

Standard Development Roadmap

This section is maintained by the drafting team during the development of the standard and will be removed when the standard becomes effective.

Development Steps Completed:

1. SAR posted for comment (April 20–May 21, 2007).
2. Revised SAR and response to comments posted ~~– (July 5, 2007).~~
3. Revised SAR and response to comments approved by SC (June 14, 2007).
4. SDT appointed on ~~(August 18, 2007)–.~~
5. Draft 1 MOD-026-1 was posted for a 45-day comment period from February 17 – April 2, 2009.
6. Draft 2 MOD-026-1 was posted for a 45-day concurrent comment and ballot period from June 15 – August 1, 2011.
7. Draft 3 of MOD-026-1 was posted for a 30-day concurrent comment and successive ballot period from February 29 – March 29, 2012.

Proposed Action Plan and Description of Current Draft:

This is the ~~third~~fourth draft of the standard and includes Time Horizons, Data Retention, Violation Risk Factors, and Violation Severity Levels. This ~~second~~fourth posting is for a 30-day comment and successive ballot period.

Future Development Plan:

Anticipated Actions	Anticipated Date
1. Develop responses to comments and develop third <u>fourth</u> version of draft standard.	August 2011– February <u>April– July</u> ne 2012
2. Post response to comments and third <u>fourth</u> version draft revision of standard for 30-day comment and successive ballot period.	February– March <u>October – November</u> 2012
3. Develop responses to successive ballot comments.	April– May <u>December 2012 - January 2013</u>
4. Post response to comments <u>and conduct recirculation ballot.</u>	June <u>February -2013</u>
5. Conduct recirculation ballot.	June 2012 <u>October 2012</u>
756. BOT adoption.	July <u>March 2012</u>
87. File with regulatory authorities.	April 2013 <u>September</u>

A. Introduction

1. **Title:** Verification of Models and Data for Generator Excitation Control System ~~and/or~~ Plant Volt/Var Control Functions
2. **Number:** MOD-026-1
3. **Purpose:** To verify that the generator excitation control system ~~and/or~~ plant volt/var control¹ function² model (including the power system stabilizer model and the impedance compensator model) and the model parameters used in dynamic simulations accurately represent the generator excitation control system ~~and/or~~ plant volt/var control function behavior when assessing Bulk Electric System (BES) reliability.
4. **Applicability:**
 - 4.1. **Functional Entities:**
 - 4.1.1 Generator Owner
 - 4.1.2 Transmission Planner
 - 4.2. **Facilities:**

For the purpose of ~~this standard~~, the ~~following requirements contained herein~~, Facilities ~~that are considered, directly connected to the Bulk Electric System (BES) will be collectively referred as an~~ “applicable units³.”

~~Units or plants with an average capacity factor⁴ greater than 5 percent over the most recent three calendar years, beginning on January 1 and ending on December 31, unit³~~ that meet the following:

¹ ~~Excitation control system and plant volt/var control function:~~

- a. ~~For individual synchronous machines, the generator excitation control system includes the generator, exciter, voltage regulator and power system stabilizer.~~
- b. ~~For an aggregate generating plant, the volt/var control system includes the voltage regulator & reactive power control system controlling and coordinating plant voltage and associated reactive capable resources.~~

² ~~Excitation control system or plant volt/var control function:~~

- a. ~~For individual synchronous machines, the generator excitation control system includes the generator, exciter, voltage regulator and power system stabilizer.~~
- b. ~~For an aggregate generating plant, the volt/var control system includes the voltage regulator & reactive power control system controlling and coordinating plant voltage and associated reactive capable resources.~~

³ ~~Applicable generating units do not include startup or standby units not normally connected to the grid.~~

⁴ ~~Once a capacity factor exemption is declared by notifying the Transmission Planner, verification is not required for 10 calendar years from the date eligibility occurs. At the end of this 10 calendar year timeframe, the current average 3 year capacity factor (for years 8, 9, and 10) is examined to determine if the capacity factor exemption can be declared for the next 10 calendar year period. If not eligible for the capacity factor exemption, then model verification must be completed within one year of the date the capacity factor exemption expired with the 10 calendar year periodicity requirement reset based on the verification date. For the definition of capacity factor, refer to Appendix F of the GADS Data Reporting Instructions on the NERC website.~~

- ~~4.2.1~~ ~~Generating units connected to~~Generation in the Eastern or Quebec Interconnections with the following characteristics:
- ~~4.2.1.1~~ Individual generating unit greater than 100 MVA (gross nameplate rating) ~~directly connected to the bulk power system.~~
- ~~4.2.1.2~~ For each Individual generating plant / ~~Facility~~ consisting of ~~one or more multiple generating~~ units that are directly connected ~~to the bulk power system~~ at a common BES bus with total generation greater than 100 MVA (gross aggregate ~~rating~~):
- ~~4.2.1.3~~~~4.2.1.2~~ ~~Each individual generating unit greater than 20 MVA (gross nameplate rating); and~~.
- ~~○ Each generating plant / Facility comprised consisting of individual generating units less than 20 MVA (gross nameplate ratings)~~
- 4.2.2 Generation in the Western Interconnection with the following characteristics:
- 4.2.2.1 Individual generating unit greater than 75 MVA (gross nameplate rating) ~~directly connected to the bulk power system.~~
- ~~4.2.2.2~~ For each Individual generating plant / ~~Facility~~ consisting of ~~one or more multiple generating~~ units that are directly connected ~~to the bulk power system~~ at a common BES bus with total generation greater than 75 MVA (gross aggregate ~~rating~~):
- ~~4.2.2.3~~~~4.2.2.2~~ ~~Each individual generating unit greater than 20 MVA (gross nameplate rating); and~~.
- ~~○ Each generating plant / Facility comprised consisting of individual generating units less than 20 MVA (gross nameplate ratings)~~
- 4.2.3 Generation in the ERCOT Interconnection with the following characteristics:
- 4.2.3.1 Individual generating unit greater than 50 MVA (gross nameplate rating) ~~directly connected to the bulk power system.~~
- 4.2.3.2 For each Individual generating plant / ~~Facility~~ consisting of ~~one or more multiple generating~~ units that are directly connected ~~to the bulk power system~~ at a common BES bus with total generation greater than 75 MVA (gross aggregate nameplate rating):
- ~~○ Each individual generating unit greater than 20 MVA (gross nameplate rating); and~~
 - ~~○ Each generating plant / Facility comprised consisting of individual generating units less than 20 MVA (gross nameplate ratings)~~
- 4.2.4 For all Interconnections:

