

A. Introduction

1. **Title:** Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions
2. **Number:** MOD-026-2
3. **Purpose:** To verify that the generator excitation control system or plant volt/var control function¹ 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 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 the requirements contained herein, Facilities that are directly connected to the Bulk Electric System (BES) will be collectively referred as an “applicable unit” that meet the following:

- 4.2.1 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).
 - 4.2.1.2 Individual generating plant consisting of multiple generating units that are directly connected at a common BES bus with total generation greater than 100 MVA (gross aggregate nameplate rating).
- 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).
 - 4.2.2.2 Individual generating plant consisting of multiple generating units that are directly connected at a common BES bus with total generation greater than 75 MVA (gross aggregate nameplate rating).

¹ 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, impedance compensation 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.

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- 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).
 - 4.2.3.2** Individual generating plant consisting of multiple generating units that are directly connected at a common BES bus with total generation greater than 75 MVA (gross aggregate nameplate rating).
- 4.2.4** For all Interconnections:
- A technically justified² unit that meets NERC registry criteria but is not otherwise included in the above Applicability sections 4.2.1, 4.2.2, or 4.2.3 and is requested by the Transmission Planner.

5. Effective Date:

- 5.1.** For Requirements R1, and R3 through R6, the first day of the first calendar quarter beyond the date that this standard is approved by applicable regulatory authorities or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities. In those jurisdictions where regulatory approval is not required, the 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.
- 5.2.** 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 or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities, or in those jurisdictions where no regulatory approval is required, on the first day of the first calendar quarter that is four years following NERC Board of Trustees adoption or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.
- 5.3.** 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 as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities, or in those jurisdictions where no regulatory approval is required, on the first day of the first calendar quarter 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.

² 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.

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5.4. For Requirement R2, 100 percent of the entity's applicable unit gross MVA for each Interconnection on the first day of the first calendar quarter that is 10 years following applicable regulatory approval or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities, or in those jurisdictions where no regulatory approval is required, on the first day of the first calendar quarter that is 10 years following NERC 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 the following requested information to the Generator Owner within 90 calendar days of receiving a written request : *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*
- Instructions on how to obtain the list of excitation control system 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 dynamic excitation control system 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 specific excitation control system 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 applicable unit, a verified generator excitation control system or plant volt/var control function model, including documentation and data (as specified in Part 2.1) to its Transmission Planner in accordance with the periodicity specified in MOD-026 Attachment 1. *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*
- 2.1.** Each applicable unit's model shall be verified by the Generator Owner using one or more models acceptable to the Transmission Planner. Verification for individual units less than 20 MVA (gross nameplate rating) in a generating plant (per Section 4.2.1.2, 4.2.2.2, or 4.2.3.2) may be performed using either individual unit or aggregate unit model(s), or both. Each verification shall include the following:
- 2.1.1.** Documentation demonstrating the applicable unit's model response matches the recorded response for a voltage excursion from either a staged test or a measured system disturbance,
 - 2.1.2.** Manufacturer, model number (if available), and type of the excitation control system including, but not limited to static, AC brushless, DC rotating, and/or the plant volt/var control function (if installed),

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- 2.1.3. Model structure and data including, but not limited to reactance, time constants, saturation factors, total rotational inertia, or equivalent data for the generator,
 - 2.1.4. Model structure and data for the excitation control system, including the closed loop voltage regulator if a 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.
- R3.** Each Generator Owner shall provide a written response to its Transmission Planner within 90 calendar days of receiving one of the following items for an applicable unit:
- Written notification from its Transmission Planner (in accordance with Requirement R6) that the excitation control system or plant volt/var control function model is not usable,
 - Written comments from its Transmission Planner identifying technical concerns with the verification documentation related to the excitation control system or plant volt/var control function model, or
 - Written comments and supporting evidence from its Transmission Planner indicating that the simulated excitation control system 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 verification³ (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 verification⁴ (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 or plant volt/var control function that alter the equipment response characteristic.⁵ [*Violation Risk Factor: Lower*] [*Time Horizon: Operations Planning*]

³ If verification is performed, the 10-year period as outlined in MOD-026 Attachment 1 is reset.

