

### 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.
3. Revised SAR and response to comments approved by SC (June 14, 2007).
4. SDT appointed on (August 18, 2007).
5. Draft 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.

#### Proposed Action Plan and Description of Current Draft:

This is the ~~first~~third draft of the ~~this~~ standard ~~including and includes~~ Time Horizons, Data Retention, Violation Risk Factors, and Violation Severity Levels. This second posting is for a ~~45~~30-day comment ~~and successive ballot~~ period.

#### Future Development Plan:

Anticipated Actions	Anticipated Date
1. <del>Post first</del> <u>Develop responses to comments and develop third version</u> draft <del>revision of</del> standard.	<del>April–May</del> <u>August 2011– February 2012</u>
2. Post response to comments and third version draft revision of standard <u>for 30 day comment and successive ballot period.</u>	<del>July–August 2011</del> <u>February – March 2012</u>
3. <del>Post response</del> <u>Develop responses</u> to <u>successive ballot</u> comments <del>and request authorization to ballot the revised standard.</del>	<del>September–October 2011</del> <u>April – May 2012</u>
<del>4. Conduct initial ballot.</del>	<del>November 2011</del>
<del>5</del> <u>4</u> . Post response to comments.	<del>December 2011</del> <u>June 2012</u>
<del>6</del> <u>5</u> . Conduct recirculation ballot.	<del>January 2012</del> <u>June 2012</u>
7. BOT adoption.	<del>February</del> <u>July</u> 2012
8. File with regulatory authorities.	<del>March</del> <u>September</u> 2012



## A. Introduction

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

For the purpose of this standard, the following Facilities are considered, “applicable units.”<sup>3</sup>

Units or plants with an average capacity factor<sup>4</sup> greater than 5% percent over the lastmost recent three calendar years, beginning on January 1 and ending on December 31, that meet the following:

- 4.2.1 Generating units connected to the Eastern or Quebec Interconnections with the following characteristics:

**4.2.1.1** EachIndividual generating unit with a greater than 100 MVA (gross nameplate rating greater than 100 MVA,) directly connected

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<sup>1</sup> 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.

<sup>2</sup> ~~Excitation control system or plant volt/var control system:~~

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

<sup>3</sup> Applicable generating units do not include startup or standby units not normally connected to the grid.

<sup>4</sup> 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.

~~at~~ to the point of interconnection<sup>5</sup> at greater than or equal to 100 kV bulk power system.

~~•4.2.1.2~~ For each generating plant / Facility consisting of one or more units that are connected to the bulk power system at a common bus with a total generation greater than 100 MVA (gross aggregate nameplate rating ~~greater than to 100 MVA, connected at the same point of interconnection at greater than or equal to 100 kV~~);

- ~~o~~ Each individual generating unit with a greater than 20 MVA (gross nameplate rating ~~greater than 20 MVA~~); and
- ~~o~~ The remainder of the plant as an aggregate.
- ~~o~~ Each generating plant / Facility comprised consisting of individual generating units less than 20 MVA (gross nameplate ratings)

4.2.2 Generating units connected to the Western Interconnection with the following characteristics:

~~•4.2.2.1~~ Each individual generating unit with a greater than 75 MVA (gross nameplate rating ~~greater than 75 MVA~~), directly connected ~~at~~ to the point of interconnection<sup>3</sup> at greater than or equal to 100 kV bulk power system.

~~•4.2.2.2~~ For each generating plant / Facility consisting of one or more units that are connected to the bulk power system at a common bus with a total generation greater than 75 MVA (gross aggregate nameplate rating ~~greater than 75 MVA, connected at the same point of interconnection with at greater than or equal to 100 kV~~);

- ~~o~~ Each individual generating unit with a gross nameplate greater than 20 MVA; (gross nameplate rating); and
- ~~o~~ The remainder of the plant as an aggregate.
- ~~o~~ Each generating plant / Facility comprised consisting of individual generating units less than 20 MVA (gross nameplate ratings)

4.2.3 Generating units connected to the ERCOT Interconnection with the following characteristics:

~~•4.2.3.1~~ Each individual generating unit with a greater than 50 MVA (gross nameplate rating ~~of greater than 50 MVA~~), directly connected ~~at~~ to the point of interconnection<sup>3</sup> with rating greater than or equal to 100 kV bulk power system.

