

A. Introduction

1. **Title:** Verification and Validation of Dynamic Models and Data
2. **Number:** MOD-026-2
3. **Purpose:** To verify and validate that the dynamic models and associated parameters used to assess Bulk Electric System (BES) reliability represent the in-service equipment of Bulk Power System (BPS) facilities including generating facilities, transmission connected dynamic reactive resources, and high-voltage direct current (HVDC) systems.
4. **Applicability:**
 - 4.1. **Functional Entities:**
 - 4.1.1. Generator Owner
 - 4.1.2. Planning Coordinator
 - 4.1.3. Transmission Owner
 - 4.1.4. Transmission Planner
 - 4.2. **Facilities:**
 - 4.2.1. Individual synchronous generating unit meeting the criteria set by Inclusion I2 of the BES definition;
 - 4.2.2. Synchronous generating plant/Facility meeting the criteria set by Inclusion I2 of the BES definition;
 - 4.2.3. Dynamic reactive resources meeting the criteria set by Inclusion I5 of the BES definition with a gross (individual or aggregate) nameplate rating greater than 20 MVA including:
 - 4.2.3.1. Synchronous condensers; and
 - 4.2.3.2. Flexible alternating current transmission system (FACTS) devices.
 - 4.2.4. High-voltage direct current (HVDC) systems including:
 - 4.2.4.1. Line commutated converter (LCC); and
 - 4.2.4.2. Voltage source converter (VSC).
 - 4.2.5. Bulk Electric System (BES) Inverter-Based Resources; and
 - 4.2.6. Non-BES Inverter-Based Resources 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.
 - 4.2.7. Non-synchronous generating plant/Facility meeting the criteria set by Inclusion I4 of the BES definition.
5. **Effective Date:** See Implementation Plan for Project 2020-06 Verifications of Models and Data for Generators.

B. Requirements and Measures

- R1.** Each Transmission Planner and its Planning Coordinator shall jointly develop dynamic model requirements for the purpose of evaluating submitted dynamic models and accompanying documentation of Model Verification and Model Validation. The dynamic model requirements shall be made available to Generator Owner(s) and Transmission Owner(s) by the Transmission Planner and shall include at a minimum the following: *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*
- 1.1.** Positive sequence dynamic model requirements, including requirements for the models and functions listed in Attachment 1;
 - 1.1.1.** Specification of which limiting and protective functions listed within Attachment 1, Table 1.1 are required to be represented in the model.
 - 1.2.** For the facilities listed in Applicability Sections 4.2.5 and 4.2.6 (Inverter-Based Resources), 4.2.3.2 (FACTS devices), 4.2.4.1 (LCC HVDC), and 4.2.4.2 (VSC HVDC):
 - 1.2.1.** Identification of which legacy¹ facilities require electromagnetic transient (EMT) model(s) under Requirement R3 accompanied by a statement of need; and
 - 1.2.2.** Specification of acceptable EMT models, format, and level of detail.
 - 1.3.** Any additional requirements not listed under Requirement R1, Parts 1.1 and 1.2 used by the Transmission Planner to determine the acceptability of submitted dynamic models and accompanying documentation under Requirement R5. If no such additional requirements exist, the Transmission Planner shall document that none are applicable.
- M1.** Each Transmission Planner and Planning Coordinator must provide dated evidence such as document(s), webpage(s), or web portal(s) outlining the jointly developed dynamic model requirements. Each Transmission Planner shall have evidence demonstrating that the dynamic model requirements were made available to Generator Owner(s) and Transmission Owner(s) in accordance with Requirement R1.
- R2.** Each Generator Owner or Transmission Owner shall provide to its Transmission Planner positive sequence dynamic model(s) with associated parameters, any information pertaining to changes to the model(s) or its parameters, and accompanying documentation in accordance with the periodicity requirements of Attachment 2. Each Generator Owner or Transmission Owner shall provide the following: *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*
- 2.1.** Positive sequence dynamic model(s) representing the in-service equipment of the facility including, at a minimum, each of the applicable models and functions listed in Attachment 1 in accordance with the requirements developed in Requirement R1;
 - 2.2.** Documentation of Model Verification demonstrating that the configurable, site-specific parameters of the model(s) are representative of the design and settings of the in-service equipment of the facility;

¹ A legacy facility for the purpose of this standard is any facility with a commercial operation date prior to the effective date of MOD-026-2.