⁴ Ibid

⁵ 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.

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- R5.** Each Generator Owner shall provide a written response to its Transmission Planner, within 90 calendar days following receipt of a technically justified⁶ unit request from the Transmission Planner to perform a model review of a unit or plant 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 an on-site review of the equipment.
- R6.** Each Transmission Planner shall provide a written response to the Generator Owner within 90 calendar days of receiving the verified excitation control system or plant volt/var control function model information in accordance with Requirement R2 that the model is usable (meets the criteria specified in Parts 6.1 through 6.3) or is not usable.
- 6.1.** The excitation control system 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.

If the model is not usable, the Transmission Planner shall provide a technical description of why the model is not usable. [*Violation Risk Factor: Medium*] [*Time Horizon: Operations Planning*]

C. Measures

- M1.** The Transmission Planner must have and provide the dated request for instructions or data, the transmitted instructions or data, and dated evidence of a written transmittal (e.g., electronic mail message, postal receipt, or confirmation of facsimile) as evidence that it provided the request within 90 calendar days in accordance with Requirement R1.
- M2.** The Generator Owner must have and provide dated evidence it verified each generator excitation control system or plant volt/var control function model according to Part 2.1 for each applicable unit and a dated transmittal (e.g., electronic mail message, postal receipt, or confirmation of facsimile) as 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

⁶ 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.

of transmittal (e.g., electronic mail message, postal receipt, or confirmation of facsimile) of the response.

- M4.** Evidence for Requirement R4 must include, for each of the Generator Owner's applicable units for which system changes specified in Requirement R4 were made, a dated revised model data or plans to perform a model verification and dated evidence (e.g., electronic mail message, postal receipt, or confirmation of facsimile) it provided the revised model and data or plans within 180 calendar days of making changes.
- M5.** Evidence for Requirement R5 must include the Generator Owner's dated written response containing the information identified in Requirement R5 and dated evidence (e.g., electronic mail message, postal receipt, or confirmation of facsimile) 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 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 (e.g., electronic mail message, postal receipt, or confirmation of facsimile) 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

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 three calendar years from the date the document was provided.

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- The Generator Owner shall retain the latest excitation control system 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 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

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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 less than or equal to 120 calendar days of receiving a written request. | The Transmission Planner provided the instructions and data to the Generator Owner more than 120 calendar days but less than or equal to 150 calendar days of receiving a written request. | The Transmission Planner provided the instructions and data to the Generator Owner more than 150 calendar days but less than or equal to 180 calendar days of receiving a written request. | The Transmission Planner failed to provide the instructions and data to the Generator Owner within 180 calendar days of receiving a written request. |
| R2 | <p>The Generator Owner provided its verified model(s), including documentation and data to its Transmission Planner after the timeframe specified in MOD-026 Attachment 1 but less than or equal to 90 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, Parts 2.1.1 through 2.1.6.</p> | <p>The Generator Owner provided its verified model(s), including documentation and data to its Transmission Planner more than 90 calendar days but less than or equal to 180 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, Parts 2.1.1 through 2.1.6.</p> | <p>The Generator Owner provided its verified model(s), including documentation and data to its Transmission Planner more than 180 calendar days but less than or equal to 270 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, Parts 2.1.1 through 2.1.6.</p> | <p>The Generator Owner provided its verified model(s), including documentation and data more than 270 calendar days late 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, Part 2.1.</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner verified model(s) but omitted four or more of the six parts identified in Requirement R2, Subparts 2.1.1 through 2.1.6.</p> |