~~•4.2.3.2~~ For each generating plant / Facility consisting of one or more units that are connected to the bulk power system at a common bus with a

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<sup>5</sup> ~~The common transmission bus voltage level at which the generator step-up transformer is connected.~~

~~total generation greater than 75 MVA (gross aggregate nameplate rating of greater than 75 MVA, connected at the same point of interconnection at greater than or equal to 100 kV):~~

- ~~o Each individual generating unit with a gross nameplate greater than 20 MVA; (gross nameplate rating); and~~
- ~~o The remainder of the plant as an aggregate.~~
- o Each generating plant / Facility comprised consisting of individual generating units less than 20 MVA (gross nameplate ratings)

**4.2.4** For all ~~interconnections:~~Interconnections:

- Any registered technically justified<sup>6</sup> unit requested by the Planning Coordinator.

**5. Effective Date:**

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

**5.1.1** ~~By~~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 applicable regulatory approval~~;~~.

~~•~~**5.1.2** 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 the first calendar quarter, four years following applicable regulatory approval.

- ~~•~~Each ~~responsible entity~~Generator Owner shall ensure ~~compliance at~~ least 50 percent of its applicable units per Interconnection on an MVA basis are compliant with ~~Requirements R1, and R3 through R6.~~

~~5.1.25.1.3~~ ByRequirement R2 by the first day of the first calendar quarter, six years following applicable regulatory approval:

- ~~•~~Each Generator Owner shall ensure ~~at least 50%~~100 percent of its applicable units ~~per Interconnection on an MVA basis~~ are compliant with Requirement R2~~;~~.

~~5.1.35.1.4~~ Byby the first day of the first calendar quarter, ten years following applicable regulatory approval:

- ~~•~~Each Generator Owner shall ensure ~~100% of its applicable units are~~ compliant with Requirement R2.

**5.2.** In those jurisdictions where no regulatory approval is required:

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<sup>6</sup> ~~A technical~~Technical justification for verifying each of those units or plant(s) that demonstrates through simulation and/or measured response that the unit or plant affects a stability limit, or evidence is achieved by demonstrating that the simulated unit or plant response does not match the measured unit or plant response.

~~5.2.1~~ ~~By~~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~~;~~.

~~•5.2.2~~ 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 the first calendar quarter, four years following Board of Trustees adoption.

- ~~•~~ ~~Each responsible entity shall ensure compliance with Requirements R1, and R3 through R6.~~

~~5.2.2~~ ~~By the first day of the first calendar quarter, six years following Board of Trustees adoption:~~

~~•5.2.3~~ 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 Board of Trustees adoption.

~~5.2.3~~ ~~By the first day of the first calendar quarter, ten years following Board of Trustees adoption:~~

~~•5.2.4~~ 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.

## ~~6. — Consideration for Early Compliance~~

~~6.1. Existing excitation control system and plant volt/var control<sup>†</sup> model verification is sufficient for demonstrating compliance for a ten-year period from the actual verification date if:~~

- ~~• The Generator Owner has a verified model that is compliant with the applicable regional entity policies, guidelines or criteria existing at the time of model verification (provided the model verification addresses the same unit criteria and the same information as required by this standard), or~~
- ~~• The Generator Owner has an existing verified model that is compliant with the requirements of this standard.~~

## B. Requirements

**R1.** Each Transmission Planner shall provide the following instructions and model data to its requesting Generator Owner within ~~3090~~ calendar days of receiving ~~the~~ request ~~from its Generator Owner~~ for those instructions and/or model data: [*Violation Risk Factor: Lower*] [*Time Horizon: ~~Long-term~~Operations Planning*];

