBRs

NERC Project 2021-01

Trevor Schultz – Vice Chair, Project 2021-01 Drafting Team  
May 2025

# What is a System Model per Order 901?

- **P42** Bulk-Power System planners and operators need accurate **planning, operations, and interconnection-wide models** to ensure the reliable operation of the Bulk-Power System. ... ..  
Each of the **planning, operations, and interconnection-wide models** consist separately of steady state, dynamic, and short circuit models.
- **P43** Without **planning, operations, and interconnection-wide models** that accurately reflect resource (e.g., generation and load) behavior in steady state and dynamic conditions, Bulk-Power System planners' and operators' **system models<sup>92</sup>** are unable to adequately predict resource behavior, ... .. and their subsequent impacts on the Bulk-Power System.

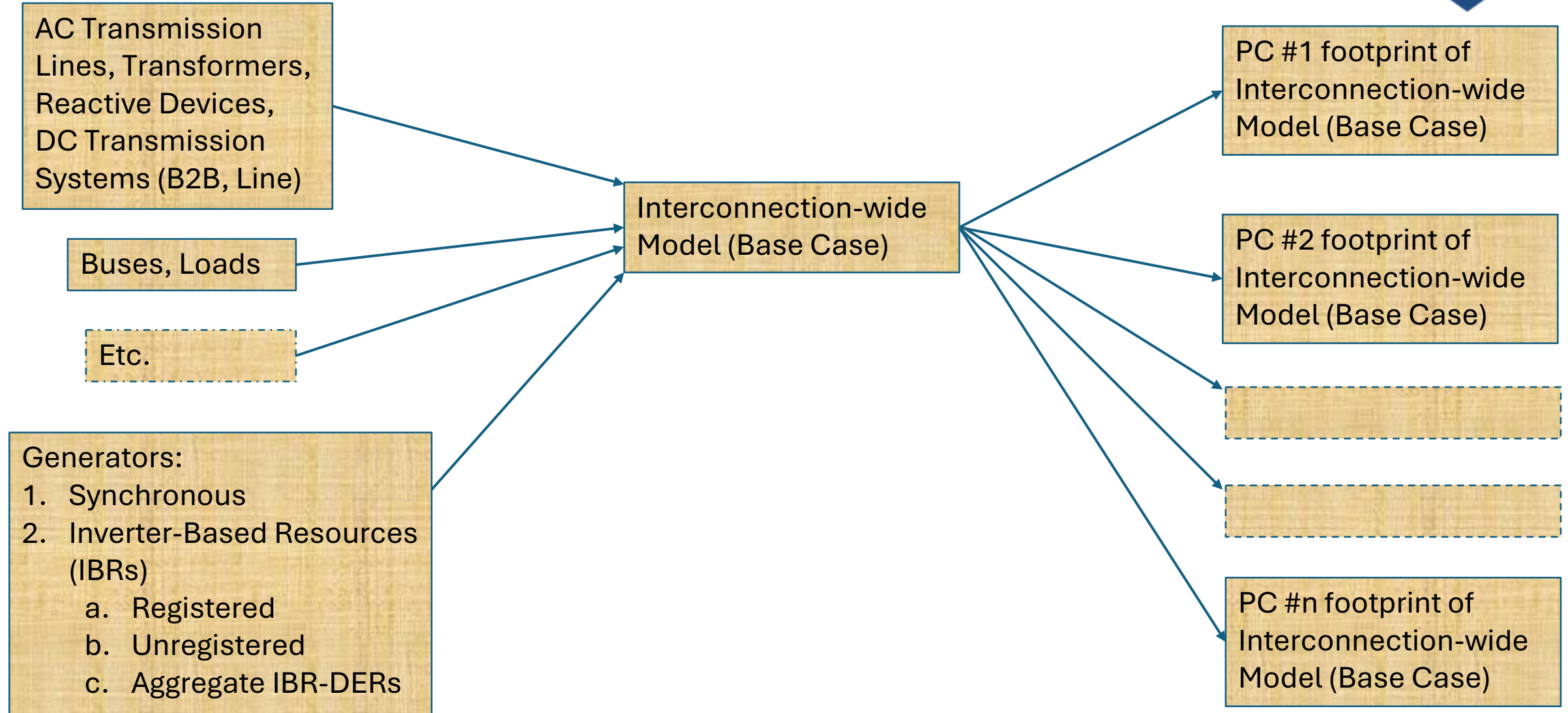
**92:** This final rule uses the term “system models” **to refer collectively to planning and operations transmission area models and interconnection-wide models.**

- **P46** Once the generator owners for registered IBRs, transmission owners for unregistered IBRs, and distribution providers for IBR-DERs in the aggregate verify plant models, *Bulk-Power System planners and operators must validate and update system models (i.e., planning and operation transmission area models as well as interconnection-wide models) by comparing the provided data and resulting system models against actual system operational behavior.*

## Are existing MOD-033 Requirements inadequate for System Model Validation with high penetration of IBRs?

- Existing MOD-033 requires system model validation of each Planning Coordinator's transmission system footprint...  
can this be squared with the “scope” of system model in Order 901?
- Does MOD-033 Applicability need to be augmented to Operations entities (Transmission Operator and/or Reliability Coordinator)?
- How to address interconnection-wide model validation?
- Assuming system model “scope” issues are resolved, would any of the existing requirements become inadequate for a system with higher penetration of IBRs (including IBR-DERs)? How about at 100% penetration?
- How to ensure any modifications are IBR penetration-level agnostic?





