Please **DO NOT** use this form to submit comments. Please use the electronic comment form located at the link below to submit comments on the First Posting of MOD-027-1, Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions (Project 2007-09). The electronic comment form must be completed by **July 15, 2011.**

[Project 2007-09 Generator Verification](https://www.nerc.net/nercsurvey/Survey.aspx?s=22acbce2a2474c108f49f69dadf30189)

If you have questions please contact Stephen Crutchfield at Stephen.Crutchfield@nerc.net or by telephone at 609-651-9455.

### **Background Information**

The purpose of Project 2007-09 - Generator Verification is:

* To ensure that generators will not trip off-line during specified voltage and frequency excursions or as a result of improper coordination between generator protective relays and generator voltage regulator controls and limit functions (such coordination will include the generating unit’s capabilities).
* To ensure that generator models accurately reflect the generator’s capabilities and operating characteristics.

The standard drafting team (SDT) for Project 2007-09 Generator Verification based its work on two existing NERC Board approved standards:

* MOD-024-1 — Verification of Generator Gross and Net Real Power Capability.
* MOD-025-1 — Verification of Generator Gross and Net Reactive Power Capability.

And four draft standards developed by the Phase III & IV SDT that were field tested by four Regions from mid 2006 through mid 2007.

* PRC-019-1 — Coordination of Generator Voltage Regulator Controls with Unit
* Capabilities and Protection
* PRC-024-1 — Generator Performance During Frequency and Voltage Excursions
* MOD-026-1 —Verification of Models and Data for Generator Excitation Control System Functions
* MOD-027-1 — Verification of Generator Unit Frequency Response

This is the second posting of standard MOD-026-1 Verification of Models and Data for Generator Excitation Control System Functions for industry review. It should be noted that the title of the standard has been changed from “Verification of Models and Data for Generator Excitation Control System Functions” to “Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions” in order to reflect the SDTs inclusion of plants with several small units, in large part to include Variable Energy Resource plants (discussed in more detail below). The second posting of standard MOD-026-1 Verification of Models and Data for Generator Excitation Control System Functions was developed with consideration of industry response to questions that were posed as part of the Comment Form accompanying the first posting. This posting also includes the initial posting of standard MOD-027-1. Note for the same reason discussed for standard MOD-026-1, standard MOD-027-1 has been re-titled from “Verification of Generator Unit Frequency Response” to “Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions”. While there are a few differences between standards MOD-026-1 and MOD-027-1 as detailed below, there are also many similarities. The two standards are similar in both substance and style.

**Standard MOD-027-1:**

There are many similarities between standards MOD-026-1 and MOD-027-1 since both address verification of dynamic models of critical generation control functionality. These similarities are:

1. Based on industry feedback and consultation with the NERC Functional Model Working Group (FMWG), the Generator Owner was identified as the appropriate entity to assign dynamic model verification responsibility. It is up to the Generator Owner and Generator Operator to define contractual arrangements needed to comply with requirements of these standards.
2. As a baseline, the SDT recognized that the excitation system models and model data are already collected through the processes identified in standards MOD-012 and MOD-013. This information, with few exceptions, already establishes a quality dynamics database. However, as confirmed through field testing, performing verification activities specified in the draft standard will improve the accuracy of exciter models used in dynamic simulation which are used to determine transmission security limits. Therefore, both standard drafts propose an identical base Applicability requiring verification of the dynamic models associated with 80% or greater of the connected MVA per Interconnection.
3. The majority of industry agreed with the standard MOD-026-1 5% capacity factor threshold for dynamic model verification. This same threshold is proposed in this current draft of standard MOD-027-1.
4. Both draft standards contain the philosophy of allowing excitation control system verification for a single unit to satisfy compliance for other units if certain conditions are met (such as having the same MVA rating, having identical applicable components and settings, and being sited at the same physical location).
5. Based on an industry comments from the first posting of MOD-026-1 and technical justification regarding the nameplate MVA of steam units for existing Combined Cycle plant technology, the proposed threshold MVA nameplate rating is ≤350 MVA in both standards.
6. Both draft standards contain a standalone Periodicity Table. The Periodicity Table provides the base ten year applicability timeframe for collecting data needed to perform verification (note: standard MOD-027 exceptions may apply as discussed below). The Periodicity Table also addresses scenarios which could require additional testing and subsequent model re-verification. The Periodicity Table will enable Generator Owners to quickly determine required retest dates for model verification.
7. Both draft standards have similar phase in periods that includes allowances for verification performed using Regional procedures that are applicable for the first 10 year period.

