

Standard Development Roadmap

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

Development Steps Completed:

1. SAR posted for comment (April 20–May 21, 2007).
2. Revised SAR and response to comments posted: ~~(July 5, 2007).~~
3. Revised SAR and response to comments approved by SC (June 14, 2007).
4. SDT appointed on (August 18, 2007).
5. Posted first draft of standard for a 30 day comment period June 15 –July 15, 2011
6. Posted second draft of standard for 45-day concurrent formal comment period and initial ballot February 29 – March 16, 2012.

Proposed Action Plan and Description of Current Draft:

This is the ~~second~~third draft of the proposed standard including Time Horizons, Data Retention, Violation Risk Factors, and Violation Severity Levels; and is being submitted for a 45-day concurrent formal comment period and ~~initial~~successive ballot.

Future Development Plan:

Anticipated Actions	Anticipated Date
1. Develop responses to <u>ballot</u> comments and develop second version draft standard.	July 2011 – February <u>April - July 2012</u>
2. Post response to comments and conduct a formal 45- <u>third version draft revision of standard for 30-day comment period with concurrent initial</u> and successive ballot for the revised standard period.	March – April <u>October - November 2012</u>
3. Develop responses to ballot comments.	April – June 2012
4. Post response to comments and conduct successive ballot.	June – July 2012
5 3. Develop responses to ballot comments.	December <u>August – September 2012 – January 2013</u>
6 4. Post responses to comments and conduct recirculation ballot.	February 2013 <u>October 2012</u>
7 5. BOT adoption.	March 2013 <u>November</u>

Standard MOD-027-1 — Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions

	<u>2012</u>
<u>86.</u> File with regulatory authorities.	December 2012 <u>April</u> <u>2013</u>

A. Introduction

1. **Title:** Verification of Models and Data for Turbine/Governor and Load Control ~~and/or~~ Active Power/Frequency Control Functions
2. **Number:** MOD-027-1
3. **Purpose:** To verify that the turbine/governor and load control ~~and/or~~ active power/frequency control¹ model and the model parameters, used in dynamic simulations that assess Bulk Electric System (BES) reliability, ~~that~~ accurately represent generator unit real power response to system frequency variations.
4. **Applicability:**
 - 4.1. Functional entities
 - 4.1.1 Generator Owner
 - 4.1.2 Transmission Planner

4.2. Facilities

For the purpose of ~~this standard~~, the ~~term requirements contained herein~~, Facilities that are directly connected to the Bulk Electric System (BES) will be collectively referred to as an “applicable Facility” is considered, “applicable units².” ~~Units or plants with an average capacity³ factor greater than 5 percent over the last three calendar years, beginning on January 1 and ending on December 31, unit~~ that meet the following:

- 4.2.1 ~~Generating units connected to~~ Generation in the Eastern or Quebec Interconnections with the following characteristics:
 - 4.2.1.1 Individual generating unit greater than 100 MVA (gross nameplate rating) ~~directly connected to the bulk power system~~.
 - ~~For each~~ Individual generating plant ~~or generating Facility~~ consisting of ~~one or more~~ multiple generating units that are directly connected to the bulk power system at a common BES bus with total generation greater than 100 MVA (gross aggregate rating):
 - 4.2.1.2 ~~Each individual generating unit greater than 20 MVA (gross nameplate rating); and~~.

¹ Turbine/governor and load control ~~and/or~~ active power/frequency control:

- a. Turbine/governor and load control applies to conventional synchronous generation.
- b. Active power/frequency control applies to ~~inverter connected generators (often found at~~ variable energy plants).