## Are existing MOD-033 Requirements inadequate for System Model Validation with high penetration of IBRs?

- Existing MOD-033 requires system model validation of each Planning Coordinator's transmission system footprint...

can this be squared with the “scope” of system model in Order 901?      Yes

- Does MOD-033 Applicability need to be augmented to Operations entities (Transmission Operator and/or Reliability Coordinator)?

No, validation is applicable to off-line (not real-time) system models

- How to address interconnection-wide model validation?

System Model Validation of each Planning Coordinator's area within an Interconnection accomplishes it



## Are existing MOD-033 Requirements inadequate for System Model Validation with high penetration of IBRs?

- Assuming system model “scope” issues are resolved, would any of the existing requirements become inadequate for a system with higher penetration of IBRs (including IBR-DERs)? How about at 100% penetration?
- How to ensure any modifications are IBR penetration-level agnostic?

Existing requirements are adequate since the “what” of system model validation is (and must be) fundamentally agnostic to the technology of facilities comprising the BES... and the premise of system model validation is that each component model assembled into the system model (aka base-case) has been verified and validated by respective model owners in accordance with MOD-032 and MOD-026/-027 requirements

- Editorial modifications to MOD-033 Requirements & Measures to improve clarity and consistency... no substantive changes
- Develop/Enhance Guidance on the “How” to support the “What”
- Technical Rationale & Guidelines for MOD-033 implementation
  - Steady-state System Model Validation (R1, Part 1.1)
  - Dynamic System Model Validation (R1, Part 1.2)
  - Acceptable (mismatch) Criteria for Model Performance (R1, Part 1.3)
  - Collaborative Model Improvement Process with Model Owner (R1, Part 1.4)
  - Access to System Operational Behavior (Real-Time) Data Sources (R2)
    - Leverage Order 901 Milestone 2 Deliverables such as PRC-028 and PRC-002
- Demonstrate that applicable Order 901 Directives are met

- R1.** Each Planning Coordinator shall implement a documented ~~data-validation~~Model Validation process for its portion of the existing system that includes the following attributes: *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*
- 1.1.** Comparison of the power flow simulation performance of the ~~Planning Coordinator's portion of the existing system in a planning power flow steady state System~~ model<sup>1</sup> to actual ~~s~~System behavior, represented by ~~a~~-state estimator case(s) or other Real-time data sources, at least once every 24 calendar months~~-through simulation;-;~~
  - 1.2.** Comparison of the dynamic local event simulation performance of the ~~Planning Coordinator's portion of the existing system in a planning dynamicdynamic System~~ model to actual ~~system response, through simulation of a dynamic local event, System~~ behavior, represented by Real-time data sources such as Disturbance data recording(s), at least once every 24 calendar months (useing a dynamic local event that occurs within 24 calendar months of the last dynamic local event used in comparison,<sup>2</sup>) and completeing each comparison within 24 calendar months of the dynamic local event.~~)-. If no dynamic local event occurs within the 24 calendar months, use the next dynamic local event that occurs;-;~~
  - 1.3.** Guidelines ~~the Planning Coordinator will use~~ to determine unacceptable differences in performance under Parts 1.1 ~~or~~and 1.2; and
  - 1.4.** Guidelines to resolve the unacceptable differences in performance identified under Part 1.3.

## Footnotes in R1:

1 System models include unregistered Inverter-Based Resources (IBRs) and aggregate Distributed Energy Resources (DERs) when present. The phrase “unregistered IBR” refers to a Bulk-Power System connected IBR that does not meet the criteria that would require the owner to register with NERC for mandatory Reliability Standards compliance purposes.

2 If no dynamic local event occurs within this 24 calendar months period, use the next dynamic local event that occurs.

A map of North America, including the United States, Canada, and Mexico. A horizontal band of varying shades of blue and grey stretches across the middle of the map, passing through the United States. The text "Questions and Answers" is centered within this band.

# Questions and Answers

- [FERC Order 901](#)
- [Standards Development Mapping of FERC Order No. 901 Directives](#)
- [Project 2020-06 project page](#)
- [Project 2021-01 project page](#)
- [Project 2022-02 project page](#)
- [Project 2022-02 Webinar \(March 2025\)](#)
- [Dynamic Modeling Recommendations](#)

For more information or assistance, contact Manager, Standards Development, [Sandhya Madan](#) (email), or at 470-698-8827.