- Instructions on how to obtain the list of ~~acceptable~~ excitation control system and plant volt/var control<sup>†</sup> function model models 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 plant volt/var control<sup>+</sup> function ~~system~~ model library block diagrams and/or data sheets.
  - ~~Any~~ Model data for any of the Generator Owner's existing unit or plant specific excitation control system and plant volt/var control<sup>+</sup> ~~model data 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 plant volt/var control<sup>+</sup> function model ~~(for each of its applicable Facilities)~~ 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 ~~subject to the following:~~ [Violation Risk Factor: ~~Lower~~Medium] [Time Horizon: Long-term Planning]
- 2.1.** ~~Each Generator Owner shall perform its~~ Perform verifications ~~with~~ using one or more models acceptable to ~~it~~ the Transmission Planner that ~~collectively~~ include(s) the following information:
- 2.1.1.** Documentation demonstrating the ~~unit or plant's~~ applicable unit's model response matches the recorded response for a voltage excursion at the ~~generator or plant~~ 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 plant volt/var control<sup>+</sup> ~~system~~ function installed (such as static, ~~ac~~ AC brushless, ~~dc~~ DC rotating, volt/var ~~system~~ function).
  - 2.1.3.** ~~Generator (or plant equivalent) model~~ Model structure and data (such as reactance, time constants, saturation factors, rotational inertia, or equivalent data) for the generator (or plant equivalent).
  - 2.1.4.** ~~Excitation~~ Model structure and data for the excitation control system ~~and~~ for the plant volt/var ~~system model structure~~ function, and ~~data~~ for the closed loop voltage regulator if the closed loop voltage regulator is installed.
  - 2.1.5.** Compensation settings (such as droop, line drop, differential compensation), if used.
  - 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 ~~that contains~~ 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, ~~a list of future or the~~ model changes, or a plan to perform model verification<sup>7</sup> ~~to its Transmission Planner within 90 calendar days of receiving notice of one of the following (in accordance with Requirement R2)~~ [Violation Risk Factor: Lower] [Time Horizon: ~~Long-term Operations Planning~~]:

- Written notification, ~~including a technical description~~ from its Transmission Planner ~~of why (in accordance with Requirement R6) that~~ the excitation control system and plant volt/var control<sup>+</sup> ~~system~~ function model is not “usable” ~~as identified in Requirement R6, Parts 6.1 through 6.3 criteria;”~~ or
- Written comments from its Transmission Planner identifying technical concerns with the verification documentation related to the excitation control system and plant volt/var control<sup>+</sup> ~~system~~ function model, or
- Written comments and supporting evidence from its Transmission Planner indicating that the predicted excitation control system and plant volt/var control<sup>+</sup> function model response did not match the recorded response to a transmission system event.

**R4.** Each Generator Owner shall provide revised model data or plans to perform model verification<sup>7</sup> ~~(in accordance with Requirement R2)~~ to its Transmission Planner within 180 calendar days of making changes to the excitation control system and plant volt/var control<sup>+</sup> ~~system function~~ that alter the equipment response<sup>8</sup> characteristic. [Violation Risk Factor: Lower] [Time Horizon: ~~Long-term Operations Planning~~]

**R5.** Each Generator Owner shall provide a written response to its Planning Coordinator, ~~within 90 calendar days~~ following receipt of a technically justified request ~~from the Planning Coordinator~~ to perform a model review of ~~a any~~ unit/plant ~~not included in the Applicability~~ that ~~meets~~ ~~includes one of~~ the following: [Violation Risk Factor: Lower] [Time Horizon: ~~Long-term Operations Planning~~]:

~~5.1. Submit within 90 calendar day’s receipt~~ ~~Details~~ of ~~the technically justified~~<sup>4</sup> request:

- ~~Either indicate~~ plans to verify the model ~~or identify (in accordance with Requirement R2)~~

~~5.2. Corrected model data including~~ the source of revised model data such as:

- ~~Discovery~~ ~~discovery~~ of manufacturer test values to replace generic model data:
- ~~Updating or updating of~~ data parameters based on a walk down of the equipment.

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<sup>7</sup> If verification is performed, the 10 year period as outlined in Attachment 1 is reset.