² ~~Applicable generating units do not include startup or standby units not normally connected to the grid.~~

³ ~~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.~~

- ~~○ — Each generating plant or generating Facility consisting of individual generating units less than 20 MVA (gross nameplate ratings)~~

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

4.2.2.1 Individual generating unit greater than 75 MVA (gross nameplate rating) ~~directly connected to the bulk power system).~~

- ~~● — For each~~**4.2.2.2 Individual** generating plant ~~or generating Facility~~ consisting of ~~one or more multiple generating~~ units that are directly connected to the bulk power system at a common BES bus with total generation greater than 75 MVA (gross aggregate rating):

~~Each individual generating unit greater than 20 MVA (gross nameplate rating); and).~~

- ~~○ — Each generating plant or generating Facility comprised consisting of individual generating units less than 20 MVA (gross nameplate ratings)~~

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

4.2.3.1 Individual generating unit greater than 50 MVA (gross nameplate rating) ~~directly connected to the bulk power system).~~

4.2.3.2 ~~For each~~Individual generating plant ~~or generating Facility~~ consisting of ~~one or more multiple generating~~ units that are directly connected to the bulk power system at a common BES bus with total generation greater than 75 MVA (gross aggregate nameplate rating):

- ~~○ — Each individual generating unit greater than 20 MVA (gross nameplate rating); and~~

~~Each generating plant or generating Facility comprised of individual generating units less than 20 MVA (gross nameplate ratings)~~

5. Effective Date:

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

~~**5.1.1** Each responsible entity shall ensure compliance with For Requirements R1, and R3 through R5 by R6, the first day of the first calendar quarter; three years following beyond the date that this standard is approved by applicable regulatory authorities. In those jurisdictions where regulatory approval:~~

~~**5.1.** Each Generator Owner is not required, the standard shall ensure at least 25 percent of its applicable units per Interconnection become effective on an MVA basis are compliant with Requirement R2 by the first day of the first calendar quarter; three beyond the date this standard is approved by the NERC Board of~~

Trustees, or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.

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

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

~~5.1.4—~~ Each Generator Owner shall ensure at least 75 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, seven years following applicable regulatory approval.

~~5.1.5—~~ Each Generator Owner shall ensure at least 100 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, nine years following applicable regulatory approval.

~~5.2. In, 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. Each responsible entity shall ensure compliance with Requirements R1, and R3 through R5 by~~ For Requirement R2, 50 percent of the entity’s applicable unit gross MVA for each Interconnection on first day of the first calendar quarter; three that is six years following applicable regulatory approval, or in those jurisdictions where no regulatory approval is required, on the first day of the first calendar quarter thirty that is six years following NERC Board of Trustees adoption; or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.

~~5.3.1—~~ Each Generator Owner shall ensure at least 25For Requirement R2, 100 percent of its the entity’s applicable units per unit gross MVA for each Interconnection on an MVA basis are compliant with Requirement R2 by the first day of the first calendar quarter, three that is 10 years following Board of Trustees adoption.

~~5.3.2—~~ Each Generator Owner shall ensure at least 50 percent of its applicable units per Interconnection regulatory approval, or in those jurisdictions where no regulatory approval is required, on an MVA basis are compliant with Requirement R2 by the first day of the first calendar quarter, five that is 10 years following NERC Board of Trustees adoption.

~~5.3.3—~~ Each Generator Owner shall ensure at least 75 percent of its or as otherwise made effective pursuant to the laws applicable units per Interconnection on an MVA basis are compliant with Requirement R2 by

~~the first day of the first calendar quarter, seven years following Board of Trustees adoption.~~

- 5.4. ~~Each Generator Owner shall ensure at least 100 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, nine years following Board of Trustees adoption to such ERO governmental authorities.~~

B. Requirements

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

- Instructions on how to obtain the list of ~~acceptable~~ turbine/governor and load control ~~and/or~~ active power/frequency control system models that are acceptable to the Transmission Planner for use in dynamic simulation.
- Instructions on how to obtain the ~~Transmission Planner's software manufacturer's~~ dynamic turbine/governor and load control ~~and/or~~ active power/frequency control system function model library block diagrams and/or data sheets: for models that are acceptable to the Transmission Planner, or
- Model data for any of the Generator Owner's existing applicable unit ~~or plant~~ specific turbine/governor and load control ~~and/or~~ active power/frequency control system contained in the Transmission Planner's dynamic database from the current (in-use) ~~model(s); models.~~