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| R # | Lower VSL | Moderate VSL | High VSL | Severe VSL |
|-----------|--|--|--|--|
| R3 | The Generator Owner provided a written response more than 90 calendar days but less than or equal to 120 calendar days of receiving written notice. | The Generator Owner provided a written response more than 120 calendar days but less than or equal to 150 calendar days of receiving written notice. | The Generator Owner provided a written response more than 150 calendar days but less than or equal to 180 calendar days of receiving written notice. | The Generator Owner failed to provide a written response within 180 calendar days of receiving written notice. OR 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 less than or equal to 210 calendar days of making changes to the excitation control system or plant volt/var control function that altered the equipment response characteristic. | The Generator Owner provided revised model data or plans to perform model verification more than 210 calendar days but less than or equal to 240 calendar days of making changes to the excitation control system or plant volt/var control function that altered the equipment response characteristic. | The Generator Owner provided revised model data or plans to perform model verification more than 240 calendar days but less than or equal to 270 calendar days of making changes to the excitation control system or plant volt/var control function that altered the equipment response characteristic. | The Generator Owner failed to provide revised model data or failed to provide plans to perform model verification within 270 calendar days of making changes to the excitation control system or plant volt/var control function that altered the equipment response characteristic. |
| R5 | The Generator Owner provided a written response more than 90 calendar days but less than or equal to 120 calendar days to the Transmission Planner following receipt of a technically justified request to perform a model review of an applicable unit. | The Generator Owner provided a written response more than 120 calendar days but less than or equal to 150 calendar days to the Transmission Planner following receipt of a technically justified request to perform a model review of an applicable unit. | The Generator Owner provided a written response more than 150 calendar days but less than or equal to 180 calendar days to the Transmission Planner following receipt of a technically justified request to perform a model review of an applicable unit. | The Generator Owner failed to provide a written response to the Transmission Planner within 180 calendar days following receipt of a technically justified request to perform a model review of an applicable unit. OR The Generator Owner's written response failed to include one of the sub bullets of Requirement R5. |

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| 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 usable or not usable; including a technical description if the model is not usable, more than 90 calendar days but less than or equal to 120 calendar days of receiving verified model information.</p> | <p>The Transmission Planner provided a written response to the Generator Owner indicating whether the model is usable or not usable; including a technical description if the model is not usable, more than 120 calendar days but less than or equal to 150 calendar days of receiving the verified model information.</p> <p>OR</p> <p>The Transmission Planner’s written response omitted confirmation for one of the specified model criteria listed in Requirement R6, Parts 6.1 through 6.3.</p> | <p>The Transmission Planner provided a written response to the Generator Owner indicating whether the model is usable or not usable; including a technical description if the model is not usable, more than 150 calendar days but less than or equal to 180 calendar days of receiving the verified model information.</p> <p>OR</p> <p>The Transmission Planner’s written response omitted confirmation for two of the specified model criteria listed in Requirement R6, Parts 6.1 through 6.3.</p> | <p>The Transmission Planner failed to provide a written response to the Generator Owner within 180 calendar days of receiving the verified model information.</p> <p>OR</p> <p>The Transmission Planner’s written response omitted confirmation for all specified model criteria listed in Requirement R6, Parts 6.1 through 6.3.</p> |

E. Regional Variances

Western Electricity Coordinating Council (WECC)

F. Associated Documents

None.

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.) | |
| 2 | TBD | TBD | WECC Regional Variance was added. |

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

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| MOD-026 Attachment 1 | | |
|--|--|---|
| Excitation Control System or Plant Volt/Var Function Model Verification Periodicity | | |
| Row Number | Verification Condition | Required Action |
| 1 | Establishing the initial verification date for an applicable unit. (Requirement R2) | Transmit the verified model, documentation and data to the Transmission Planner on or before the Effective Date. Row 4 applies when calculating generation fleet compliance during the 10-year implementation period. See Section A5 for Effective Dates. |
| 2 | Subsequent verification for an applicable unit. (Requirement R2) | 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). |
| 3 | 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. (Requirement R2) | Transmit the verified model, documentation and data to the Transmission Planner within 365 calendar days after the commissioning date. |

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

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| MOD-026 Attachment 1 | | |
|--|--|--|
| Excitation Control System or Plant Volt/Var Function Model Verification Periodicity | | |
| Row Number | Verification Condition | Required Action |
| 6 | <p>New or existing applicable unit does not include an active closed loop voltage or reactive power control function.</p> <p>(Requirement R2)</p> | <p>Requirement 2 is met with a written statement to that effect transmitted to the Transmission Planner.</p> <p>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.</p> <p>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).</p> |
| 7 | <p>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.</p> <p>(Requirement R2)</p> | <p>Requirement 2 is met with a written statement to that effect transmitted to the Transmission Planner.</p> <p>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.</p> <p>For the definition of net capacity factor, refer to Appendix F of the GADS Data Reporting Instructions on the NERC website.</p> |