- 2.2.1. For any parameters that cannot be verified, the Generator Owner or Transmission Owner shall provide a written statement to the Transmission Planner identifying the unverifiable parameters and reasons they cannot be verified.
 - 2.3. Documentation of Model Validation comparing the behavior of the model(s) to the measured behavior during a staged test or system disturbance for:
 - 2.3.1. A dynamic reactive power or voltage excursion event to perform Model Validation of generator, excitation control, reactive power control, and voltage control models, as applicable; and
 - 2.3.2. A dynamic active power or frequency excursion event to perform Model Validation of governor control, active power control, and frequency control models, as applicable. For a frequency excursion event to be sufficient for Model Validation, the applicable facility must be operating in a frequency responsive mode and the frequency deviation (nadir point) from the scheduled frequency must be greater than or equal to:
 - 2.3.2.1. 0.04 hertz in the Eastern Interconnection;
 - 2.3.2.2. 0.08 hertz in the ERCOT and Western Interconnections; and
 - 2.3.2.3. 0.30 hertz in the Quebec Interconnection.
- M2. Each Generator Owner or Transmission Owner must provide dated evidence (e.g., email message, postal receipt, upload via web portal, etc.) for each applicable facility that it provided positive sequence dynamic model(s) and accompanying documentation to its Transmission Planner in accordance with Requirement R2.
- R3. For facilities listed in Applicability Sections 4.2.3.2 (FACTS devices), 4.2.4 (HVDC), 4.2.5 (BES IBRs), and 4.2.6 (Non-BES IBRs), excluding legacy facilities where the original equipment manufacturer² no longer supports EMT model(s) for the facility as well as legacy facilities not identified by the Transmission Planner under Requirement R1, Part 1.2.1, each Generator Owner or Transmission Owner shall provide to its Transmission Planner EMT model(s) with associated parameters, any information pertaining to changes to the model(s) or its parameters, and accompanying documentation, in accordance with the periodicity requirements of Attachment 2. Each Generator Owner or Transmission Owner shall provide the following: *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*
 - 3.1. A facility EMT model with associated parameters representing the applicable HVDC, FACTS device, IBR unit(s),³ collector system, auxiliary control device(s),⁴ power plant controller, generator step-up transformer(s), and main power transformer(s) that includes:

² If the original equipment manufacturer that commissioned the facility was acquired, merged, or operating under a different name, the new company would be considered the original equipment manufacturer.

³ For purposes of this standard, the phrase “IBR unit” refers to an individual device, or a grouping of multiple devices, that uses a power electronic interface(s), such as an inverter or converter, that is capable of exporting Real Power from a primary energy source or energy storage system, and that connects at a single point on the collector system.

⁴ Only to include those auxiliary control devices that act on voltage and/or frequency.

- 3.1.1.** Enabled protective functions⁵ that directly trip the IBR unit(s) or facility; and
 - 3.1.2.** Limiting functions⁶ that limit active/reactive output of the IBR unit(s) or facility.
 - 3.2.** Documentation of Model Verification demonstrating that the configurable, site-specific parameters of the model(s) are representative of the design and settings of the in-service equipment of the facility;
 - 3.2.1.** For any parameters that cannot be verified, the Generator Owner or Transmission Owner shall provide a written statement to the Transmission Planner identifying the unverifiable parameters and reasons they cannot be verified.
 - 3.3.** Documentation of Model Validation comparing the behavior of the facility EMT model to the measured behavior during a staged test or system disturbance for:
 - 3.3.1.** A dynamic reactive power or voltage excursion event to perform Model Validation of reactive power control and voltage control models, as applicable; and
 - 3.3.2.** A dynamic active power or frequency excursion event to perform Model Validation of active power control and frequency control models, as applicable. For a frequency excursion event to be sufficient for Model Validation, the applicable facility must be operating in a frequency responsive mode and the frequency deviation (nadir point) from the scheduled frequency must be greater than or equal to:
 - 3.3.2.1.** 0.04 hertz in the Eastern Interconnection;
 - 3.3.2.2.** 0.08 hertz in the ERCOT and Western Interconnections; and
 - 3.3.2.3.** 0.30 hertz in the Quebec Interconnection.
 - 3.4.** For IBR facilities, test⁷ result(s) demonstrating a comparison of the IBR unit response and the IBR unit EMT model response for large signal disturbances. If test results are not obtainable, the Generator Owner shall document the reason; and
 - 3.5.** Documentation comparing the response of the facility positive sequence dynamic model provided in Requirement R2 to the response of the facility EMT model for large signal disturbances as defined by the Transmission Planner.
- M3.** Each Generator Owner or Transmission Owner must provide dated evidence (e.g., email message, postal receipt, upload via web portal, etc.) for each applicable facility that it provided EMT model(s) and accompanying documentation to its Transmission Planner in accordance with Requirement R3.