- ~~Any registered~~⁵ technically justified unit that meets NERC registry criteria and is requested by the ~~Planning Coordinator~~ Transmission Planner.

5. Effective Date:

~~5.1. In those jurisdictions where regulatory approval is required:~~

~~5.1.1 Each responsible entity shall ensure compliance with For Requirements R1, and R3 through R6 ~~by~~, the first day of the first calendar quarter, ~~four~~ years following beyond the date that this standard is approved by applicable regulatory approval.~~

~~5.1. Each Generator Owner shall ensure at least 30 percent of its applicable units per Interconnection on an MVA basis are compliant with Requirement R2 by the first day of authorities. In those jurisdictions where regulatory approval is not required, the first calendar quarter, standard shall become effective on the first day of the first calendar quarter beyond the date this standard is approved by the NERC Board of Trustees, or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.~~

~~5.1.2 For Requirement R2, 30 percent of the entity's applicable unit gross MVA for each Interconnection on the first day of the first calendar quarter that is four years following applicable regulatory approval.~~

~~5.1.3 Each Generator Owner shall ensure at least 50 percent of its applicable units per Interconnection on an MVA basis are compliant with Requirement R2 by the first day of the first calendar quarter, six years following applicable regulatory approval.~~

~~5.2. Each Generator Owner shall ensure 100 percent of its applicable units are compliant with Requirement R2 by, or in those jurisdictions where no regulatory approval is required, on the first day of the first calendar quarter, ~~ten~~ that is four years following NERC Board of Trustees adoption or as otherwise made effective pursuant to the laws applicable ~~regulatory approval~~ to such ERO governmental authorities.~~

~~5.3. In For Requirement R2, 50 percent of the entity's applicable unit gross MVA for each Interconnection on first day of the first calendar quarter that is six years following applicable regulatory approval, or in those jurisdictions where no regulatory approval is required:~~

~~5.3.1 Each responsible entity shall ensure compliance with Requirements R1, and R3 through R6 by the first day of the first calendar quarter, four years following Board of Trustees adoption.~~

~~5.4.5.3. Each Generator Owner shall ensure at least 30 percent of its applicable units per Interconnection on an MVA basis are compliant with Requirement R2~~

⁵ Technical justification is achieved by the Transmission Planner demonstrating that the simulated unit or plant response does not match the measured unit or plant response.

~~by, on~~ the first day of the first calendar quarter, ~~four thirty that is six~~ years following NERC Board of Trustees adoption or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.

~~5.4.1~~ Each Generator Owner shall ensure at least 50% ~~For Requirement R2, 100 percent of its~~ the entity's applicable units ~~per Interconnection on an MVA basis are compliant with Requirement R2 by~~ unit gross MVA for each Interconnection on the first day of the first calendar quarter that is 10 years following applicable regulatory approval, or in those jurisdictions where no regulatory approval is required, on the first day of the first calendar quarter, ~~six that is 10~~ years following NERC Board of Trustees adoption.

~~5.5.5.4.~~ Each Generator Owner shall ensure 100 percent of its applicable units are compliant with Requirement R2 by the first day of the first calendar quarter, ~~ten years following Board of Trustees adoption or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.~~

B. Requirements

R1. Each Transmission Planner shall provide one or more of the following ~~instructions and model data~~ to its requesting Generator Owner within 90 calendar days of receiving a written request for those instructions or model data: [Violation Risk Factor: Lower] [Time Horizon: Operations Planning:]

- Instructions on how to obtain the list of excitation control system ~~and/or~~ plant volt/var control function models that are acceptable to the Transmission Planner for use in dynamic simulation.
- Instructions on how to obtain the ~~Transmission Planner's software manufacturer's~~ dynamic excitation control system ~~and/or~~ plant volt/var control function model library block diagrams and/or data sheets. for models that are acceptable to the Transmission Planner, or
- Model data for any of the Generator Owner's existing applicable unit ~~or plant~~ specific excitation control system ~~and/or~~ plant volt/var control function contained in the Transmission Planner's dynamic database from the current (in-use) models, including generator MVA base.