<sup>8</sup> 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.



~~5.3. Include corrected~~ Each Transmission Planner shall notify the Generator Owner within 90 calendar days of receiving the verified excitation control system and plant volt/var control<sup>+</sup> function model ~~data~~.

R6. ~~Each Transmission Planner shall determine if the verified generator excitation control system and plant volt/control<sup>+</sup> model received information whether the model is useable (meets the criteria identified in Requirement R6 specified in Parts 6.1 through 6.3 and provide a written response to the Generator Owner indicating whether the model is useable), or is not useable; including and shall include a technical description if the model is not useable. This written response shall be submitted within 90 calendar days of receiving the excitation control system and plant volt/var control<sup>+</sup> verified model information. [Violation Risk Factor: ~~Lower~~Medium] [Time Horizon: ~~Long-term~~Operations Planning]~~

6.1. The excitation control system and plant volt/var control<sup>+</sup> function model ~~can initialize~~initializes to compute modeling data without error.

6.2. A no-disturbance simulation results in negligible transients.

6.3. For an otherwise stable simulation, a disturbance simulation results in the excitation control and plant volt/var control<sup>+</sup> ~~system function~~ model exhibiting positive damping.

### C. Measures

M1. ~~Each Transmission Planner shall have evidence to show that it provided~~ Evidence for Requirement R1 must include the transmitted instructions or data and dated evidence of transmission of requested instructions and data ~~(, such as dated electronic mail messages or mail, dated postal receipts) within 30 calendar days of receiving a request as specified in Requirement R1, dated confirmation of facsimile transmission.~~

~~M2. Each Generator Owner shall have evidence (such as a dated electronic mail messages or mail receipts) including~~ Evidence for Requirement R2 must include, for each of the Generator Owner's applicable Facilities, the verification report ~~to show~~showing that it ~~provided the verified~~ generator excitation control system ~~or and~~ plant volt/var control<sup>+</sup> function model as specified in Requirement R2.

~~M3.M2. Each Generator Owner shall have~~ was verified and dated evidence ~~to show that it provided a written response (of transmission, such as a dated copy of the response, or dated electronic mail messages or mail, dated postal receipts) containing identified information and submitted within 90 calendar days, or dated confirmation of receiving any written notification~~facsimile transmission as specified in Requirement ~~R3.R2~~.

~~M3. Each~~ Evidence for Requirement R3 must include the Generator Owner shall have evidence to show that it provided a Owner's dated written response ~~(containing the information identified in Requirement R3 and dated evidence of transmittal, such as a dated copy of the request, or dated electronic mail messages or mail, dated postal receipts) submitted within 180 calendar days, or dated confirmation of making~~facsimile transmission.

M4. Evidence for Requirement R4 must include, for each of the Generator Owner's Facilities for which system changes specified in Requirement R4 were made, dated

revised model data or dated plans to perform a model verification and dated evidence of transmittal, such as dated electronic mail messages, dated postal receipts, or dated confirmation of facsimile transmittal.

~~M5. Each Generator Owner shall have evidence to show that it provided a written response (Evidence for Requirement R5 must include, for each request received as specified in Requirement R5, the dated written response provided and dated evidence of transmittal, such as dated electronic mail messages, dated postal receipts, or dated confirmation of facsimile transmittal.~~

~~M5. Evidence of Requirement R6 must include, for each model received, the dated response containing the information required in Parts 6.1 through 6.3 and dated evidence of transmittal, such as dated electronic mail messages or mail receipts) and submitted within 90 calendar days of receiving the request as specified in Requirement R5.~~

~~M6. Each Transmission Planner shall have evidence to show that it provided a written response (such as dated electronic mail messages or mail, dated postal receipts) within 90 calendar days of receiving the model as specified in Requirement R6, or dated confirmation of facsimile transmittal.~~

## D. Compliance

### 1. Compliance Monitoring Process

#### 1.1. Compliance Enforcement Authority

Regional Entity

#### 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 calendar years from the date the document was provided.
- The Generator Owner shall retain the latest and previous excitation control system and plant volt/var control<sup>+</sup> system 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 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 ~~found compliant~~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 ~~Audits~~Audit