⁵ Required protective functions are those that act directly on, or act on quantities derived from, voltage, frequency, and/or current. Examples of protections include DC reverse current, DC bus over-voltage and under-voltage, DC voltage unbalance, DC overcurrent, AC over-voltage and under-voltage protection (instantaneous and RMS), AC overcurrent, over-frequency and under-frequency protection, feeder (equivalent) AC over-voltage and under-voltage, feeder (equivalent) over-frequency and under-frequency, PLL (or equivalent) loss of synchronism, and phase jump tripping.

⁶ Required limiting functions are those that act directly on, or act on quantities derived from, voltage, frequency, and/or current.

⁷ A hardware specific test may include a factory type test, hardware in the loop test, or other manufacturer test to ensure the EMT model's large signal response emulates the supplied equipment to the extent possible.

- R4.** Each Generator Owner or Transmission Owner shall, within 180 calendar days after making a hardware, software, firmware, control mode, or setting change(s)⁸ to an applicable unit or facility that alters the dynamic response characteristic(s), provide its Transmission Planner with updated model(s) and accompanying documentation as described in Requirement R2, Parts 2.1 through 2.3 and, if applicable, Requirement R3, Parts 3.1 through 3.5. If mutually agreed upon with the Transmission Planner, model(s) and accompanying documentation may be provided according to a revised timeline. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning]*
- M4.** Each Generator Owner or Transmission Owner must provide dated evidence (e.g., email message, postal receipt, upload via web portal, etc.) that it provided its Transmission Planner with updated model(s) and accompanying documentation in accordance with Requirement R4 for each change altering dynamic response characteristic(s) of an applicable unit or facility.
- R5.** Each Transmission Planner shall, within 120 calendar days after receiving model(s) and accompanying documentation provided by a Generator Owner or Transmission Owner or within a mutually agreed upon timeline with the applicable Generator Owner or Transmission Owner, evaluate the model(s) and accompanying documentation to determine if it meets the dynamic model requirements developed under Requirement R1 and provide: *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*
- A written notification to the Generator Owner or Transmission Owner that the model(s) and accompanying documentation are acceptable, and a written notification, or the accepted model(s) and accompanying documentation, to its Planning Coordinator; or
 - A written notification to the Generator Owner or Transmission Owner that the model(s) and accompanying documentation are not acceptable, along with an explanation and any supporting evidence demonstrating the issue(s).
- M5.** Each Transmission Planner must provide dated evidence that it reviewed provided model(s) and accompanying documentation in accordance with the dynamic model requirements developed in Requirement R1 and provided a written response notification in accordance with Requirement R5. Dated evidence may include date received, review date of provided model(s) and accompanying documentation, and dated response (e.g., email message, postal receipt, etc.).
- R6.** Each Generator Owner or Transmission Owner shall, within 120 calendar days after receiving a notification of unacceptability under Requirement R5 or within 180 calendar days after receiving a request from its Transmission Planner to perform a model review due to identified model or accompanying documentation deficiencies, provide a response to its Transmission Planner. If mutually agreed upon with the Transmission Planner, the response to a request to perform a model review may be provided according to a revised timeline. The provided response shall include one of the following: *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*
- Updated model(s) and accompanying documentation as described in Requirement R2, Parts 2.1 through 2.3 and, if applicable, Requirement R3, Parts 3.1 through 3.5; or

⁸ Automatic changes in settings that occur due to changes in operating mode are excluded from Requirement R4.