R2. Each Generator Owner shall provide, for each ~~of its~~ applicable units, a verified generator excitation control system ~~and/or~~ plant volt/var control function model, including documentation and data (as specified in Parts 2.1 ~~and 2.2~~) to its Transmission Planner in accordance with the periodicity specified in MOD-026 Attachment 1, ~~to ensure modeling data is accurate for use in simulation software.~~ [Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]

2.1. ~~Perform verifications~~ Each applicable unit's model shall be verified by the Generator Owner using one or more models acceptable to the Transmission Planner ~~that~~. Verification of an individual unit less than 20 MVA (gross nameplate rating) may be performed using either individual unit or plant

~~aggregate model(s), or both. Each verification shall~~ include(s) the following information:

- 2.1.1. Documentation demonstrating the applicable unit's model response matches the recorded response for a voltage excursion ~~at the applicable unit's point of interconnection~~ from either a staged test or a measured system disturbance~~;~~
- 2.1.2. Manufacturer, model number (if available), and type of excitation control system ~~and/or~~ plant volt/var control function installed ~~(such as including, but not limited to~~ static, AC brushless, DC rotating, ~~and~~ volt/var function)~~;~~
- 2.1.3. Model structure and data ~~(such as including, but not limited to~~ reactance, time constants, saturation factors, ~~total~~ rotational inertia, or equivalent data) ~~for the generator (or plant equivalent);~~
- 2.1.4. Model structure and data for the excitation control system, ~~for the plant volt/var function, and for~~ including the closed loop voltage regulator if ~~the~~ closed loop voltage regulator is installed~~; or the model structure and data for the plant volt/var control function system,~~
- 2.1.5. Compensation settings (such as droop, line drop, differential compensation), if used~~; and~~
- 2.1.6. Model structure and data for power system stabilizer, if so equipped.

~~2.2. For plants that are comprised of units that have a gross nameplate rating of less than 20 MVA, each Generator Owner shall perform its verification using plant aggregate model(s) that include the information required by Requirement sub-parts 2.1.1 through 2.1.6~~

R3. Each Generator Owner shall provide a written response to its Transmission Planner within 90 calendar days of receiving one of the following items. ~~The written response shall contain either the technical basis for maintaining the current model, or the model changes, or a plan to perform model verification⁶ (in accordance with Requirement R2) [Violation Risk Factor: Lower] [Time Horizon: Operations Planning]:~~ for an applicable unit:

- Written notification from its Transmission Planner (in accordance with Requirement R6) that the excitation control system ~~and/or~~ plant volt/var control function model is not “usable,” ~~or;~~
- Written comments from its Transmission Planner identifying technical concerns with the verification documentation related to the excitation control system ~~and/or~~ plant volt/var control function model, or

⁶ If verification is performed, the 10 year period as outlined in Attachment 1 is reset.

- Written comments and supporting evidence from its Transmission Planner indicating that the ~~predicted~~simulated excitation control system ~~and/or~~ plant volt/var control function model response did not match the recorded response to a transmission system event.

The written response shall contain either the technical basis for maintaining the current model, the model changes, or a plan to perform model verification⁷ (in accordance with Requirement R2). [Violation Risk Factor: Lower] [Time Horizon: Operations Planning]

- R4.** Each Generator Owner shall provide revised model data or plans to perform model verification⁷ (in accordance with Requirement R2) for an applicable unit to its Transmission Planner within 180 calendar days of making changes to the excitation control system ~~and/or~~ plant volt/var control function that alter the equipment response⁸ characteristic.⁹ [Violation Risk Factor: Lower] [Time Horizon: Operations Planning]
- R5.** Each Generator Owner shall provide a written response to its ~~Planning Coordinator~~Transmission Planner, within 90 calendar days following receipt of a technically justified¹⁰ unit request from the ~~Planning Coordinator~~Transmission Planner to perform a model review of ~~any~~unit/ or plant ~~not included in the Applicability~~ that includes one of the following: [Violation Risk Factor: Lower] [Time Horizon: Operations Planning]~~:-]~~
- Details of plans to verify the model (in accordance with Requirement R2~~);, or~~
 - Corrected model data including the source of revised model data such as discovery of manufacturer test values to replace generic model data or updating of data parameters based on ~~a walk down~~an on-site review of the equipment.
- R6.** Each Transmission Planner shall notify the Generator Owner within 90 calendar days of receiving the verified excitation control system ~~and/or~~ plant volt/var control function model information ~~whether~~in accordance with Requirement R2 that the model is useable (meets the criteria specified in Parts 6.1 through 6.3~~);,]~~ or is not useable~~;~~ and

⁷ If verification is performed, the 10-year period as outlined in MOD-026 Attachment 1 is reset.

⁸ ~~Exciter, voltage regulator, plant volt/var or power system stabilizer control replacement including software alterations that alter excitation control system equipment response, plant digital control system addition or replacement, plant digital control system software alterations that alter excitation control system equipment response, plant volt/var function equipment addition or replacement (such as static var systems, capacitor banks, individual unit excitation systems, etc), a change in the voltage control mode (such as going from power factor control to automatic voltage control, etc), exciter, voltage regulator, impedance compensator, or power system stabilizer settings change.~~⁸ Ibid.