**Differences also exist between MOD-026-1 and MOD-027-1:**

1. The implementation plan for standard MOD-027-1 is structured to recognize that Generator Owners will either need to install equipment to record the real power output of units during an appropriate frequency excursion or modify the existing recording equipment (such as frequency triggers, recording time, etc.). The proposed implementation plan specifies compliance with R2 at intervals of 25% of applicable units per Interconnection on a MVA basis three years after the effective date, 50% at five years, 75% at seven years, and 100% at nine years. Compliance with R2 as per the Periodicity Table (Table 1), means that beginning on the implementation date, the Generator Owner has 10 years to obtain an appropriate recorded response, and 2 years after obtaining the appropriate recorded response to verify the model (see Item 4 below that discusses exceptions to the aforementioned timeframe).
2. Like the draft standard for verification of excitation control system models, this draft standard allows for both staged tests and for ambient monitoring. However, the SDT expects that the majority of turbine/governor and load control functions will be verified through ambient monitoring. To ensure the impact of outer loop controls is captured and replicated in the model, the standard allows staged tests where a frequency reference change is applied if the unit is on-line. This type of test is not common. Many units do not have a frequency reference change input where such a signal can be applied. Therefore, the SDT recognized that the Generator Owner’s opportunity to verify that the predicted model response matches the recorded response for an appropriate system frequency excursion will often be dependent on its unit being on-line and in an operating state to respond to the system frequency excursion when it occurs. The basis for this strategy is:
	1. Large economical units have a higher probability of being on-line in a proper operating state to experience a frequency excursion requiring model verification.
	2. Units which are not on-line or not in a proper operating state will not help arrest the frequency excursion. Even if this is not the case, it is better to experience an event for model verification as opposed to relying on a survey that may be inaccurate.
3. In the current draft of MOD-026, the Generator Owner has one year from the capture of a voltage excursion to verify the excitation control system model. This timeframe is based on the SDT’s belief that the majority of exciters will be verified using a staged test; and if ambient monitoring is utilized, there will be frequent naturally occurring transmission system voltage excursions. Since the SDT anticipates that the majority of the units’ turbine/governor and load control models will be verified utilizing ambient monitoring, it is recognized that it is appropriate to give the Generator Owner time to retrieve captured data. Unlike ambient voltage excursion data needed for excitation control system model verification, the unit must be in an operating state that would allow the unit to respond to the frequency excursion. Also, it is likely that the number of acceptable frequency excursions (from a compliance perspective) will be significantly fewer than the number of acceptable voltage excursions that would occur for model verification. Therefore, the SDT decided to allow the Generator Owner two years for verifying the model. This timeframe allows adequate time to a) realize the event has occurred while the unit was in the proper operating state, and b) to verify the model. This timeframe will also assist the Generator Owner with planning contractor, budget and schedule support if activities are outsourced.
4. A unit has to be on-line and in the proper operating state during a frequency excursion in order to capture an effective real power response for model verification. Therefore, the standard provides time for the Generator Owner to capture and record a response requiring verification, even if it takes longer than ten years to do so. This language, which is contained in the Periodicity Table, is specifically crafted so that extension of the ten year periodicity cycle will only happen if a frequency excursion does not occur with the unit on-line and in the proper operating state. Therefore, the lack of installed and operating recording equipment during a frequency excursion is not a valid excuse for obtaining a ten year timeframe extension.
5. Industry experience has shown that a unit’s real power response to a system frequency excursion could be different from one event to the next. Reasons include different unit load levels, prime mover control conditions, operator control mode, and magnitude of the frequency deviation. By contrast, excitation control system responses to system voltage excursions are much more consistent. Therefore, the main model verification requirement (R2 Part 2.1.1) calls for the turbine/governor and load control model to be “compared to” the recorded response of actual equipment whereas in standard MOD-026-1, the wording is “matches”.
6. In standard MOD-026-1 R3, there is a process where a Transmission Planner can make a written request, including evidence that the excitation control system (or plant volt/var) model response did not match an actual recorded response, to the Generator Owner which essentially requires the Generator Owner to review the model. While there is similar language in standard MOD-027-1 R3, there is the additional stipulation that the Transmission Planner must include supporting evidence of instances where model response did not match an actual recorded response. The reason for this is that the governor response is not consistent enough from one frequency excursion event to the next for several reasons, such as the operating condition of the plant, ambient temperature, the number of coal pulverizes on line, the pre-contingency MW output of the unit, etc. In fact, while the fundamental requirement for verifying the model once every ten years can be satisfied by taking into account only a single frequency excursion, it is strongly recommended that model verification be performed taking into account multiple frequency excursions (if available and assuming the unit was in a proper operating state as required for model verification).
7. The activity specified in Requirement R4 is similar to draft standard MOD-026-1 Requirement, R4 which lists the evidence of compliance that the Generator Owner must maintain whenever certain activities occur that alter the equipment response; resulting in providing either revised model data or re-verifying the model. Unlike excitation control systems, there are many control parameters associated with the turbine/governor and load control system which will not impact equipment performance that is required to be replicated in the dynamic model. Thus, standard MOD-027-1 Requirement R4 is specifically crafted to only include setting changes for droop, and/or dead band, and/or load control mode. Since it is likely that many Generator Owners will rely on the expertise of consultants to make the determination of how modifications to droop, dead band, and/or load control mode translate into modified model parameter values, a time period of 180 days is proposed.
8. In MOD-026-1, the SDT is proposing a process where the Planning Coordinator can request a review of an excitation control system model for a unit not specified in the standard Applicability section. The new MOD-026-1 Requirement (R5) was added in response to industry comments. It requires the Planning Coordinator to supply technical justification that demonstrates either a) the unit affects a stability limit, or b) the simulated unit response does not match a measured unit response (most likely captured during a system disturbance event). However, this process is not being proposed for MOD-027-1. It is extremely unlikely that the turbine/governor and load control or active power/frequency control system will contribute to a stability limit. Also, as already discussed (Item 6), governor response is not consistent from one frequency excursion event to the next. Therefore, the SDT did not feel that such a Requirement in MOD-027-1 was necessary.
9. There is no need for the Transmission Planner to provide the generator MVA base when providing models for turbine/governor and load control or active power/frequency control systems. The MVA base associated with the generator model is already required to be provided per Requirement R1 of standard MOD-026. The MW base information is reflective of turbine capability and is provided as one of the turbine/governor and load control model data parameters specified. The MW base information, depending on the dynamic simulation software provider model requirements, will either be in the form of an actual MW value or a per unit MW value; with the base being the MVA value that is used in the generator steady state model.
10. The Generation Verification SDT is closely following and coordinating with the Frequency Response SDT. It is hoped that the Frequency Response SDT will create a process where frequency excursions meeting certain criteria for each Interconnection are captured. However, though the Frequency Response SDT has discussed this concept and is investigating the use of a tool to help facilitate the identification of appropriate frequency excursions, the process is still evolving. As an interim step, the Generation Verification SDT has included minimum frequency excursion thresholds in the Periodicity Table for each Interconnection that a) are large enough to be expected to exercise turbine/governor and load control functions for the purpose of model verification and b) would be expected to occur 15 times a year or more. If by chance a process identifying frequency excursions that can be utilized in support of standard MOD-027-1 requirements is not developed by the Frequency Response SDT, then such a process will have to be proposed for future revision to standard MOD-027-1 by the Generation Verification SDT.