- R2. Each Generator Owner shall provide, for each ~~of its~~ applicable units, a verified turbine/governor and load control ~~and/or~~ active power/frequency control model, including documentation and data (as specified in Parts 2.1 ~~and 2.2,~~) to its Transmission Planner (~~within 365 calendar days from the date that the response was recorded~~) in accordance with the periodicity specified in MOD-027 Attachment 1, ~~to ensure modeling data is accurate for use in simulation software.~~ *[Violation Risk Factor: Medium]* *[Time Horizon: Long-term Planning]*

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

- 2.1.1. Documentation comparing the applicable unit's MW model response to the recorded MW response to the recorded response for either a:

- A frequency excursion from a system disturbance that meets MOD-027 Attachment 1 Criteria Note 1 with the applicable unit on-line, ~~a~~

- A speed governor reference change with the applicable unit on-line, or ~~from a~~
- A partial load rejection test^{4, 5}

~~2.1.1.2.1.2.~~ 2.1.1.2.1.2. Type of governor and load control and/or active power control/frequency control equipment₂.

~~2.1.2.2.1.3.~~ 2.1.2.2.1.3. A description of the turbine (e.g. for Hhydro turbine - Kaplan, Francis, or Pelton; for steam turbine - boiler type, normal fuel type, and turbine type; for gas turbine - the type and manufacturer; for variable energy plant - type and manufacturer)₂).

~~2.1.3.2.1.4.~~ 2.1.3.2.1.4. Model structure and data for turbine/governor and load control and/or active power/frequency control₂, and

~~2.1.4.2.1.5.~~ 2.1.4.2.1.5. Representation of the real power response effects of outer loop controls (such as operator set point controls, and load control but excluding AGC control) that would override the governor response (including blocked or nonfunctioning governors or modes of operation that limit Frequency Response), if applicable.

~~2.2. For plants that are comprised of units that have a gross nameplate rating of less than 20 MVA, perform verification using plant aggregate model(s) that include the information required by Requirement sub-parts 2.1.1 through 2.1.5~~

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. ~~The written response shall contain either the technical basis for maintaining the current model, or the model changes, or a plan to perform model verification⁶ (in accordance with Requirement R2): [Violation Risk Factor: Lower] [Time Horizon: Operations Planning]~~

- Written notification, from its Transmission Planner (in accordance with Requirement R5) that the turbine/governor and load control and/or active power/frequency control model is not “usable”₂, ~~or₂~~

~~⁴ Differences between the control mode tested and the final simulation model must be identified, particularly when analyzing load rejection data. Most controls change gains or have a set point runback which takes effect when the breaker opens. Load or set point controls will also not be in effect once the breaker opens. Some method of accounting for these differences must be presented if the final model is not validated from on-load data under the normal operating conditions under which the model is expected to apply~~

~~⁵ Differences between the control mode tested and the final simulation model must be identified, particularly when analyzing load rejection data. Most controls change gains or have a set point runback which takes effect when the breaker opens. Load or set point controls will also not be in effect once the breaker opens. Some method of accounting for these differences must be presented if the final model is not validated from on-line data under the normal operating conditions under which the model is expected to apply~~

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

- Written comments from its Transmission Planner identifying technical concerns with the verification documentation related to the turbine/governor and load control ~~and/or~~ active power/frequency control model, or
- Written comments and supporting evidence from its Transmission Planner indicating that the ~~predicted~~simulated turbine/governor and load control ~~and/or~~ active power/frequency control response did not approximate the recorded response for three or more transmission system events.