⁹ ~~Exciter, voltage regulator, plant volt/var or power system stabilizer control replacement including software alterations that alter excitation control system equipment response, plant digital control system addition or replacement, plant digital control system software alterations that alter excitation control system equipment response, plant volt/var function equipment addition or replacement (such as static var systems, capacitor banks, individual unit excitation systems, etc), a change in the voltage control mode (such as going from power factor control to automatic voltage control, etc), exciter, voltage regulator, impedance compensator, or power system stabilizer settings change. Automatic changes in settings that occur due to changes in operating mode do not apply to Requirement R4.~~

¹⁰ Technical justification is achieved by the Transmission Planner demonstrating that the simulated unit or plant response does not match the measured unit or plant response.

shall include a technical description if the model is not ~~useable.~~ usable that includes the following: [*Violation Risk Factor: Medium*] [*Time Horizon: Operations Planning*]

- 6.1. The excitation control system ~~and/or~~ plant volt/var control function model initializes to compute modeling data without error.
- 6.2. A no-disturbance simulation results in negligible transients, ~~and~~
- 6.3. For an otherwise stable simulation, a disturbance simulation results in the excitation control and plant volt/var control function model exhibiting positive damping.

C. Measures

- M1. ~~Evidence for Requirement R1~~ The Transmission Planner must include have and provide the dated request for instructions or data, the transmitted instructions or data, and dated evidence of ~~transmission of requested instructions and data, such as dated a written transmittal (e.g., electronic mail messages, dated message, postal receipts, dated receipt, or confirmation of facsimile transmission) as evidence that it provided the request within 90 calendar days in accordance with Requirement R1.~~
- M2. ~~Evidence for Requirement R2 must include, for each of the Generator Owner's applicable Facilities, the verification report showing that the~~ The Generator Owner must have and provide dated evidence it verified each generator excitation control system ~~and/or~~ plant volt/var control function model ~~was verified according to Part 2.1 for each applicable unit and dated evidence of transmission, such as a dated transmittal (e.g., electronic mail messages, dated message, postal receipts, or dated confirmation of facsimile transmission) as specified~~ evidence it provided the model, documentation, and data to its Transmission Planner, in accordance with Requirement R2.
- M3. Evidence for Requirement R3 must include the Generator Owner's dated written response containing the information identified in Requirement R3 and dated evidence of transmittal, ~~such as a dated (e.g., electronic mail messages, dated message, postal receipts, or dated confirmation of facsimile transmission) of the response.~~
- M4. Evidence for Requirement R4 must include, for each of the Generator Owner's ~~Facilities~~ applicable units for which system changes specified in Requirement R4 were made, a dated revised model data or ~~dated~~ plans to perform a model verification and dated evidence ~~of transmittal, such as dated (e.g., electronic mail messages, dated message, postal receipts, or dated confirmation of facsimile transmittal) it~~ provided the revised model and data or plans within 180 calendar days of making changes.
- M5. Evidence for Requirement R5 must include, ~~for each request received as specified in Requirement R5, the~~ the Generator Owner's dated written response ~~provided containing the information identified in Requirement R5 and dated evidence of transmittal, such as dated (e.g., electronic mail messages, dated message, postal receipts, or dated confirmation of facsimile transmittal) it provided a written response within 90 calendar days following receipt of a technically justified request.~~

- M6. Evidence of Requirement R6 must include, for each model received, the dated response ~~containing the information required in indicating the model was usable or not usable according to the criteria specified in~~ Parts 6.1 through 6.3 and ~~for a model that is not usable, a technical description; and~~ dated evidence of transmittal, ~~such as dated (e.g., electronic mail messages, dated message, postal receipts, or dated~~ confirmation of facsimile ~~transmittal)~~ that the Generator Owner was notified within 90 calendar days of receipt of model information.

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance Enforcement Authority

~~Regional Entity~~

The Regional Entity shall serve as the Compliance Enforcement Authority unless the applicable entity is owned, operated, or controlled by the Regional Entity. In such cases the ERO or a Regional entity approved by FERC or other applicable governmental authority shall serve as the CEA.

1.2. Data Retention

The following evidence retention periods 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 Generator Owner and Transmission Planner shall each 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:

- The Transmission Planner shall retain the information/data request and provided response evidence of Requirements R1 and R6, Measures M1 and M6 for ~~3~~three calendar years from the date the document was provided.
- The Generator Owner shall retain the latest ~~and previous~~ excitation control system ~~and/or~~ plant volt/var control function model verification evidence of Requirement R2, Measure M2.
- The Generator Owner shall retain the information/data request and provided response evidence of Requirements R3 through R5, and Measures M3 through M5 for ~~3~~three calendar years from the date the document was provided.

If a Generator Owner or Transmission Planner is found non-compliant, it shall keep information related to the non-compliance until mitigation is complete or 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 Assessment Processes