**Compliance Elements for MOD-027-1:**

The SDT added Compliance Elements to the second posting of the standard. The VRF for Requirement, R1-R5 are all designated as low risk. All of these Requirements provide for an update of dynamic modeling data for an existing unit. Violation of these requirements would not be expected to adversely affect the electrical state or capability of the bulk electric system, or the ability to effectively monitor and control the bulk electric system, which is consistent with the low risk level guidelines.

The VSL for R2 was selected using the metric of “Requirements with Parts that Contribute Equally to the Requirement”. All of the items listed in Requirement R2 are required for successful model verification. The remaining VSLs were selected using the metric of “Increments for Tardiness”. The Requirements cover activities that are not typical such as peer reviews and instances where there is concern that the model does not reliably reflect actual equipment performance. As such, timeliness of communications is paramount.

**You do not have to answer all questions. Enter All Comments in Simple Text Format.**

*Insert a “check” mark in the appropriate boxes by double-clicking the gray areas.*

1. The Applicability section of MOD-027 standard is expanded to include plants/facilities comprised of multiple small units such as variable energy resource plants/facilities. Are you aware of other generation configurations/types that should be covered in the Applicability?

[ ]  Yes

[ ]  No

Comments:

1. Because it is not likely that the turbine/governor and load control or active power/frequency control system will contribute to a stability limit, and because governor response is not consistent from one frequency excursion event to the next, the SDT is not proposing a Requirement in MOD-027-1 where the Planning Coordinator can request a review of a turbine/governor and load control or active power/frequency control system model for a unit not specified in the standard Applicability section.

Do you agree with the proposal to not include a Requirement in MOD-027-1 where the Planning Coordinator can request a review of a turbine/governor and load control or active power/frequency control system model for a unit not specified in the standard Applicability section?

[ ]  Yes

[ ]  No

Comments:

1. The SDT discussed if MOD-027-1 should also include verification of excitation control systems of synchronous condensers. Synchronous condensers are not currently addressed in the NERC Registry Criteria. Synchronous condensers are not mentioned in the Generation Verification SAR. On an MVA capacity basis, the penetration of synchronous condensers in North America is extremely low. It is common for Transmission Owners to be the owners of synchronous condensers. As such, the peer review draft requirements would not make sense. Therefore, the team decided that a more appropriate strategy would be to include synchronous condensers with other transmission system dynamic reactive devices (such as SVCs, STATCOMs, etc.) in a separate SAR.

Do you agree with the proposal to not include the verification of synchronous condensers in MOD-027-1?

[ ]  Yes

[ ]  No

Comments:

1. Are you aware of any regional variances that would be required as a result of MOD-027-1? If yes, please identify the regional variance.

[ ]  Yes

[ ]  No

Comments:

1. Are you aware of any conflicts between the proposed MOD-027-1 and any regulatory function, rule, order, tariff, rate schedule, legislative requirement, or agreement?

[ ]  Yes

[ ]  No

Comments:

1. Do you have any other questions or concerns with the proposed standards that have not been addressed? If yes, please explain.

[ ]  Yes

[ ]  No

Comments: