NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

# Uniform Modeling Framework for IBR Industry Webinar

## NERC Project 2022-02

NERC Project 2022-02 Drafting Team
John Schmall (chair) and Jonathan Hayes (vice chair) – Presenters
March 2025

# FERC Order 901 - Milestone 3 Projects

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

- MOD-026
- MOD-027

## Project 2021-01 System Model Validation with IBRs

- MOD-033

## Project 2022-02 Uniform Framework Model for IBRs

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

# Agenda

- FERC Order 901
- Drafting Team Members
- DER Definition
- MOD-032-2
- TOP-003-8
- IRO-010-5
- Implementation Plan
- ERO Approved Criteria for an Acceptable Model
- Resources
- Q&A

# NERC Project 2022-02 Project Summary and FERC Order 901

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

# NERC Project 2022-02 Drafting Team Members

| | Name | Entity |
|---|---|---|
| **Chair** | John Schmall | **Electric Reliability Council of Texas, Inc.** |
| **Vice Chair** | Jonathan Hayes | **Southwest Power Pool** |
| **Members** | Josie Daggett | **Western Area Power Administration** |
| | Hassan Baklou | **SDG&E** |
| | Qiushi (Cho) Wang | **The AES Corporation** |
| | Patrick Dalton | **Midcontinent Independent System Operator (MISO)** |
| | Alexander Stewart | **Bonneville Power Administration** |
| | Joshua Pierce | **Southern Company Services** |
| | Mohit Singh | **Exelon** |
| | Andrea Pinceti | **Dominion Energy** |
| | Hayden Maples | **Evergy** |
| | Ejovi Ovhori | **Duke Energy Carolinas** |
| | Steve Wendling | **American Transmission Company, LLC** |

# DER Definition

**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.

## A. Introduction

1. **Title: Data for Power System Modeling and Analysis**

2. **Number: MOD-032-~~1~~2**

3. **Purpose:** To establish consistent modeling data requirements and reporting procedures for development of planning horizon cases necessary to support analysis of the reliability of the interconnected transmission system.

4. **Applicability:**

   **4.1. Functional Entities:**

   **4.1.1** Balancing Authority

   **4.1.2** Distribution Provider

   **~~4.1.2~~4.1.3** Generator Owner

   **~~4.1.3~~** ~~Load Serving Entity~~

   **4.1.4** Planning Authority and Planning Coordinator (hereafter collectively referred to as "Planning Coordinator")

   ~~This proposed standard combines "Planning Authority" with "Planning Coordinator" in the list of applicable functional entities. The NERC Functional Model lists "Planning Coordinator" while the registration criteria list "Planning Authority," and they are not yet synchronized. Until that occurs, the proposed standard applies to both Planning Authority and Planning Coordinator.~~

   **4.1.5** Resource Planner

   **4.1.6** Transmission Owner

   **4.1.7** Transmission Planner

   **4.1.8** Transmission Service Provider

5. **Effective Date: See Implementation Plan for Project 2022-02.**

# MOD-032-2 Requirement R1

**R1.** Each Planning Coordinator and each of its Transmission Planners shall jointly develop steady-state, dynamics, and short circuit modeling data requirements and reporting procedures for the Planning Coordinator's planning area that include: *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*

**1.1.** The data listed in Attachment 1~~.~~

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

~~**1.2.**~~**1.3.** Specifications of the following items consistent with procedures for building the Interconnection-wide case(s):

~~**1.2.1.**~~**1.3.1.** Data format;

~~**1.2.2.**~~**1.3.2.** Level of detail to which equipment shall be modeled;

~~**1.2.3.**~~**1.3.3.** Case types or scenarios to be modeled; and

~~**1.2.4.**~~**1.3.4.** A schedule for submission of data at least once every 13 calendar months.

~~**1.3.**~~**1.4.** Specifications for distribution or posting of the data requirements and reporting procedures so that they are available to those entities responsible for providing the data.

# MOD-032-2 Requirement R2

**R2.** Each Balancing Authority, Generator Owner, ~~Load Serving Entity~~Distribution Provider, Resource Planner, Transmission Owner, and Transmission Service Provider shall provide steady-state, dynamics, and short circuit modeling data to its Transmission Planner(s) and Planning Coordinator(s) according to the data requirements and reporting procedures developed by its Planning Coordinator and Transmission Planner in Requirement R1. For data that has not changed since the last submission, a written confirmation that the data has not changed is sufficient. *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*

**2.1.** If the responsible entity is unable to gather unregistered IBR data or DER data and provide it to the Transmission Planner and Planning Coordinator, as specified in the data requirements and reporting procedures developed under Requirement R1, the responsible entity shall provide an estimate of the modeling data and parameters and include an explanation of the limitations of the availability of data, an explanation of the limitations of any data provided for unregistered IBRs or DERs, and the method used for estimation.

# MOD-032-2 Attachment 1

**MOD-032-~~01~~2 – ATTACHMENT 1**
**Data Reporting Requirements**

*The table~~,~~ below~~,~~ indicates the ~~information~~information[1] that is required to effectively model the interconnected transmission system for the Near-Term Transmission Planning Horizon and Long-Term Transmission Planning Horizon. -Data must be shareable on an interconnection-wide basis to support use in the Interconnection-wide cases. –A Planning Coordinator may specify additional information that includes specific information required for each item in the table below. -Each functional ~~entity~~[1]entity[2] typically responsible for reporting the respective data in the table is identified by brackets "[functional entity]" adjacent to and following each data item. The joint Planning Coordinator /Transmission Planner modeling data requirements and reporting procedures developed under Requirement R1 will specify the functional entity responsibility and data flow processes. The data reported shall be as identified by the bus number, name, and/or identifier that is assigned in conjunction with the Planning Coordinator, Transmission Owner, or Transmission Planner.*

# MOD-032-2 Attachment 1

| **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**<br>~~*(If a user-written model(s) is submitted in place of a generic or library model, it must include the characteristics of the model, including block diagrams, values and names for all model parameters, and a list of all state variables)*~~ | **short circuit** |
|---|---|---|
| 1. Each bus [TO]<br>a. nominal voltage<br>b. area, zone and owner<br>2. Aggregate ~~Demand[3] [LSE~~Demand[3] [DP]<br>a. real and reactive power*<br>b. in-service status*<br>3. Generating ~~Units[3]~~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. ~~Demand [LSE]~~Aggregate Demand[3] [DP]<br>6. Wind ~~Turbine Data~~plant model (for plants with type 1 and type 2 wind turbines) [GO]<br>~~7. Photovoltaic systems [GO]~~<br>7. Inverter-Based Resource [GO, TO[5]]<br>a. IBR capabilities related to momentary cessation, tripping, Ride-through, and frequency control<br>8. Static Var Systems and FACTS [GO, TO, ~~LSE~~DP]<br>9. DC system models [TO] | 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, ~~LSE~~DP, TO, TSP] |

# MOD-032-2 Attachment 1 Continued

| 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<br>~~*(If a user-written model(s) is submitted in place of a generic or library model, it must include the characteristics of the model, including block diagrams, values and names for all model parameters, and a list of all state variables)*~~ | short circuit |
|---|---|---|
| f. generator step up transformer data (provide same data as that required for transformer under item 6, below)<br>g. generator type (hydro, wind, fossil, solar, nuclear, etc)<br>h. in-service status*<br>4. AC Transmission Line or Circuit [TO]<br>a. impedance parameters (positive sequence)<br>b. susceptance (line charging)<br>c. ratings (normal and emergency)*<br>d. in-service status*<br>5. DC Transmission systems [TO]<br>6. Transformer (voltage and phase-shifting) [TO]<br>a. nominal voltages of windings<br>b. impedance(s)<br>c. tap ratios (voltage or phase angle)*<br>d. minimum and maximum tap position limits<br>e. number of tap positions (for both the ULTC and NLTC)<br>f. regulated bus (for voltage regulating transformers)*<br>g. ratings (normal and emergency)*<br>h. in-service status* | | |

# MOD-032-2 Attachment 1 Continued

| 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<br>~~*(If a user-written model(s) is submitted in place of a generic or library model, it must include the characteristics of the model, including block diagrams, values and names for all model parameters, and a list of all state variables)*~~ | short circuit |
|---|---|---|
| 7. Reactive compensation (shunt capacitors and reactors) [TO]<br>a. admittances (MVars) of each capacitor and reactor<br>b. regulated voltage band limits* (if mode of operation not fixed)<br>c. mode of operation (fixed, discrete, continuous, etc.)<br>d. regulated bus* (if mode of operation not fixed)<br>e. in-service status*<br>8. Static Var Systems [TO]<br>a. reactive limits<br>b. voltage set point*<br>c. fixed/switched shunt, if applicable<br>d. in-service status*<br>9. Aggregate Distributed Energy Resource (DER) data [DP, TO][6]<br>a. Location (bus from item 1)<br>b. Real power capability<br>c. DER type (solar, battery, diesel generator, etc.)<br>~~9.~~10. Other information requested by the Planning Coordinator or Transmission Planner necessary for modeling purposes. [BA, GO, ~~LSE~~DP, TO, TSP] | 10. Aggregate Distributed Energy Resource (DER) data [DP, TO][6]<br>a. DER capabilities related to momentary cessation, tripping, Ride-through, voltage control, and frequency control or information that can be used to infer those capabilities for modeling purposes.<br>b. Indication whether DER is subject to tripping in conjunction with UFLS or UVLS.<br>~~10.~~11. Other information requested by the Planning Coordinator or Transmission Planner necessary for modeling purposes. [BA, GO, ~~LSE~~DP, TO, TSP] | |

# MOD-032-2 Table 1 footnotes

**Table 1**

**Attachment 1 Data Reporting Requirements Footnotes**

1. Data specified in the sub-bullets of each column that are required for both steady-state and dynamics are not duplicated in the table.
2. For purposes of this attachment, the functional entity references are represented by abbreviations as follows: Balancing Authority (BA), Generator Owner (GO), Distribution Provider (DP), Planning Coordinator (PC), Resource Planner (RP), Transmission Owner (TO), Transmission Planner (TP), and Transmission Service Provider (TSP).
3. For purposes of this item, aggregate Demand is the gross Demand aggregated at each bus under item 1 under Steady State Column that is identified by a Transmission Owner as a load serving bus rather than the net Demand that incorporates offsets due to output from Distributed Energy Resources. A Distribution Provider is the typical responsible entity for providing this information, generally through coordination with the Transmission Owner.
4. Including IBR, synchronous condensers, and pumped storage.
5. The Transmission Owner is the typical responsible entity for collecting and providing data for unregistered IBRs that are not DERs.
6. The DP is the typical responsible entity for collecting and providing data for DER connected to its system either directly or through an unregistered Distribution Provider (i.e. not included on the NERC Compliance Registry) with no other registered entity systems between the DER connection point and the DP's system. The Transmission Owner is the typical responsible entity for collecting and providing data for DER where there is no associated registered Distribution Provider between the DER connection point and the TO's system.

# TOP-003-8 Requirement R1

**R1.** Each Transmission Operator shall maintain documented specification(s) for the data and information necessary for it to perform its Operational Planning Analyses, Real-time monitoring, and Real-time Assessments. The specification shall include, but not be limited to: *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

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

**1.5.** Method(s) for the entity identified in Part 1.1 to provide the data and information that includes, at a minimum, the following.

**1.5.1.** Specified deadlines or periodicity which data and information is to be provided;

**1.5.2.** Performance criteria for the availability and accuracy of data and information as applicable;

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

~~**1.5.3.**~~**1.5.4.** Provisions to update or correct data and information, as applicable or necessary;

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~~**1.5.4.**~~**1.5.5.** A mutually agreeable format;

~~**1.5.5.**~~**1.5.6.** Mutually agreeable method(s) for securely transferring data and information.

# TOP-003-8 Requirement R2

**R2.** Each Balancing Authority shall maintain documented specification(s) for the data and information necessary for it to perform its analysis functions, Real-time monitoring, and Near-Term Energy Reliability Assessments. The data specification shall include, but not be limited to: *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

**2.1.** A list of data and information needed by the Balancing Authority to support its analysis functions, Real-time monitoring, and Near-Term Energy Reliability Assessments, including non-Bulk Electric System data and information, IBR-specific data and parameters, and external network data and information, as deemed necessary by the Balancing Authority, and identification of the entity responsible for responding to the specification.