Compliance Audit

Self-Certification

Spot Checking

Compliance Investigation

Self-Reporting

Complaints

1.4. Additional Compliance Information

None

2. Violation Severity Levels

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	The Transmission Planner provided the instructions and data to the Generator Owner more than 90 calendar days but no more less than <u>or equal to</u> 120 calendar days of receiving a <u>written</u> request.	The Transmission Planner provided the instructions and data to the Generator Owner more than 120 calendar days but no more less than <u>or equal to</u> 150 calendar days of receiving a <u>written</u> request.	The Transmission Planner provided the instructions and data to the Generator Owner more than 150 calendar days but no more less than <u>or equal to</u> 180 calendar days of receiving a <u>written</u> request.	The Transmission Planner failed to provide the instructions and data to the Generator Owner within 181 180 calendar days of receiving a <u>written</u> request.
R2	<p>The Generator Owner provided its verified model(s), <u>including documentation and data</u> to its Transmission Planner after the timeframe specified in MOD-026 Attachment 1 but no moreless than 30<u>or equal to 90</u> calendar days late;</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner verified models that omitted one of the six Parts identified in Requirement R2, SubpParts 2.1.1 through 2.1.6.</p>	<p>The Generator Owner provided its verified model(s), <u>including documentation and data</u> to its Transmission Planner more than 30<u>90</u> calendar days but no moreless than 60<u>or equal to 180</u> calendar days late as specified by the periodicity timeframe in MOD-026 Attachment 1.</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner verified models that omitted two of the six Parts identified in Requirement R2, SubpParts 2.1.1 through 2.1.6.</p>	<p>The Generator Owner provided its verified model(s), <u>including documentation and data</u> to its Transmission Planner more than 60<u>180</u> calendar days but no moreless than 90<u>or equal to 270</u> calendar days late as specified by the periodicity timeframe in MOD-026 Attachment 1.</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner verified models that omitted three of the six Parts identified in Requirement R2, SubpParts 2.1.1 through 2.1.6.</p>	<p>The Generator Owner provided its verified generator excitation control systemmodel(s), <u>including documentation</u> and <u>plant volt/var control function model</u>data more than 90<u>270</u> calendar days late or failed to provide the verified model(s) to its Transmission Planner in accordance with the periodicity specified in MOD-026 Attachment 1.</p> <p>OR</p> <p>The Generator Owner failed to use model(s) acceptable to the Transmission Planner as specified in Requirement R2, SubpPart 2.1.</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner verified model(s) thatbut omitted four or more of the six Pparts identified in Requirement R2, Subparts 2.1.1 through 2.1.6.</p>

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R3	The Generator Owner provided a written response more than 90 calendar days but no more <u>less than or equal to</u> 120 calendar days of receiving written notice. (R3)	The Generator Owner provided a written response more than 120 calendar days but no more <u>less than or equal to</u> 150 calendar days of receiving written notice. (R3)	The Generator Owner provided a written response more than 150 calendar days but no more <u>less than or equal to</u> 180 calendar days of receiving written notice. (R3)	The Generator Owner failed to provide a written response within 181 <u>180</u> calendar days of receiving written notice. (R3) . OR The Generator Owner's written response was provided within 181 calendar days of receiving written notice however, the The Generator Owner's written response failed to contain either the technical basis for maintaining the current model, or a list of future model changes, or a plan to perform another model verification.
R4	The Generator Owner provided revised model data or plans to perform model verification more than 180 calendar days but no more <u>less than or equal to</u> 210 calendar days of making changes to the excitation control system and/or plant volt/var control function that altered the equipment response characteristic. (R4)	The Generator Owner provided revised model data or plans to perform model verification more than 210 calendar days but no more <u>less than or equal to</u> 240 calendar days of making changes to the excitation control system and/or plant volt/var control function that altered the equipment response characteristic. (R4)	The Generator Owner provided revised model data or plans to perform model verification more than 240 calendar days but no more <u>less than or equal to</u> 270 calendar days of making changes to the excitation control system and/or plant volt/var control function that altered the equipment response characteristic. (R4)	The Generator Owner failed to provide revised model data or failed to provide plans to perform model verification within 271 <u>270</u> calendar days of making changes to the excitation control system and/or plant volt/var control function that altered the equipment response characteristic. (R4) .

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R5	<p>The Generator Owner provided a written response more than 90 calendar days but no more<u>less</u> than <u>or equal to</u> 120 calendar days to the Planning Coordinator<u>Transmission Planner</u> following receipt of a technically justified request to perform a model review of <u>aan applicable</u> unit/plant. (R5).</p>	<p>The Generator Owner provided a written response more than 120 calendar days but no more<u>less</u> than <u>or equal to</u> 150 calendar days to the Planning Coordinator<u>Transmission Planner</u> following receipt of a technically justified request to perform a model review of <u>aan applicable</u> unit/plant. (R5).</p>	<p>The Generator Owner provided a written response more than 150 calendar days but no more<u>less</u> than <u>or equal to</u> 180 calendar days to the Planning Coordinator<u>Transmission Planner</u> following receipt of a technically justified request to perform a model review of <u>aan applicable</u> unit/plant. (R5).</p> <p>OR</p> <p>The Generator Owner provided a written response within 181 calendar days to the Planning Coordinator following receipt of a technically justified request to perform a model review of a unit/plant however the written response failed to include Requirement R5, Subpart 5.2 or Part 5.3.</p>	<p>The Generator Owner failed to provide a written response to the Planning Coordinator<u>Transmission Planner</u> within <u>180 calendar days</u> following receipt of a technically justified request to perform a model review of <u>aan applicable</u> unit/plant. (R5).</p> <p>OR</p> <p>The Generator Owner provided a written response within 181 calendar days to the Planning Coordinator following receipt of a technically justified request to perform a model review of a unit/plant however the Owner's written response failed to include one of the sub bullets of Requirement R5, Subparts 5.2 and 5.3.</p>