- A technical justification and supporting evidence for maintaining the current model(s) and accompanying documentation.
- M6.** Each Generator Owner or Transmission Owner must provide dated evidence (e.g., email message, postal receipt, etc.) that it provided a response to its Transmission Planner in accordance with Requirement R6.
- R7.** Each Transmission Planner shall provide the current (in-use) model(s) and accompanying documentation for an existing facility within 90 calendar days of receiving a written request for such data from the Generator Owner or Transmission Owner that owns the facility. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*
- M7.** Each Transmission Planner must provide dated evidence (e.g., email message, postal receipt, etc.) that it provided the current (in-use) model(s) and accompanying documentation to the Generator Owner or Transmission Owner in accordance with Requirement R7.

C. Compliance

1. Compliance Monitoring Process

- 1.1. Compliance Enforcement Authority:** “Compliance Enforcement Authority” means NERC or the Regional Entity in their respective roles of monitoring and enforcing compliance with the NERC Reliability Standards.
- 1.2. Evidence Retention:** The following evidence retention period(s) identify the period of time an entity is required to retain specific evidence to demonstrate compliance. For instances where the evidence retention period specified below is shorter than the time since the last audit, the Compliance Enforcement Authority may ask an entity to provide other evidence to show that it was compliant for the full time period since the last audit.

The applicable entity shall keep data or evidence to show compliance as identified below unless directed by its Compliance Enforcement Authority to retain specific evidence for a longer period of time as part of an investigation.

- Requirements R1 through R7, and Measures M1 through M7, since the last audit, unless directed by its Compliance Enforcement Authority to retain specific evidence for a longer period of time as part of an investigation.

If an applicable entity is found non-compliant, it shall keep information related to the non-compliance until mitigation is complete and approved, or for the time specified above, whichever is longer. The Compliance Enforcement Authority shall keep the last audit records, and all requested and submitted subsequent audit records.

- 1.3. Compliance Monitoring and Enforcement Program:** “Compliance Monitoring Enforcement Program” or “CMEP” means, depending on the context, (1) the NERC Compliance Monitoring and Enforcement Program (Appendix 4C to the NERC Rules of Procedure) or the Commission-approved program of a Regional Entity, as applicable, or (2) the program, department, or organization within NERC or a Regional Entity that is responsible for performing compliance monitoring and enforcement activities with respect to Registered Entities’ compliance with Reliability Standards.

Violation Severity Levels

R #	Violation Severity Levels			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
R1.	N/A	The Transmission Planner and Planning Coordinator jointly developed dynamic model requirements, but they failed to include one of the items in Requirement R1, Parts 1.1 through 1.3.	The Transmission Planner and Planning Coordinator jointly developed dynamic model requirements, but they failed to include two of the items in Requirement R1, Parts 1.1 through 1.3.	The Transmission Planner and Planning Coordinator jointly developed dynamic model requirements, but they failed to include three of the items in Requirement R1, Parts 1.1 through 1.3. OR The Transmission Planner and Planning Coordinator failed to jointly develop dynamic model requirements. OR The Transmission Planner failed to make dynamic model requirements available to Generator Owners and Transmission Owners.
R2.	The applicable entity provided positive sequence dynamic model(s), with associated parameters, and accompanying documentation to its Transmission Planner in accordance with the periodicity requirements of Attachment 2 with the exception of Row 2, but within	The applicable entity provided positive sequence dynamic model(s), with associated parameters, and accompanying documentation to its Transmission Planner between 91 and 180 calendar days after the date in accordance with the periodicity requirements of	The applicable entity provided positive sequence dynamic model(s), with associated parameters, and accompanying documentation to its Transmission Planner between 181 and 270 calendar days after the date in accordance with the periodicity requirements of	The applicable entity provided positive sequence dynamic model(s), with associated parameters, and accompanying documentation to its Transmission Planner more than 270 calendar days after the date in accordance with the periodicity requirements of Attachment 2 with the exception of Row 2.

R #	Violation Severity Levels			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
	90 calendar days after the date required. OR The applicable entity provided dynamic model(s) that failed to include one of the applicable items in Attachment 1, Table 1.1 or Table 1.2.	Attachment 2 with the exception of Row 2. OR The applicable entity provided dynamic model(s) that failed to include two of the applicable items in Attachment 1, Table 1.1 or Table 1.2.	Attachment 2 with the exception of Row 2. OR The applicable entity provided dynamic model(s) that failed to include three of the applicable items in Attachment 1, Table 1.1 or Table 1.2.	OR The applicable entity failed to provide dynamic model(s) or accompanying information.
R3.	The applicable entity provided EMT model(s) for its applicable facility with associated parameters and accompanying documentation to its Transmission Planner, in accordance with the requirements developed by its Transmission Planner and Planning Coordinator, after the date required but within 90 calendar days after the date required. OR The applicable entity provided EMT model(s) and accompanying documentation by the required date, but failed to include one of the items in Requirement R3, Parts 3.1 through 3.5.	The applicable entity provided EMT model(s) for its applicable facility with associated parameters and accompanying documentation to its Transmission Planner, in accordance with the requirements developed by its Transmission Planner and Planning Coordinator, between 91 and 180 calendar days after the date required. OR The applicable entity provided EMT model(s) and accompanying documentation by the required date, but failed to include two of the items in Requirement R3, Parts 3.1 through 3.5.	The applicable entity provided EMT model(s) for its applicable facility with associated parameters and accompanying documentation to its Transmission Planner, in accordance with the requirements developed by its Transmission Planner and Planning Coordinator, between 181 and 270 calendar days after the date required. OR The applicable entity provided EMT model(s) and accompanying documentation by the required date, but failed to include three of the items in Requirement R3, Parts 3.1 through 3.5.	The applicable entity provided EMT model(s) for its applicable facility with associated parameters and accompanying documentation to its Transmission Planner, in accordance with the requirements developed by its Transmission Planner and Planning Coordinator, more than 270 calendar days after the date required. OR The applicable entity provided EMT model(s) by the required date, but failed to include four of the items in Requirement R3, Parts 3.1 through 3.5. OR The applicable entity failed to provide EMT model(s) and accompanying documentation.

R #	Violation Severity Levels			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
R4.	The applicable entity provided updated model(s) and accompanying documentation to its Transmission Planner between 181 and 210 calendar days (or within 30 calendar days after the timeline mutually agreed to by the Transmission Planner) after making a change that alters the dynamic response characteristic(s).	The applicable entity provided updated model(s) and accompanying documentation between 211 and 240 calendar days (or between 31 and 60 calendar days after the timeline mutually agreed to by the Transmission Planner) after making a change that alters the dynamic response characteristic(s).	The applicable entity provided updated model(s) and accompanying documentation between 241 and 270 calendar days (or between 61 and 90 calendar days after the timeline mutually agreed to by the Transmission Planner) after making a change that alters the dynamic response characteristic(s).	The applicable entity provided updated model(s) and accompanying documentation more than 270 calendar days (or more than 90 calendar days after the timeline mutually agreed to by the Transmission Planner) after making a change that alters the dynamic response characteristic(s). OR The applicable entity failed to identify, provide updated model(s) and accompanying documentation after making a change that alters the dynamic response characteristic(s).
R5.	The Transmission Planner reviewed the submitted model(s) and accompanying documentation for adherence to the dynamic model requirements developed in Requirement R1, but provided a written response to the submitter between 121 to 150 calendar days (or within 30 calendar days after the timeline mutually agreed to by the Generator Owner or	The Transmission Planner reviewed the submitted model(s) and accompanying documentation for adherence to the dynamic model requirements developed in Requirement R1, but provided a written response to the submitter between 151 to 180 calendar days (or within 31 and 60 calendar days after the timeline mutually agreed to by the Generator Owner or	The Transmission Planner reviewed the submitted model(s) and accompanying documentation for adherence to the dynamic model requirements developed in Requirement R1, but provided a written response to the submitter between 181 to 210 calendar days (or within 61 and 90 calendar days after the timeline mutually agreed to by the Generator Owner or	The Transmission Planner reviewed the submitted model(s) and accompanying documentation for adherence to the dynamic model requirements developed in Requirement R1, but provided a written response to the submitter more than 210 calendar days (or more than 90 calendar days after the timeline mutually agreed to by the Generator Owner or

R #	Violation Severity Levels			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
	Transmission Owner) after receiving the submission.	Transmission Owner) after receiving the submission.	Transmission Owner) after receiving the submission.	Transmission Owner) after receiving the submission. OR The Transmission Planner reviewed the submitted model(s) and accompanying documentation for adherence to the dynamic model requirements developed in Requirement R1, and provided a response indicating that the model was unacceptable, but did not include an explanation and supporting evidence. OR The Transmission Planner failed to review the submitted model(s) and accompanying documentation for adherence to the dynamic model requirements developed in Requirement R1, and failed to provide a response to the submitter.
R6.	The applicable entity provided a response to the Transmission Planner after receiving a notification of unacceptability under Requirement R5, but did so between 121 to 150	The applicable entity provided a response to the Transmission Planner after receiving a notification of unacceptability under Requirement R5, but did so between 151 to 180	The applicable entity provided a response to the Transmission Planner after receiving a notification of unacceptability under Requirement R5, but did so between 181 to 210	The applicable entity failed to provide a response to the Transmission Planner after receiving a notification of unacceptability under Requirement R5 or a request to perform a model review.

R #	Violation Severity Levels			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
	calendar days after receiving a notification of unacceptability. OR The applicable entity provided a response to the Transmission Planner after receiving a request to perform a model review, but did so between 181 to 210 calendar days (or within 30 calendar days after the timeline mutually agreed to by the Transmission Planner) after receiving a request to perform a model review.	calendar days after receiving a notification of unacceptability. OR The applicable entity provided a response to the Transmission Planner after receiving a request to perform a model review, but did so between 211 to 240 calendar days (or between 31 and 60 calendar days after the timeline mutually agreed to by the Transmission Planner) after receiving a request to perform a model review.	calendar days after receiving a notification of unacceptability. OR The applicable entity provided a response to the Transmission Planner after receiving a request to perform a model review, but did so between 241 to 270 calendar days (or between 61 and 90 calendar days after the timeline mutually agreed to by the Transmission Planner) after receiving a request to perform a model review.	OR The applicable entity provided a response to the Transmission Planner after receiving a notification of unacceptability under Requirement R5, but did so more than 210 calendar days after receiving a notification of unacceptability. OR The applicable entity provided a response to the Transmission Planner after receiving a request to perform a model review, but did so more than 270 calendar days (or more than 120 calendar days after the timeline mutually agreed to by the Transmission Planner) after receiving a request to perform a model review. OR The applicable entity provided a response to the Transmission Planner after receiving a notification of unacceptability or a request to perform a model review, but its response failed to contain one of the

R #	Violation Severity Levels			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
				two options for responses described in Requirement R6.
R7	The Transmission Planner provided the current (in-use) model(s) and accompanying documentation to the Generator Owner or Transmission Owner, but did so between 91 and 120 calendar days after receiving a request.	The Transmission Planner provided the current (in-use) model(s) and accompanying documentation to the Generator Owner or Transmission Owner, but did so between 121 and 150 calendar days after receiving a request.	The Transmission Planner provided the current (in-use) model(s) and accompanying documentation to the Generator Owner or Transmission Owner, but did so between 151 and 180 calendar days after receiving a request.	The Transmission Planner provided the current (in-use) model(s) and accompanying documentation to the Generator Owner or Transmission Owner, but did so more than 180 calendar days after receiving a request. OR The Transmission Planner failed to provide the current (in-use) model(s) and accompanying documentation to the Generator Owner or Transmission Owner after receiving a request.

D. Regional Variances

None.

E. Associated Documents

- Project 2020-06 Verifications of Models and Data for Generators Implementation Plan
- Project 2020-06 MOD-026-2 Technical Rationale
- Project 2020-06 VRF VSL Justifications Document
- Project 2020-06 Consideration of Directives

Version History

Version	Date	Action	Change Tracking
1	February 7, 2013	Adopted by NERC Board of Trustees.	New
1	March 20, 2014	FERC Order issued approving MOD-026-1. (Order becomes effective for R1, R3, R4, R5, and R6 on 7/1/14. R2 becomes effective on 7/1/18.)	
1	May 7, 2014	NERC Board of Trustees adopted revisions to VSLs in Requirement R6.	Revisions
1	November 26, 2014	FERC issued a letter order approved revision to VSLs in Requirement R6.	
2	October 31, 2025	Adopted by NERC Board of Trustees.	FERC Order No. 901 Revisions by Project 2020-06.
2	TBD	FERC approved	

Attachment 1

Table 1.1 Applicability: Facility Sections 4.2.1 or 4.2.2 Synchronous Condenser Identified in Facility Section 4.2.3.1			
Generator Model	Excitation Control	Governor Control	Additional Limiting and Protective Functions
1. Manufacturer, model number (if available), and type of generator/synchronous condenser; 2. Models representing the generator/synchronous condenser.	1. Manufacturer, model number (if available), and type of excitation system hardware and control; 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; 2. Model(s) representing the prime mover, governor control system, and any other controls which impact the dynamic active real 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: 1. Model(s) representing enabled excitation limiters; 2. Model(s) representing enabled 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.

Table 1.2
Applicability:
Facility Sections 4.2.5, 4.2.6 and 4.2.7
FACTS Devices Identified in Facility Section 4.2.3.2
HVDC Systems Identified in Facility Section 4.2.4

The facility	Volt/VAR Control	Frequency/ Power Control ⁹	Additional Limiting and Protective Functions
1. Manufacturer 2. Model Number (if available) 3. Software/Firmware versions for applicable facility's a. IBR unit(s) b. FACTS device(s) c. VSC HVDC d. LCC HVDC e. Power plant controller(s)	1. Model(s) representing associated reactive power/voltage control as applicable for the specific facility or equipment. a. In the case of IBR, the model shall include: i. IBR unit(s) electronic control ii. The facility's power plant control iii. Supplemental reactive power devices and their control b. Other equipment which impacts facility voltage and reactive power dynamic response. ¹⁰	1. Model(s) representing the associated active power/frequency control including the specific facility or equipment. a. In the case of the IBR, the model shall include: i. IBR unit(s) electronic control ii. The facility's power plant control b. Other equipment which impacts facility active power or grid frequency dynamic response. ¹¹	1. Model(s) representing enabled limiting functions, which limit active or reactive output of the IBR unit or facility. Limiting functions include active or reactive power limiting, active or reactive current limiting, or other limiting functions as may be involved in active or reactive power prioritization, ramping, disturbance ride-through and post-disturbance recovery behaviors. 2. Model(s) representing enabled protection functions that directly trip IBR unit(s) or facility, to include AC over-voltage and under-voltage protection, and over-frequency and under-frequency protection.

⁹ Not applicable for FACTS Devices identified in Facility Section 4.2.3.2

¹⁰ This includes models such as induction generator dynamics and associated reactive compensation devices (e.g., capacitor banks, SVCs) in Type 1 and Type 2 wind turbine generators.

¹¹ This includes models such as induction generator dynamics, rotor resistance controls, and blade pitch controls in Type 1 and Type 2 wind turbine generators.

Attachment 2

Periodicity		
Row Number	Triggering Condition	Required Action
1	Establishing the initial verification date for an applicable facility. (Applies to Requirement R2 and Requirement R3)	For Requirement R2, transmit the model(s) and accompanying documentation meeting Requirement R2, Parts 2.1 through 2.3 to its Transmission Planner in accordance with the date(s) of the Implementation Plan. For Requirement R3, transmit the model(s) and accompanying documentation meeting Requirement R3, Parts 3.1 through 3.5 to its Transmission Planner in accordance with the date of the Implementation Plan or within 365 calendar days after the Transmission Planner identifies the facility as an applicable facility in accordance with Requirement R1, Part 1.2.1, whichever is later.
2	Initial verification for a newly commissioned facility. (Applies to Requirement R2 and Requirement R3)	Transmit the model(s) and accompanying documentation meeting Requirement R2, Parts 2.1 through 2.3 and, if applicable, Requirement R3, Parts 3.1 through 3.5 to its Transmission Planner within 365 calendar days after the commercial operation date.
3	Subsequent Model Validation and Model Verification for an applicable facility. (Applies to Requirement R2 and Requirement R3)	Transmit the model(s) and accompanying documentation meeting Requirement R2, Parts 2.1 through 2.3 and, if applicable, Requirement R3, Parts 3.1 through 3.5 to its Transmission Planner within 10 calendar years of the most recent transmittal.
4	Applicable facility with installed and operating recording equipment does not experience a frequency excursion as applicable per Requirement R2, Part 2.3.2 or Requirement R3, Part 3.3.2 by the date otherwise required to meet the dates per Attachment 2, Rows 1, 2, or 3.	Requirement R2, Part 2.3.2 and Requirement R3, Part 3.3.2 are met with a written statement transmitted to its Transmission Planner. Transmit the model(s) and accompanying documentation meeting Requirement R2, Parts 2.1 through 2.3 or Requirement R3, Parts 3.1 through 3.5 to its Transmission Planner on or before 365 calendar days after a frequency