**2.5.** Methods for the entity identified in Part 2.1 to provide data and information that includes at a minimum the following.

**2.5.1.** Specific deadlines or periodicity in which data and information is to be provided;

**2.5.2.** Performance criteria for the availability and accuracy of data and information, as applicable;

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**2.5.3.** Requirements for model submissions in accordance with the Criteria for Acceptable Models maintained by the ERO;

~~**2.5.3.**~~**2.5.4.** Provisions to update or correct data and information, as applicable or necessary.

~~**2.5.4.**~~**2.5.5.** A mutually agreeable format.

~~**2.5.5.**~~**2.5.6.** A mutually agreeable method(s) for securely transferring data and information.

**R1.** The Reliability Coordinator shall maintain documented specification(s) for the data and information necessary for it to perform its Operational Planning Analyses, Real-time monitoring, and Real-time Assessments. The specification shall include but not be limited to: *(Violation Risk Factor: Low) (Time Horizon: Operations Planning)*

**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, 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.** Method(s) for the entity identified in Part 1.1 to provide data and information that includes, but is not limited to.

**1.5.1** Specific deadlines or periodicity in which data and information is to be provided;

**1.5.2** Performance criteria for the availability and accuracy of data and information, as applicable;

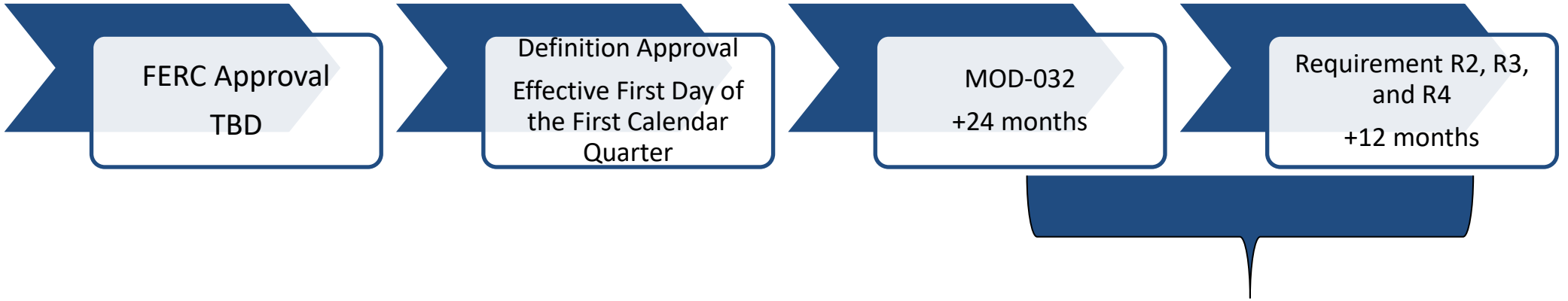
**1.5.3** Requirements for model submissions in accordance with the Criteria for Acceptable Models maintained by the Electric Reliability Organization.

~~**1.5.3**~~**1.5.4** Provisions to update or correct data and information, as applicable or necessary.

~~**1.5.4**~~**1.5.5** A mutually agreeable format.

~~**1.5.5**~~**1.5.6** A mutually agreeable method(s) for securely transferring data and information.

# Implementation Plan (MOD-032-2)




## 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

# Implementation Plan (TOP-003-8 and IRO-010-5)

# ERO Approved Criteria for Acceptable Models

- **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 fulfils 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*[1] but is standalone. Entities are encouraged to review those recommendations for further consideration and technical background for this Criteria for Acceptable Models.

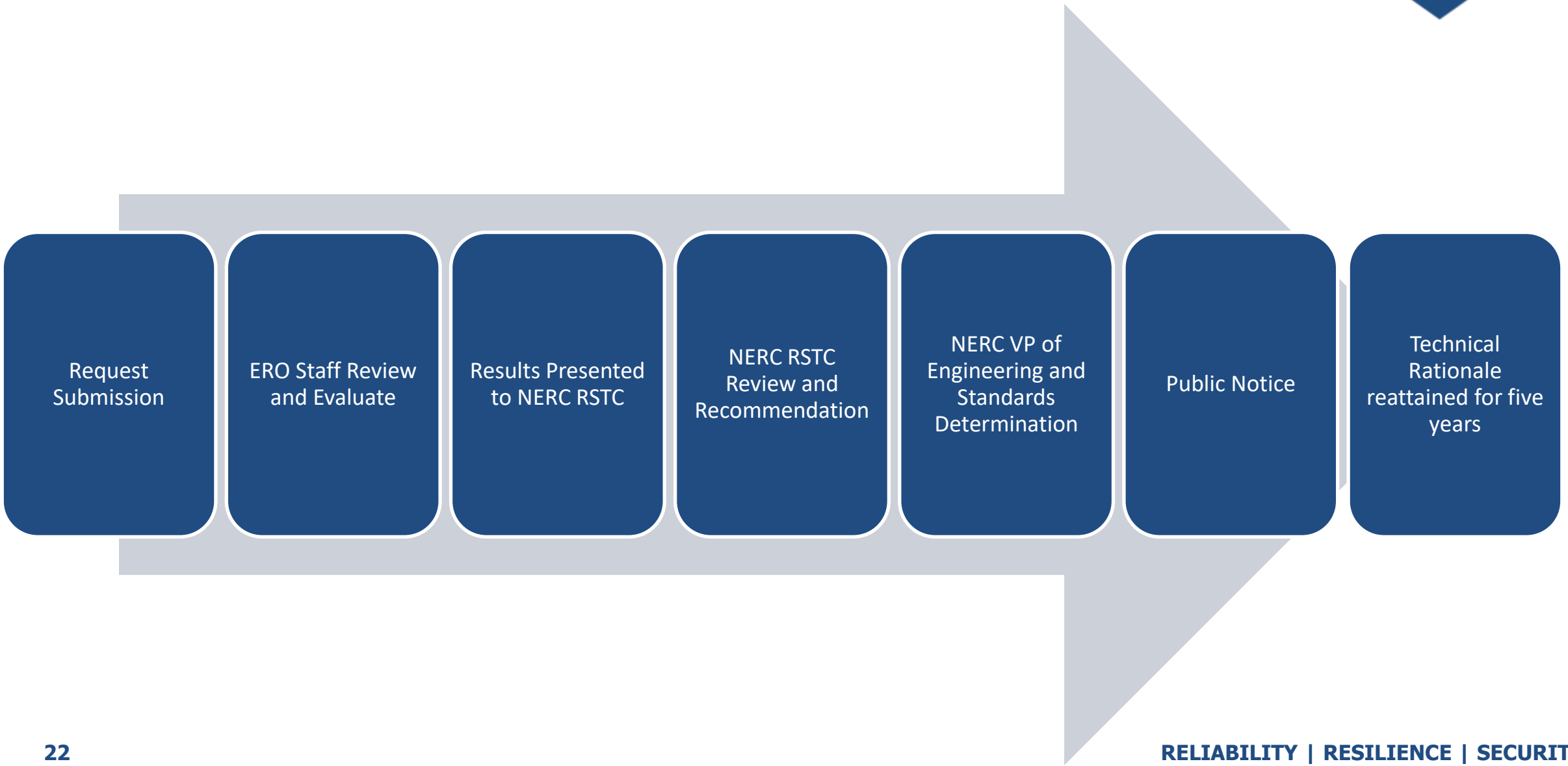
**Use of this Criteria for Acceptable Models**

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.

# ERO Approved Criteria for Acceptable Models Revisions for Updates

Request Submission → Review → 45-day Comment Period → NERC RSTC Review and Determination → Recommendation to NERC Board → Public Notice

# ERO Approved Criteria for Acceptable Models Updates for the unacceptable Models List



# Next Steps

- March 7 through March 14 – Outreach
- March 17 through March 21 – Quality Review
- March 24 through March 28 – DT to review QR Comments
- April 16 – Request authorization to post from the Standards Committee for MOD-032-2, TOP-003-8, IRO-010-5, and Implementation Plan
- April 17, 2025 – Post documents mentioned above for a comment and ballot period

# Resources

- NERC Project 2022-02 Project Page (link).
- NERC Project 2022-02 Standards Authorization Request (link).
- Dynamic Modeling Recommendations (link).
- FERC Order 901 (link).
- Standards Development Work Plan in Response to FERC Order No. 901 (link).

# Questions and Answers