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R6	<p>The Transmission Planner provided a written response to the Generator Owner indicating whether the model is useable or not useable; including a technical description if the model is not useable, more than 90 calendar days but less than <u>or equal to</u> 120 calendar days of receiving verified model information. (R6)</p>	<p>The Transmission Planner provided a written response to the Generator Owner indicating whether the model is useable or not useable; including a technical description if the model is not useable, more than <u>or equal to</u> 150 calendar days of receiving the verified model information. (R6)</p> <p>OR</p> <p>The Transmission Planner provided a written response within 181 calendar days to the Generator Owner however thePlanner's written response omitted confirmation for one of the specified model criteria listed in Requirement R6, SubpParts 6.1 through 6.3.</p>	<p>The Transmission Planner provided a written response to the Generator Owner indicating whether the model is useable or not useable; including a technical description if the model is not useable, more than <u>or equal to</u> 180 calendar days of receiving the verified model information. (R6)</p> <p>OR</p> <p>The Transmission Planner provided a written response within 181 calendar days to the Generator Owner however thePlanner's written response omitted confirmation for two of the specified model criteria listed in Requirement R6, SubpParts 6.1 through 6.3.</p>	<p>The Transmission Planner failed to provide a written response to the Generator Owner within 181<u>180</u> calendar days of receiving the verified model information. (R6).</p> <p>OR</p> <p>The Transmission Planner provided a written response within 181 calendar days to the Generator Owner however thePlanner's written response omitted confirmation for all specified model criteria listed in Requirement R6, SubpParts 6.1 through 6.3.</p>

E. Regional Variances

None.

F. Associated Documents

None.

Version History

Version	Date	Action	Change Tracking
<u>1.0</u>	<u>TBD</u>	<u>Effective Date</u>	<u>New</u>

G. References

The following documents contain technical information beyond the scope of this Standard on excitation control system functionality, modeling, and testing.

1. IEEE 421.1 Definitions for Excitation Systems for Synchronous Machines
2. IEEE 421.2 Guide for Identification, Testing, and Evaluation of the Dynamic Performance of Excitation Control Systems
3. IEEE 421.5 IEEE Recommended Practice for Excitation System Models for Power System Stability Studies
4. K. Clark, R.A. Walling, N.W. Miller, "Solar Photovoltaic (PV) Plant Models in PSLF," IEEE/PES General Meeting, Detroit, MI, July 2011
5. M. Asmine, J. Brochu, J. Fortmann, R. Gagnon, Y. Kazachkov, C.-E. Langlois, C. Larose, E. Muljadi, J. MacDowell, P. Pourbeik, S. A. Seman, and K. Wiens, "Model Validation for Wind Turbine Generator Models", IEEE Transactions on Power System, Volume 26, Issue 3, August 2011
6. A. Ellis, E. Muljadi, J. Sanchez-Gasca, Y. Kazachkov, "Generic Models for Simulation of Wind Power Plants in Bulk System Planning Studies," IEEE PES General Meeting 2011, Detroit, MI, July 24-28
7. N.W. Miller, J. J. Sanchez-Gasca, K. Clark, J.M. MacDowell, "Dynamic Modeling of GE Wind Plants for Stability Simulations," IEEE PES General Meeting 2011, Detroit, MI, July 24-28
8. A. Ellis, Y. Kazachkov, E. Muljadi, P. Pourbeik, J.J. Sanchez-Gasca, Working Group Joint Report – WECC Working Group on Dynamic Performance of Wind Power Generation & IEEE Working Group on Dynamic Performance of Wind Power Generation, "Description and Technical Specifications for Generic WTG Models – A Status Report," Proc. IEEE PES 2011 Power Systems Conference and Exposition (PSCE), March 2011, Phoenix, AZ

9. K. Clark, N.W. Miller, R.A. Walling, "Modeling of GE Solar Photovoltaic (PV) Plants for Grid Studies," version 1.1, April 2010
10. K. Clark, N.W. Miller, J. J. Sanchez-Gasca, "Modeling of GE Wind Turbine-Generators for Grid Studies," version 4.5, April 16, 2010, Available from GE Energy
11. R.J. Piwko, N.W. Miller, J.M. MacDowell, "Field Testing & Model Validation of Wind Plants," in Proc. IEEE PES General Meeting, Pittsburg, PA, July 2008
12. N. Miller, K. Clark, J. MacDowell and W. Barton, "Experience with Field and Factory Testing for Model Validation of GE Wind Plants," in Proc. Eur. Wind Energy Conf. Exhib., Brussels, Belgium, March/April 2008
13. IEEE Task Force on Generator Model Validation Testing of the Power System Stability Subcommittee, "Guidelines for Generator Stability Model Validation Testing," IEEE PES General Meeting 2007, paper 07GM1307
14. W.W. Price and J. J. Sanchez-Gasca, "Simplified Wind Turbine Generator Aerodynamic Models for Transient Stability Studies," in PROC IEEE PES 2006 Power Systems Conf. Expo. (PSCE), Atlanta, GA, October 1, 2006, p. 986-992
15. J.J. Sanchez-Gasca, R.J. Piwko, N. W. Miller, W. W. Price, "On the Integration of Wind Power Plants in Large Power Systems," Proc. X Symposium of Specialists in Electric and Expansion Planning (SEPOPE), Florianopolis, Brazil, May 2006
16. N. W. Miller, J. J. Sanchez-Gasca, W. W. Price, R. W. Delmerico, "Dynamic Modeling of GE 1.5 and 3.6 MW Wind Turbine-Generators for Stability Simulations," Proc. IEEE Power Engineering Society General Meeting, Toronto, Ontario, July 2003
17. P. Pourbeik, C. Pink and R. Bisbee, "Power Plant Model Validation for Achieving Reliability Standard Requirements Based on Recorded On-Line Disturbance Data", Proceedings of the IEEE PSCE, March, 2011

MOD-026 Attachment 1

~~Excitation Control System and Plant Volt/Var Function Model Verification Periodicity~~

Periodicity Determination Supporting Criteria MOD-026 Attachment 1 Excitation Control System or Plant Volt/Var Function Model Verification Periodicity		
<u>Row Number</u>	<u>Verification Condition</u>	<u>Required Action</u>
<u>1</u>	<u>Establishing the initial verification date for an applicable unit.</u> (Requirement R2)	<u>Transmit the verified model, documentation and data to the Transmission Planner on or before the Effective Date.</u> <u>Row 4 applies when calculating generation fleet compliance during the 10-year implementation period.</u> <u>See Section A5 for Effective Dates.</u>
<u>2</u>	<u>Subsequent verification for an applicable unit.</u> (Requirement R2)	<u>Transmit the verified model, documentation and data to the Transmission Planner on or before the 10-year anniversary of the last transmittal (per Note 1).</u>
<u>3</u>	<u>Initial verification for a new applicable unit or for an existing applicable unit with new excitation control system or plant volt/var control function equipment installed.</u> (Requirement R2)	<u>Transmit the verified model, documentation and data to the Transmission Planner within 365 calendar days after the commissioning date.</u>

Periodicity-Determination Supporting Criteria <u>MOD-026 Attachment 1</u> <u>Excitation Control System or Plant Volt/Var Function Model Verification Periodicity</u>		
<u>Row Number</u>	<u>Verification Condition</u>	<u>Required Action</u>
4	<p><u>Existing applicable unit that is equivalent to another unit(s) at the same physical location.</u></p> <p><u>AND</u></p> <p><u>Each applicable unit has the same MVA nameplate rating.</u></p> <p><u>AND</u></p> <p><u>The nameplate rating is ≤ 350 MVA.</u></p> <p><u>AND</u></p> <p><u>Each applicable unit has the same components and settings.</u></p> <p><u>AND</u></p> <p><u>The model for one of these equivalent applicable units has been verified.</u></p> <p><u>(Requirement R2)</u></p>	<p><u>Document circumstance with a written statement and include with the verified model, documentation and data provided to the Transmission Planner for the verified equivalent unit.</u></p> <p><u>Verify a different equivalent unit during each 10-year verification period.</u></p> <p><u>Applies to Row 1 when calculating generation fleet compliance during the 10-year implementation period.</u></p>
5	<p><u>The Generator Owner has submitted a verification plan.</u></p> <p><u>(Requirement R3, R4 or R5)</u></p>	<p><u>Transmit the verified model, documentation and data to the Transmission Planner within 365 calendar days after the submittal of the verification plan.</u></p>

Periodicity Determination Supporting Criteria MOD-026 Attachment 1 Excitation Control System or Plant Volt/Var Function Model Verification Periodicity		
<u>Row Number</u>	<u>Verification Condition</u>	<u>Required Action</u>
6	<p><u>New or existing applicable unit does not include an active closed loop voltage or reactive power control function.</u></p> <p><u>(Requirement R2)</u></p>	<p><u>Requirement 2 is met with a written statement to that effect transmitted to the Transmission Planner.</u></p> <p><u>Perform verification per the periodicity specified in Row 3 for a “New Generating Unit” (or new equipment) only if active closed loop function is established.</u></p> <p><u>See Footnote 1 (see Section A.3) for clarification of what constitutes an active closed loop function for both conventional synchronous machines (reference Footnote 1a) and aggregate generating plants (reference Footnote 1b).</u></p>
7	<p><u>Existing applicable unit has a 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.</u></p> <p><u>(Requirement R2)</u></p>	<p><u>Requirement 2 is met with a written statement to that effect transmitted to the Transmission Planner.</u></p> <p><u>At the end of this 10-year timeframe, the current average three year net capacity factor (for years 8, 9, and 10) can be examined to determine if the capacity factor exemption can be declared for the next 10-year period. If not eligible for the capacity factor exemption, then model verification must be completed within 365 calendar days of the date the capacity factor exemption expired.</u></p> <p><u>For the definition of net capacity factor, refer to Appendix F of the GADS Data Reporting Instructions on the NERC website.</u></p>

~~Periodicity Determination Supporting Criteria~~ **MOD-026 Attachment 1**
Excitation Control System or Plant Volt/Var Function Model Verification Periodicity

<u>Row Number</u>	<u>Verification Condition</u>	<u>Required Action</u>
<p>Criteria <u>NOTES:</u></p> <p style="text-align: center;"><u>NOTE 1:</u> Establishing the Initial Ten Year Unit Verification Period Start Date:</p> <p style="text-align: center;">For each applicable unit, set the initial start date for compliance with Requirement R2 to the 30 percent, 50 percent, or 100 percent Standard Implementation Effective Dates established for compliance in accordance with the ten calendar recurring 10-year transition period and in accordance with the following rules:</p> <ul style="list-style-type: none"> • 30 percent of the applicable units in the generation fleet unit MVA is compliant within the first 4 years. • 50 percent of the applicable units in the generation fleet unit MVA is compliant within the first 6 years. • 100 percent of the applicable units in the generation fleet unit MVA is compliant within the first 10 years. <p>Criteria 2: Establishing the Recurring Ten Year Unit Verification Period Start Date <u>unit verification period start date:</u></p> <p style="text-align: center;">The start date is the actual data collection <u>date of submittal of a verified model to the Transmission Planner</u> for the most recently performed applicable unit verification.</p> <p>Criteria 3: For the purpose of calculating the initial ten year unit verification period 30 percent, 50 percent, or 100 percent threshold for generation fleet compliance, equivalent unit MVA is included.</p> <p><u>NOTE 2:</u> Consideration for Early Compliance <u>early compliance:</u></p> <p>Existing <u>generator</u> excitation control system and/or plant volt/var control function model verification is sufficient for demonstrating compliance for a ten 10-year period from the actual verification <u>transmittal</u> date if either of the following applies:</p> <ul style="list-style-type: none"> • The Generator Owner has a verified model that is compliant with the applicable regional policies, guidelines or criteria existing at the time of model verification. • The Generator Owner has an existing verified model that is compliant with the requirements of this standard. 		

Event Triggering Verification	Verification Periodicity	Comments
Establishing the initial verification period (Criteria 1) for an applicable unit (Requirement R2)	Record and collect excitation control system and plant volt/var control response validation data on or before the initial start date per Criteria 1	Transmit the verified model and documentation and data to the Transmission Planner no more than 365 calendar days from the date that the response was recorded. Criteria 3 applies when calculating generation fleet compliance during the 10-year transition period
Subsequent verification for an existing applicable unit (Requirement R2)	Record and collect excitation control system and plant volt/var control function response validation data on or before the ten-year anniversary date of the collection of the recorded unit excitation control system and plant volt/var control function response used for the current validation.	Transmit the verified model and documentation and data to the Transmission Planner no more than 365 calendar days from the date that the recorded response was collected.
Initial verification for a new applicable unit or for an existing applicable unit with new excitation control system and plant volt/var control function equipment installed with settings final (Requirement R2)	Record and collect excitation control system and plant volt/var control function response validation data no more than 356 days from the commissioning date	Transmit the verified model and documentation and data to the Transmission Planner no more than 180 calendar days from the date that the recorded response was collected.
Existing applicable unit that is equivalent to another operating unit(s) at the same physical location. AND Each equivalent unit has the same MVA nameplate rating. AND	Verify a different equivalent unit during each ten-year verification period.	Document circumstance with a written statement and include with the verified model and documentation and data provided to the Transmission Provider for the verified equivalent unit.

Standard MOD-026-1 — Verification of Models and Data for Generator Excitation Control System ~~Functions and/or~~ Plant Volt/Var Control Functions

Event Triggering Verification	Verification Periodicity	Comments
<p>The nameplate rating is \leq 350 MVA.</p> <p>AND</p> <p>Each equivalent unit has identical applicable components and settings.</p> <p>AND</p> <p>The model for one of these equivalent units has been verified.</p> <p>(Requirement R2)</p>		<p>Criteria 3 applies when calculating generation fleet compliance during the 10-year transition period.</p>
<p>Existing unit was subjected to an activity that resulted in an alteration of the response of the excitation control system and plant volt/var control function model and the altered unit settings are final</p> <p>AND</p> <p>The Generator Owner has submitted a verification plan.</p> <p>(Requirement R4)</p>	<p>Record and collect excitation control system and plant volt/var control response validation data no more than 365 calendar days from the date of the submitted verification plan.</p>	<p>Transmit the verified model and documentation and data to the Transmission Planner no more than 180 calendar days from the date that the recorded response was collected.</p>
<p>The Generator Owner receives written comments including dated electronic or hard copy evidence indicating that the recorded excitation control system and plant volt/var response to a transmission system event did not match the predicted excitation control system model response.</p> <p>AND</p> <p>The Generator Owner has submitted a verification plan.</p> <p>(Requirement R3)</p>	<p>Record and collect excitation control system and plant volt/var control response validation data no more than 365 calendar days from the date of the submitted verification plan.</p>	<p>Transmit the verified model and documentation and data to the Transmission Planner no more than 180 calendar days from the date that the recorded response was collected.</p>
<p>The Generator Owner receives written comments detailing technical concerns with the Generator Owner's excitation control system and plant volt/var control function model verification documentation.</p>	<p>Record and collect excitation control system and plant volt/var control response validation data no more than 365 calendar days from the date of the</p>	<p>Transmit the verified model and documentation and data to the Transmission Planner no more than 180 calendar days from the date that</p>

Standard MOD-026-1 — Verification of Models and Data for Generator Excitation Control System ~~Functions and/or~~ Plant Volt/Var Control Functions

Event Triggering Verification	Verification Periodicity	Comments
<p>AND The Generator Owner has submitted a verification plan (Requirement R3)</p>	<p>submitted verification plan</p>	<p>the recorded response was collected.</p>
<p>The excitation control system and volt/var control model are identified as unusable by the Transmission Planner. AND The Generator Owner has submitted a verification plan (Requirement R3)</p>	<p>Record and collect excitation control system and plant volt/var control response validation data no more than 365 calendar days from the date of the submitted verification plan.</p>	<p>Transmit the verified model and documentation and data to the Transmission Planner no more than 180 calendar days from the date that the recorded response was collected.</p>
<p>Planning Coordinator requests a review of the excitation control system and plant volt/var control function model for a unit or plant that is not an applicable unit. AND The Generator Owner has submitted a verification plan (Requirement R5)</p>	<p>Record and collect excitation control system and plant volt/var control response validation data no more than 365 calendar days from the date of the submitted verification plan.</p>	<p>Transmit the verified model and documentation and data to the Transmission Planner no more than 180 calendar days from the date that the recorded response was collected.</p>
<p>New or existing applicable unit does not include active closed loop function.</p>	<p>Not required until unit has an installed control system</p>	<p>Document circumstance with a written statement Perform verification per the periodicity specified in Row 3 for a “New Generating Unit” (or new equipment) once an active closed loop function is established.</p>