Self-~~Certifications~~Certification

Spot Checking

Compliance ~~Violation Investigations~~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 <del>lessno more than</del> <del>or equal to</del> 120 calendar days of receiving a request.	The Transmission Planner provided the instructions and data to the Generator Owner more than 120 calendar days but <del>lessno more than</del> <del>or equal to</del> 150 calendar days of receiving a request.	The Transmission Planner provided the instructions and data to the Generator Owner more than 150 calendar days but <del>lessno more than</del> <del>or equal to</del> 180 calendar days of receiving a request.	The Transmission Planner failed to provide the instructions and data to the Generator Owner within 181 calendar days of receiving a request.
R2	<p>The Generator Owner provided its verified model(s) to its Transmission Planner after the <del>periodicity</del> timeframe specified in MOD-026 Attachment 1 but <del>lessno more than</del> <del>or equal to</del> 30 calendar days late;</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner verified <del>model(s)</del> <del>models</del> that omitted one of the six Parts identified in Requirement R2, <del>PartsSubparts</del> 2.1.1 through 2.1.6.</p>	<p>The Generator Owner provided its verified model(s) to its Transmission Planner more than 30 calendar days but <del>lessno more than</del> <del>or equal to</del> 60 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 <del>model(s)</del> <del>models</del> that omitted two of the six Parts identified in Requirement R2, <del>PartsSubparts</del> 2.1.1 through 2.1.6.</p>	<p>The Generator Owner provided its verified model(s) to its Transmission Planner more than 60 calendar days but <del>lessno more than</del> <del>or equal to</del> 90 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 <del>model(s)</del> <del>models</del> that omitted three of the six Parts identified in Requirement R2, <del>PartsSubparts</del> 2.1.1 through 2.1.6.</p>	<p>The Generator Owner <del>failed to provide the</del> <del>provided its</del> verified generator excitation control system <del>and</del> plant volt/var control <del>function</del> <del>model(s)</del> <del>more than 90 calendar days late</del> or failed to provide the verified model(s) <del>no more than 90 calendar days late</del> 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, <del>PartSubpart</del> 2.1.</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner verified model(s) that omitted four or more of</p>

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				the six Parts identified in Requirement R2, <del>Parts</del> <u>Subparts</u> 2.1.1 through 2.1.6.
<b>R3</b>	The Generator Owner provided a written response more than 90 calendar days but <del>lessno more</del> <u>more</u> than <del>or equal to</del> 120 calendar days of receiving <u>written</u> notice. (R3)	The Generator Owner provided a written response more than 120 calendar days but <del>lessno more</del> <u>more</u> than <del>or equal to</del> 150 calendar days of receiving <u>written</u> notice. (R3)	The Generator Owner provided a written response more than 150 calendar days but <del>lessno more</del> <u>more</u> than <del>or equal to</del> 180 calendar days of receiving <u>written</u> notice. (R3)	The Generator Owner failed to provide a written response within 181 calendar days of receiving <u>written</u> notice <del>as specified in Requirement (R3-)</del> .  OR  The Generator Owner's written response was provided within 181 calendar days of receiving written notice however, <u>the Generator Owner's written response</u> failed to contain either the technical basis for maintaining the current model, or a list of future model changes, or a plan to perform <u>another</u> model verification.
<b>R4</b>	The Generator Owner provided revised model data or plans to perform model verification more than 180 calendar days but <del>lessno more</del> <u>more</u> than <del>or equal to</del> 210 calendar days of making changes to the excitation control system <del>or and</del> <u>and</u> plant volt/var control <sup>+</sup> <del>system</del> <u>function</u> 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 <del>lessno more</del> <u>more</u> than <del>or equal to</del> 240 calendar days of making changes to the excitation control system <del>or and</del> <u>and</u> plant volt/var control <sup>+</sup> <del>system</del> <u>function</u> 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 <del>lessno more</del> <u>more</u> than <del>or equal to</del> 270 calendar days of making changes to the excitation control system <del>or and</del> <u>and</u> plant volt/var control <sup>+</sup> <del>system</del> <u>function</u> 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 calendar days of making changes to the excitation control system <del>or and</del> <u>and</u> plant volt/var control <sup>+</sup> <del>system</del> <u>function</u> that altered the equipment response characteristic <del>as specified in Requirement (R4-)</del> .
<b>R5</b>	The Generator Owner provided a written response more than 90 calendar days but <del>lessno more</del> <u>more</u> than <del>or equal to</del> 120 calendar days to	The Generator Owner provided a written response more than 120 calendar days but <del>lessno more</del> <u>more</u> than <del>or equal to</del> 150 calendar days to the	The Generator Owner provided a written response more than 150 calendar days but <del>lessno more</del> <u>more</u> than <del>or equal to</del> 180 calendar days to the	The Generator Owner failed to provide a written response to the Planning Coordinator following receipt of a technically justified