Periodicity		
Row Number	Triggering Condition	Required Action
	(Applies to Requirement R2 and Requirement R3) This row applies only if a frequency excursion from a system disturbance that meets Requirement R2, Part 2.3.2 or Requirement R3, Part 3.3.2 is selected for the validation method and the ability to record the applicable unit's real power response to a frequency excursion is installed and expected to be available.	excursion per Requirement R2, Part 2.3.2 or Requirement R3, Part 3.3.2 occurs, and the recording equipment captures the applicable facility's active power response as expected.
5	For an existing applicable facility with a change to in-service equipment as described under Requirement R4. (Applies to Requirement R4)	In order for the transmittal to reset the 10-year anniversary transmittal date for Requirement R2 and Requirement R3 as described in Row 3, all model(s) and model parameters must be verified according to the applicable requirement(s) and included in the transmittal.
6	Existing, new, or upgraded synchronous generating unit or synchronous condenser that is equivalent to other unit(s) at the same physical location. AND Each unit has the same MVA nameplate rating; AND The nameplate rating is ≤ 350 MVA; AND Each unit has the same components, ratings, and settings; AND The model for one of these equivalent units has been verified. (Applies to Requirement R2)	Provide a written explanation and include with the model(s) and accompanying documentation provided to its Transmission Planner for the equivalent unit. Model Verification and Model Validation shall be performed for a different equivalent unit during each 10-year period.

Periodicity		
Row Number	Triggering Condition	Required Action
7	Applicable facility is not responsive to voltage excursion events during normal operation; OR New or existing applicable facility does not have an installed closed loop voltage or reactive power control function or has a disabled closed loop voltage or reactive power control system function. (Applies to Requirement R2, Part 2.3.1 or Requirement R3, Part 3.3.1)	Requirement R2, Part 2.3.1 and Attachment 1, Table 1.1, Excitation Control column or Table 1.2, Volt/VAR Control column and Requirement R3, Part 3.3.1 are met with a written statement to that effect transmitted to its Transmission Planner.
8	Applicable facility is not designed to be responsive to frequency excursion events during normal operation. (The applicable facility does not operate in a frequency control mode, except during normal start up and shut down, that would result in a prime mover/governor and load control or active power/frequency control mode response.) OR New or existing applicable facility does not have an installed frequency control system or has a disabled frequency control system. (Applies to Requirement R2, Part 2.3.2 or Requirement R3, Part 3.3.2) If the applicable facility is operating in a frequency control mode that is responsive to a frequency excursion event in only one direction (over- or under-frequency), then Requirement R2, Part 2.3.2 and Requirement R3, Part 3.3.2 are still applicable.	Requirement R2, Part 2.3.2 and Attachment 1, Table 1.1, Governor Control column or Table 1.2, Frequency/Power Control column and Requirement R3, Part 3.3.2 are met with a written statement to that effect transmitted to its Transmission Planner.
9	Existing applicable unit or facility, excluding synchronous condensers, FACTS devices, and HVDC facilities, has a	Requirements R2 or Requirement R3 are met with a written statement to that effect transmitted to its Transmission Planner

Periodicity		
Row Number	Triggering Condition	Required Action
	current average net capacity factor over the most recent three calendar years, beginning on January 1 and ending on December 31, of 5% or less. (Requirement R2 or Requirement R3 periodicity exemption of Row 3; does not exempt obligation under Requirement R4 or Requirement R6.)	annually. If the current average net capacity factor over the most recent three calendar years exceeds 5%, then transmit the model(s) and accompanying documentation meeting Requirement R2, Parts 2.1 through 2.3 and, if applicable, Requirement R3, Parts 3.1 through 3.5 within 365 calendar days. For the definition of net capacity¹² factor refer to Appendix F of the GADS Data Reporting Instructions.¹³

¹² Net Capacity Factor: $NCF = [\Sigma (\text{Net Actual Generation}) / \Sigma (\text{Net Maximum Capacity} \times \text{Period Hours})] \times 100\%$

Where, Period Hours = 8760 x 3 = 26280. In the case of batteries, the absolute value of discharging and charging shall be summed into Net Actual Generation.

¹³ Refer to Appendix F of the GADS Conventional Data Reporting Instructions.

https://www.nerc.com/pa/RAPA/gads/DataReportingInstructions/Appendix_F_Equations_2025_DRI.pdf