

A. Introduction

1. **Title:** Verification of Models and Data for Generator Excitation System Functions
2. **Number:** MOD-026-1
3. **Purpose:** To verify that the excitation system model (including power system stabilizer model and impedance compensator model if so installed) and the model parameters used in dynamic simulations that assess Bulk Electric System (BES) reliability accurately represent generator excitation system behavior.
4. **Applicability:**

4.1. Functional entities

4.1.1 Generator Operators of generating facilities:

4.1.1.1 Connected to Eastern or Quebec Interconnections with the following characteristics:

Each unit (including synchronous condensers) ≥ 100 MVA, connected at the point of interconnection at 100 kV or above and with an average Capacity Factor greater than 5% over the last three calendar years.

Each unit (including synchronous condensers) ≥ 20 MVA within a plant ≥ 200 MVA, connected at the point of interconnection at 100 kV or above and with an average Capacity Factor greater than 5% over the last three calendar years.

4.1.1.2 Connected to Western Interconnection with the following characteristics:

Each unit (including synchronous condensers) ≥ 75 MVA, connected at the point of interconnection at 100 kV or above and with an average Capacity Factor greater than 5% over the last three calendar years.

Each unit (including synchronous condensers) ≥ 20 MVA within a plant ≥ 150 MVA, connected at the point of interconnection at 100 kV or above and with an average Capacity Factor greater than 5% over the last three calendar years.

4.1.1.3 Connected to ERCOT Interconnection with the following characteristics:

Each unit (including synchronous condensers) ≥ 50 MVA, connected at the point of interconnection at 100 kV or above and with an average Capacity Factor greater than 5% over the last three calendar years.

Each unit (including synchronous condensers) ≥ 20 MVA within a plant ≥ 100 MVA, connected at the point of interconnection at 100 kV or above and with an average Capacity Factor greater than 5% over the last three calendar years.

4.1.2 Transmission Planners.

Proposed Effective Date:

In those jurisdictions where regulatory approval is required:

- By the first day of the first calendar quarter, two years following applicable regulatory approval:
 - Each Generator Operator shall verify at least 10% of its applicable units per Interconnection on a MVA basis.
- By the first day of the first calendar quarter, six years following applicable regulatory approval:
 - Each Generator Operator shall verify at least 50% (this includes the units verified in the first year) of its applicable units per Interconnection on a MVA basis.
- By the first day of the first calendar quarter, eleven calendar years following applicable regulatory approval:
 - Each Generator Operator shall verify 100% of its applicable units.

In those jurisdictions where no regulatory approval is required:

- By the first day of the first calendar quarter, two years following Board of Trustees adoption:
 - Each Generator Operator shall verify at least 10% of its applicable units per Interconnection on a MVA basis.
- By the first day of the first calendar quarter, six years following Board of Trustees adoption:
 - Each Generator Operator shall verify at least 50% (this includes the units verified in the first year) of its applicable units per Interconnection on a MVA basis.
- By the first day of the first calendar quarter, eleven calendar years following Board of Trustees adoption:
 - Each Generator Operator shall verify 100% of its applicable units.

B. Requirements

R1. The Generator Operator shall verify the excitation system model (including power system stabilizer model and impedance compensator model if so installed) which represents generator excitation system behavior in dynamic simulations per the following schedules:

- 1) For a new or existing unit with a new excitation system, within 180 days of the commercial operation date or new equipment commissioning date, whichever occurs first.
- 2) For an existing unit, once in a ten calendar year period. If multiple units have the same MVA rating that is ≤ 250 MVA, and if they have identical applicable components and settings and are sited at the same physical location, verification of one unit is sufficient for all units. Verification shall be performed on a different unit each ten calendar year cycle.
- 3) If verification cannot be performed within the ten year period because a unit has not been on-line, the ten year period shall be extended. It is permissible to wait until the unit is scheduled to operate in order to conduct verification so that sufficient

advance notice to make arrangements for verification is available. After verification is performed, the subsequent ten year schedule for the next verification will start.

- 4) For units that reach an average Capacity Factor greater than 5% over the last three calendar years, and have not been verified within the last ten calendar years, verification shall be performed within the next calendar year. The subsequent ten year schedule will start upon a successful verification.
- R2.** The Transmission Planner shall provide the Generator Operator a set of model data sheets for the acceptable excitation system models (models cannot be confidential or proprietary) for use in dynamic simulation software, with each data sheet including the excitation system model block diagram structure and data requirements, within 30 calendar days of a request from the Generator Operator.
- R3.** The Transmission Planner shall provide the Generator Operator the unit specific data contained in the Transmission Planner's dynamic database from the current in-use excitation system model, within 30 calendar days of a request from the Generator Operator.
- R4.** The Generator Operator shall provide to the Transmission Planner the following unit specific information within 90 calendar days of completion of the excitation system model verification:
- 1) Manufacturer, model number if available, and type of excitation system (for example: static, ac brushless, dc rotating).
 - 2) Generator model structure and data (reactances, time constants, saturation factors, rotational inertia)
 - 3) Excitation system model structure and data for the closed loop voltage regulator (including main exciter if so equipped).
 - 4) Reactive compensation settings (for example: reactive droop, line drop, differential compensation), if utilized.
 - 5) Model structure and data for power system stabilizer, if so equipped.
- R5.** The Transmission Planner shall determine if the excitation system model is useable by including the excitation system model in dynamic simulation software and substantiating that:
- 1) A no-disturbance simulation contains no transients.
 - 2) For an otherwise stable simulation, a disturbance simulation results in the equipment exhibiting positive damping.
- R6.** The Transmission Planner shall inform the Generator Operator whether the excitation system model is useable or not within 90 calendar days of receipt (R4). If the excitation system model is not useable, the Transmission Planner shall provide the Generator Operator with a description of the problem and any relevant details.

Standard MOD-026-1 — Verification of Models and Data for Generator Excitation System Functions

- R7.** The Generator Operator shall provide a written response within 90 calendar days following notification by the Transmission Planner that the excitation system model is not useable. The Generator Operator's response shall either:
- Indicate what changes will be made to the excitation system model, or
 - Provide the technical basis why no changes will be made.
- R8.** The Generator Operator shall provide to the Transmission Planner documentation demonstrating that the excitation system model's response matches the recorded response for a voltage excursion at the generator from either a staged test or a measured system disturbance (i.e., an ambient event) within 90 calendar days of completion of the excitation system model verification.
- R9.** The Generator Operator shall make documentation demonstrating that the excitation system model's response matches the recorded response for a voltage excursion at the generator from either a staged test or a measured system disturbance (i.e., an ambient event) available for inspection and technical review to the Reliability Coordinators, Transmission Operators, and Planning Coordinators that have responsibility for the area in which the associated unit is located, within 60 calendar days after receipt of a request.
- R10.** The Generator Operator shall provide a written response within 90 calendar days after receipt of a Transmission Planner's or a Planning Coordinator's written comments detailing technical concerns with the Generator Operator's excitation system model verification documentation. That written response shall either:
- Indicate what changes will be made to the excitation system model, or
 - Provide the technical basis why no changes will be made.
- R11.** The Generator Operator shall perform a review of its current excitation system model when its Transmission Operator or Reliability Coordinator provides the Generator Operator dated electronic or hard copy evidence that the recorded excitation control system response to a Transmission system event did not match the predicted excitation system model response. Upon review the Generator Operator shall either:
- Provide a dated electronic or hard copy explanation detailing why the current excitation system model is still appropriate within 90 days to the commenter and the Transmission Planner whose area the generating facility is located in, or
 - Perform a re-verification in accordance with R4, and R8 within 180 days. Once the re-verification is performed, the 10 year period as outlined in R1 will be reset.
- R12.** The Generator Operator shall perform a review of its current excitation system model and model parameters each time an activity that may alter the equipment response is performed. An activity that potentially alters the response of the excitation system and/or power system stabilizer includes but is not limited to:
- Exciter, voltage regulator or power system stabilizer control replacement including software alterations that could alter excitation system equipment response
 - Plant Digital Control System addition or replacement

- Plant Digital Control System software alterations that could alter excitation system equipment response
- Exciter, voltage regulator, impedance compensator or power system stabilizer settings change

The Generator Operator shall either:

- Provide documentation that the response has not changed to the Transmission Planner within 90 days of completion of an activity that could have altered equipment response, or
- Perform a re-verification in accordance with Requirements R4 and R8 within 180 days. Once the re-verification is performed, the ten year period as outlined in Requirement R1 is reset.

C. Measures

M1. (To be developed.)

References

The following documents contain technical information beyond the scope of this Standard on excitation system functions, models, 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