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	<p>the Planning Coordinator following receipt of a technically justified request to perform a model review of a unit/plant. (R5)</p>	<p>Planning Coordinator following receipt of a technically justified request to perform a model review of a unit/plant. (R5)</p>	<p>Planning Coordinator following receipt of a technically justified request to perform a model review of a 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, <u>PartSubpart 5.2</u> or Part 5.3.</p>	<p>request to perform a model review of a unit/plant <del>as specified in Requirement R5-(R5).</del></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, <u>PartsSubparts 5.2</u> and 5.3.</p>
<p><b>R6</b></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 90 calendar days but less than 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 120 calendar days but less than 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 the written response omitted confirmation for one of the specified model criteria listed in Requirement R6, <u>PartsSubparts 6.1</u> 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 150 calendar days but less than 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 the written response omitted confirmation for two of the specified model criteria listed in Requirement R6, <u>PartsSubparts 6.1</u> through 6.3.</p>	<p>The Transmission Planner failed to provide a written response to the Generator Owner within 181 calendar days of receiving the verified model information <del>as specified in Requirement R6-(R6).</del></p> <p>OR</p> <p>The Transmission Planner provided a written response within 181 calendar days to the Generator Owner however the written response omitted confirmation for all specified model criteria listed in Requirement R6, <u>PartsSubparts 6.1</u> through 6.3.</p>

E. Regional Variances

None.

F. Associated Documents

Version History

Version	Date	Action	Change Tracking

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. ~~A. Ellis, M. Asmine, J. Brochu, J. Fortmann, R. Gagnon, Y. Kazachkov, C.-E. Langlois, C. Larose, E. Muljadi, J. MacDowell, P. Pourbeik, J.J. Sanchez-Gasca, Working Group Joint Report — WECC Working Group on Dynamic Performance of S. A. Seman, and K. Wiens, “Model Validation for Wind Turbine Generator Models”, IEEE Transactions on Power Generation and IEEE Working Group on Dynamic Performance of Wind Power Generation, Description and Technical Specifications for Generic WTG models — A Status Report, IEEE PES General Meeting System, Volume 26, Issue 3, August 2011, Detroit, MI, July 24-28~~
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. ~~ODP~~. 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 ~~or~~and Plant Volt/~~VA~~Var Function Model Verification Periodicity**