MOD-026 Attachment 1

Excitation Control System or Plant Volt/Var Function Model Verification Periodicity

| Row Number | Verification Condition | Required Action |
|--|-------------------------------|------------------------|
| <p>NOTES:</p> <p>NOTE 1: Establishing the recurring 10-year unit verification period start date: The start date is the actual date of submittal of a verified model to the Transmission Planner for the most recently performed unit verification.</p> <p>NOTE 2: Consideration for early compliance: Existing generator excitation control system or plant volt/var control function model verification is sufficient for demonstrating compliance for a 10-year period from the actual transmittal 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. | | |

Standard Development Roadmap

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

| Anticipated Actions | Anticipated Date |
|---|-------------------------|
| SAR filed | December 11, 2012 |
| Approved by WECC Standards Committee (WSC) | December 19, 2012 |
| Drafting Team Solicited | July 9, 2013 |
| Drafting Team Approved | August 8, 2013 |
| Posting 1 Open | March 13, 2014 |
| Posting 1 Closed | April 28, 2014 |
| Posting 1 Responses Posted | May 21, 2014 |
| Posting 2 Open | July 29, 2014 |
| Posting 2 Closed | August 29, 2014 |
| Posting 2 Responses Posted (Extension of time was granted by the WECC Standards Committee (WSC) on December 3, 2014.) | December 3, 2014 |
| WSC approved Posting 3 | December 3, 2014 |
| Posting 3 Open | December 10, 2014 |
| Posting 3 Closed | January 16, 2015 |
| Posting 3 Responses Posted | April 22, 2015 |
| Posting 4 Open | May 18, 2015 |
| Posting 4 Closed | June 17, 2015 |
| Meet to Respond to Comments | June 18, 2015 |
| Posting 5 Open | July 7, 2015 |
| Posting 5 Closed | August 6, 2015 |
| Meet to Respond to Comments | August 11, 2015 |
| WSC approves request for Ballot | August 12, 2015 |

Projected Dates

| | |
|---|-------------------------|
| Notice of Ballot and Standards Briefing | August 18, 2015 |
| Open Ballot Pool | August 18, 2015 |
| Standards Briefing | September 2, 2015 |
| Close Ballot Pool | September 3, 2015 |
| Open Ballot | September 16, 2015 |
| Close Ballot | October 8, 2015 |
| WSC disposition | October 29, 2015 |
| NERC Open Posting for 45-day | TBD- November 5, 2015 |
| NERC Close Posting for 45-day | TBD – December 21, 2015 |
| NERC provides comments (if any) to WECC | TBD – December 22, 2015 |
| Notice of DT Meeting – Answer NERC | TBD- December 23, 2015 |

Standard MOD-026-2 — Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions

| | |
|--|------------------------|
| Comments | |
| DT meets to answer NERC comments – if needed | TBD- January 12, 2016 |
| Documents to WECC Board | TBD – January 19, 2016 |
| WECC Board | TBD – March 2016 |
| NERC Board of Trustees | TBD |
| FERC Review | TBD |

Formatting / Measures and Compliance

This document will be reformatted to meet NERC formatting.

Implementation Plan for MODs-26 and 27 with Regional Difference / Variance

MOD-026-2 with WECC Regional Difference / Variance (MOD-26)

Verification of Models and Data for Governor Excitation Control Systems or Plant Volt/Var Control Functions

MOD-027-2 with WECC Regional Difference / Variance (MOD-27)

Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions

Prerequisite Approvals

- WECC Ballot Pool
- WECC Standards Committee
- WECC Board of Directors
- NERC Board of Trustees
- Federal Energy Regulatory Commission

Conforming Changes to Other Standards

None required.

Justification for Implementation Plan

The Effective Dates for years 0-5 reflect an estimated convergence with the hard-coded Effective Dates of the underlying standard. Years 6 and beyond smooth out compliance by adding a 75% tier between the 50% and 100% tiers of the underlying standard. The additional tier is designed to ameliorate the potential for delayed compliance between the 50% and 100% effective dates.

The proposed Regional Difference is based on the WECC Generator Model Validation Policy (Policy). As WECC participants have been voluntarily complying with the Policy for nearly a decade, the proposed Effective Dates should impose no undue surprise.

Consideration of Early Compliance

The proposed Regional Difference is based on an existing WECC Policy for which voluntary adherence has been in place for nearly a decade. Early compliance by an Applicable Entity would only enhance the exchange of information and would therefore have no foreseeable negative impact.

For those in adherence with the Policy there should be little to no change in implementation.

Retirements

Retirement of existing NERC Standards is not required.

E. Regional Variance

E.A. Regional Variance for the Western Electricity Coordinating Council

The following Interconnection-wide variance shall be applicable in the Western Electricity Coordinating Council (WECC).

- Section E.A.1 replaces Applicability Section 4.2.2 in its entirety.
- Section E.A.2 replaces Effective Date, Section 5 in its entirety.
- Section E.A.3 is added to Requirement R2.2.1.1 resulting in an additional tiered subsection. (This section would otherwise be numbered R2.2.1.1.1.)
- Section E.A.4 is added to Requirement R2.2.1 resulting in an additional subsection following Requirement R2.2.1.6. (This section would otherwise be numbered R2.2.1.7.)
- Section E.A.5 is added to Requirement R2.2.1 resulting in an additional subsection following Requirement R2.2.1.6. (This section would otherwise be numbered R2.2.1.8.)
- Section E.A.6 replaces Requirement R4 in its entirety.
- Section E.A.7 is added to the Requirement Section.
- Row 2 of the variance replaces Row 2 of MOD-026 Attachment 1 in its entirety.

E.A.1. Generation in the Western Interconnection meeting the Bulk-Electric System definition.

E.A.2. Effective Date

E.A.2.1 In those jurisdictions where regulatory approval is not required, all Requirements of this variance shall become effective on the first day of the first calendar quarter after the date this standard and its variance are approved by the NERC Board of Trustees, or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.

For all other jurisdictions:

E.A.2.2 The Effective Date for Requirements R1, R3, R4, R5 and R6 is the first day of the first calendar quarter after the date that this standard and its variance are approved, by applicable regulatory authorities, or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities (Applicable Regulatory Approval).

For Requirement R2 and Regional Variance E.A.7 only:

The Effective Date for Requirements R2 and Regional Variance E.A.7 is as follows:

E.A.2.3 For 30% of an entity's applicable-unit gross MVA, the Effective Date is the latter of either July 1, 2019, or Applicable Regulatory Approval.

Standard MOD-026-2 — Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions

- E.A.2.4** For 50% of an entity's applicable-unit gross MVA, the Effective Date is the latter of either July 1, 2020 or Applicable Regulatory Approval.
- E.A.2.5** For 75% of an entity's applicable-unit gross MVA, the Effective Date is the latter of either July 1, 2021 or Applicable Regulatory Approval.
- E.A.2.6** For 100% of an entity's applicable-unit gross MVA, the Effective Date is the latter of either July 1, 2022 or Applicable Regulatory Approval.

E.A.3. The recorded response used for Requirement R2.1.1 shall be from either of the following: [*Violation Risk Factor: Medium*] [*Time Horizon: Long-term Planning*]

- A staged test of the unit; (or)
- A measured system disturbance supported by a previously conducted staged test.

M.E.A.3. The Measure for M.E.A.3 is the same as Measure M2 for MOD-026-1, Requirement R2.

E.A.4. Where staged tests are used, verification shall include each of the following: [*Violation Risk Factor: Lower*] [*Time Horizon: Operations Planning*]

- 1) Terminal voltage;
- 2) Real power;
- 3) Reactive power;
- 4) Generator field voltage and generator field current, or exciter field voltage and exciter field current in those instances where there is no way to measure the generator field voltage, or generator field current;
- 5) Recorded signals shall have a sample rate of 30 samples per second, or higher.

M.E.A.4. The Measure for M.E.A.4 is the same as Measure M2 for MOD-026-1, Requirement R2.

E.A.5. Where measured system disturbance is used verification shall meet each of the following: [*Violation Risk Factor: Lower*] [*Time Horizon: Operations Planning*]

- 1) Input measured frequency and voltage into the model and then compare measured real and reactive power output to the modeled real and reactive power output;
- 2) Measured real and reactive power output and measured frequency and voltage shall both be recorded at either the point of interconnection or the generator's terminals;
- 3) Recorded signals shall have a sample rate of 30 samples per second or higher.

M.E.A.5. The Measure for M.E.A.5 is the same as Measure M2 for MOD-026-1, Requirement R2.

Standard MOD-026-2 — Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions

E.A.6. Each Generator Owner shall provide to its Transmission Planner, revised model data or its plans to perform model verification⁷ (in accordance with Requirement R2) for an applicable unit, within 180 calendar days of making changes to the excitation control system or plant volt/var control function that alters the equipment response characteristic, except when the change is 180 days or less in duration.⁸ [*Violation Risk Factor: Lower*] [*Time Horizon: Operations Planning*]

M.E.A.6 The Measure for M.E.A.6 is the same as Measure M4 for MOD-26-1, Requirement R4.

E.A.7. Each Generator Owner shall provide each of the following to its Transmission Planner whenever validation of the generator has not been previously performed: [*Violation Risk Factor: Lower*] [*Time Horizon: Operations Planning*]

- 1) Revised model and validation data described in E.A.4;
- 2) Documentation demonstrating the generator's open-circuit saturation;
- 3) The generator's V curve illustrating either the generator field current or exciter field current;
- 4) The rotating exciter open circuit and on-load saturation characteristics for those machines equipped with rotating exciters; (and)
- 5) Model structure and data for excitation limiters.

M.E.A.7 Each Generator Owner will have evidence that it provided to its Transmission Planner, each of the numbered items as required in Requirement E.A.7.

⁷ Ibid

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 alternations that alter excitation system equipment response, plant volt/var functions equipment addition or replacement (such as static var system, capacitor banks, individual unit excitation system, 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 4.

Violation Severity Levels for WECC Regional Variance

| E # | Lower VSL | Moderate VSL | High VSL | Severe VSL |
|--------------|---|---|---|--|
| E.A.3 | Same as MOD-026-1 R2.1.1. | Same as MOD-026-1 R2.1.1. | Same as MOD-026-1 R2.1.1. | Same as MOD-026-1 R2.1.1. |
| E.A.4 | Same as MOD-026-1 R2.1.1. | Same as MOD-026-1 R2.1.1. | Same as MOD-026-1 R2.1.1. | Same as MOD-026-1 R2.1.1. |
| E.A.5 | Same as MOD-026-1 R2.1.1. | Same as MOD-026-1 R2.1.1. | Same as MOD-026-1 R2.1.1. | Same as MOD-026-1 R2.1.1. |
| E.A.6 | The Generator Owner did not provide all of the data required in E.A.6, on any one occasion. | The Generator Owner did not provide to the Transmission Planner all of the data required in E.A.6 on any two occasions. | The Generator Owner did not provide to the Transmission Planner all of the data required in E.A.6 on any three occasions. | The Generator Owner did not provide to the Transmission Planner all of the data required in E.A.6 on any four or more occasions. |
| E.A.7 | The Generator Owner did not provide all of the data required in E.A.7, on any one occasion | The Generator Owner did not provide all of the data required in E.A.7, on any two occasions | The Generator Owner did not provide all of the data required in E.A.7, on any three occasions. | The Generator Owner did not provide all of the data required in E.A.7, on any four or more occasions. |

| MOD-026 Attachment 1 – Applicable to the Western Interconnection Only Turbine/Governor and Load Control or Active Power/Frequency Control Model Periodicity | | |
|--|--|--|
| Row Number | Verification Condition | Required Action |
| 2 | Subsequent verification for an applicable unit. (Requirement R2) | Transmit the verified model, documentation and data to the Transmission Planner on or before the 5-year anniversary of the last transmittal (per Note 2), except on notification to the Transmission Planner by the Generator Owner that the provision of the required data is unavailable due to either forced outage or pending modification to equipment, in which case, the Generator Owner will have a single one-year extension of time to provide the data. |