~~Note that local grid codes may specify shorter time frames.~~

Facility	Condition	Periodicity <u>Determination Supporting Criteria</u>
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<p>Existing Generating Unit</p>	<p><del>During the eleven calendar year (January–December) transition period and no exceptions apply.</del></p> <p><b>OR</b></p> <p><del>During the ten calendar year (January–December) period and no exceptions apply.</del></p>	<p><del>A recorded response for a voltage excursion shall be collected during a</del> <b><u>Criteria 1: Establishing the Initial Ten Year Unit Verification Period Start Date:</u></b></p> <p><b><u>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 year (January–December) transition period and in accordance with the following rules:</u></b></p> <ul style="list-style-type: none"> <li><b><u>• 30 percent of the applicable units in the generation fleet unit MVA is compliant within the first 4 years.</u></b></li> <li><b><u>• 50 percent of the applicable units in the generation fleet unit MVA is compliant within the first 6 years.</u></b></li> <li><b><u>• 100 percent of the applicable units in the generation fleet unit MVA is compliant within the first 10 years.</u></b></li> </ul> <p><b><u>Criteria 2: Establishing the Recurring Ten Year Unit Verification Period Start Date:</u></b></p> <p><b><u>The start date is the actual data collection date for the most recently performed applicable unit verification.</u></b></p> <p><b><u>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.</u></b></p> <p><b><u>Consideration for Early Compliance</u></b></p> <p><b><u>Existing excitation control system and plant volt/var control function model verification is sufficient for demonstrating compliance for a ten year period from the effective date actual verification date if either of the following applies:</u></b></p> <ul style="list-style-type: none"> <li><b><u>• 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</u></b></li> <li><b><u>• The Generator Owner has an existing verified model that is compliant with the requirements of this standard with the verified model and documentation transmitted to the Transmission Planner no more than 365 days from the date that the recorded response was collected.</u></b></li> </ul>
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Existing Generating Unit	<p><del>During the eleven calendar year (January–December) transition period.</del></p> <p><b>OR</b></p> <p><del>During the ten calendar year (January–December) period.</del></p> <p><b>AND</b></p> <p><del>The following exception applies:</del></p> <ul style="list-style-type: none"> <li><del>1) Multiple units have the same MVA nameplate rating that are <math>\leq</math> 350 MVA</del></li> <li><del><b>AND</b></del></li> <li><del>2) The same multiple units have identical applicable components and settings</del></li> <li><del><b>AND</b></del></li> <li><del>3) The same multiple units are sited at the same physical location</del></li> <li><del><b>AND</b></del></li> <li><del>4) The model for one of these equivalent units has been verified.</del></li> </ul>	Not Required (however, perform verification on a different unit each ten calendar year cycle).
Existing Generating Unit	Installation of new excitation control system equipment.	A recorded response for a voltage excursion shall be collected and the verified model and documentation transmitted to the Transmission Planner no more than 180 days from the new equipment commissioning date.
Existing Generating Unit	Subjected to an activity resulting in an alteration of the response of the	A recorded response for a voltage excursion shall be collected within 365

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	<del>excitation control system.</del>	<del>days of settings or software changes with the verified model and documentation transmitted to the Transmission Planner no more than 180 calendar days from the date that the recorded response was collected.</del>
Existing Generating Unit	<del>Receive written comments including dated electronic or hard copy evidence indicating that the recorded excitation control system response to a Transmission System event did not match the predicted excitation control system model response.</del>	<del>A recorded response for a voltage excursion shall be collected within 365 days of a written response by the Generator Owner committing to perform model verification with the verified model and documentation transmitted to the Transmission Planner no more than 180 calendar days from the date that the recorded response was collected.</del>
Existing Generating Unit	<del>A model verification plan submitted as a result of a review requested by the Planning Coordinator for an existing Generating Unit.</del>	<del>A recorded response for a voltage excursion shall be collected within 365 days of the submission of a plan to perform model verification as a result of a request for a review from the Planning Coordinator with the verified model and documentation specified in transmitted to the Transmission Planner no more than 180 calendar days from the date that the recorded response was collected.</del>
New or Existing Generator Unit	<del>Excitation control system model identified as unusable by the Transmission Planner.</del> <b>OR</b> <del>Receive written comments detailing technical concerns with the Generator Owner's excitation control system model verification</del>	<del>A recorded response for a voltage excursion shall be collected within 365 days of a written response by the Generator Owner committing to perform model verification with the verified model and documentation transmitted to the Transmission Planner no more than 180 calendar days from the date that the</del>

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	<del>documentation.</del>	<del>recorded response was collected.</del>
New Generating Unit	New unit installed	A recorded response for a voltage excursion shall be collected and the verified model and documentation transmitted to the Transmission Planner no more than 180 calendar days of the unit commercial operating date.

<u>Event Triggering Verification</u>	<u>Verification Periodicity</u>	<u>Comments</u>
<u>Establishing the initial verification period (Criteria 1) for an applicable unit (Requirement R2)</u>	<u>Record and collect excitation control system and plant volt/var control response validation data on or before the initial start date per Criteria 1</u>	<u>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.</u>  <u>Criteria 3 applies when calculating generation fleet compliance during the 10-year transition period</u>
<u>Subsequent verification for an existing applicable unit (Requirement R2)</u>	<u>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.</u>	<u>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.</u>
<u>Initial verification for a new applicable unit or for an existing applicable unit with new excitation control system and plant volt/var control function</u>	<u>Record and collect excitation control system and plant volt/var control</u>	<u>Transmit the verified model and documentation and data to the</u>

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<u>Event Triggering Verification</u>	<u>Verification Periodicity</u>	<u>Comments</u>
<p><u>equipment installed with settings final</u> <u>(Requirement R2)</u></p>	<p><u>function response validation data no more than 356 days from the commissioning date</u></p>	<p><u>Transmission Planner no more than 180 calendar days from the date that the recorded response was collected.</u></p>
<p><u>Existing applicable unit that is equivalent to another operating unit(s) at the same physical location.</u> <u>AND</u> <u>Each equivalent unit has the same MVA nameplate rating.</u> <u>AND</u> <u>The nameplate rating is ≤ 350 MVA.</u> <u>AND</u> <u>Each equivalent unit has identical applicable components and settings.</u> <u>AND</u> <u>The model for one of these equivalent units has been verified.</u> <u>(Requirement R2)</u></p>	<p><u>Verify a different equivalent unit during each ten year verification period.</u></p>	<p><u>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.</u></p> <p><u>Criteria 3 applies when calculating generation fleet compliance during the 10-year transition period.</u></p>
<p><u>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</u> <u>AND</u> <u>The Generator Owner has submitted a verification plan.</u> <u>(Requirement R4)</u></p>	<p><u>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.</u></p>	<p><u>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.</u></p>
<p><u>The Generator Owner receives written comments including dated electronic or hard copy evidence indicating that the recorded excitation control system and</u></p>	<p><u>Record and collect excitation control system and plant volt/var control</u></p>	<p><u>Transmit the verified model and documentation and data to the</u></p>

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<u>Event Triggering Verification</u>	<u>Verification Periodicity</u>	<u>Comments</u>
<p><u>plant volt/var response to a transmission system event did not match the predicted excitation control system model response.</u></p> <p><u>AND</u></p> <p><u>The Generator Owner has submitted a verification plan.</u></p> <p><u>(Requirement R3)</u></p>	<p><u>response validation data no more than 365 calendar days from the date of the submitted verification plan.</u></p>	<p><u>Transmission Planner no more than 180 calendar days from the date that the recorded response was collected.</u></p>
<p><u>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.</u></p> <p><u>AND</u></p> <p><u>The Generator Owner has submitted a verification plan</u></p> <p><u>(Requirement R3)</u></p>	<p><u>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.</u></p>	<p><u>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.</u></p>
<p><u>The excitation control system and volt/var control model are identified as unusable by the Transmission Planner.</u></p> <p><u>AND</u></p> <p><u>The Generator Owner has submitted a verification plan.</u></p> <p><u>(Requirement R3)</u></p>	<p><u>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.</u></p>	<p><u>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.</u></p>
<p><u>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.</u></p> <p><u>AND</u></p> <p><u>The Generator Owner has submitted a verification plan.</u></p> <p><u>(Requirement R5)</u></p>	<p><u>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.</u></p>	<p><u>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.</u></p>
<p><u>New or existing applicable unit does not include active closed loop function.</u></p>	<p><u>Not required until unit has an installed control system</u></p>	<p><u>Document circumstance with a written statement</u></p>



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<u>Event Triggering Verification</u>	<u>Verification Periodicity</u>	<u>Comments</u>
		<u>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.</u>