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

- R4.** Each Generator Owner shall provide revised model data or plans to perform model verification⁸⁶ (in accordance with Requirement R2) for an applicable unit to its Transmission Planner within 180 calendar days of making changes to the turbine/governor and load control ~~and/or~~ active power/frequency control system that alter the equipment response characteristic⁹. [Violation Risk Factor: Lower] [Time Horizon: Operations Planning]
- R5.** Each Transmission Planner shall notify the Generator Owner within 90 calendar days of receiving the turbine/governor and load control ~~and/or~~ active power/frequency control system verified model information whether in accordance with Requirement R2 that the model is useable (meets the criteria specified in Parts 5.1 through 5.3) or is not usable; and shall include a technical description if the model is not ~~useable-usable that includes the following:~~ [Violation Risk Factor: Medium] [Time Horizon: Operations Planning]
- 5.1.** The turbine/governor and load control ~~and/or~~ active power/frequency control function model initializes to compute modeling data without error~~2~~.
- 5.2.** A no-disturbance simulation results in negligible transients~~2~~, and
- 5.3.** For an otherwise stable simulation, a disturbance simulation results in the turbine/governor and load control ~~and/or~~ active power/frequency control model exhibiting positive damping.

C. Measures

- M1.** ~~Evidence for Requirement R4~~The Transmission Planner must include have and provide the transmitted dated request for instructions or data and, the transmitted instruction or data, and dated evidence of transmission of requested instructions and data, such as dated a written transmittal (e.g., electronic mail messages, dated message, postal

⁷ If verification is performed, the 10 year period as outlined in MOD-027 Attachment 1 is reset.

⁸ Ibid.

⁹ Control replacement or alteration including software alterations or plant digital control system addition or replacement, plant digital control system software alterations that alter droop, and/or dead band, and/or frequency response and/or a change in the frequency control mode (such as going from droop control to constant MW control, etc).

- ~~receipts, dated receipt, or~~ confirmation of facsimile ~~transmission~~) as evidence that it ~~provided the request within 90 calendar days in accordance with Requirement R1.~~
- M2. ~~Evidence for Requirement R2 must include, for The Generator Owner must have and provide dated evidence it verified each of the Generator Owner's applicable Facilities, the verification report showing that the generator turbine/governor and load control and/or active power/frequency control model was verified according to Part 2.1 for each applicable unit and dated evidence of transmission, such as a dated transmittal (e.g., electronic mail messages, dated message, postal receipts, or dated confirmation of facsimile transmission) as specified evidence it provided the model, documentation, and data to its Transmission Planner, in accordance with Requirement R2.~~
- M3. Evidence for Requirement R3 must include the Generator Owner's dated written response containing the information identified in Requirement R3 and dated evidence of transmittal, ~~such as a dated (e.g., electronic mail messages, dated message, postal receipts, or dated confirmation of facsimile transmission.)~~ of the response.
- M4. Evidence for Requirement R4 must include, for each of the Generator Owner's ~~Facilities applicable units~~ for which system changes specified in Requirement R4 were made, dated revised model data or dated plans to perform a model verification and dated evidence of transmittal, ~~such as dated (e.g., electronic mail messages, dated message, postal receipts, or dated confirmation of facsimile transmittal) within 180 calendar days of making changes.~~
- M5. Evidence of Requirement R5 must include, for each model received, the dated response ~~containing indicating the information required model was usable or not usable according to the criteria specified in Parts 5.1 through 5.3 and for a model that is not useable, a technical description is the model is not usable, and~~ dated evidence of transmittal, ~~such as dated (e.g., electronic mail messages, dated postal receipts, or dated confirmation of facsimile transmittal.)~~ that the Generator Owner was notified within 90 calendar days of receipt of model information in accordance with Requirement R5.

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance Enforcement Authority

Regional Entity

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

1.2. Data Retention

The following evidence retention periods identify the period of time an entity is required to retain specific evidence to demonstrate compliance. For instances where the evidence retention period specified below is shorter than the time since the last audit, the Compliance Enforcement Authority may ask an entity to

provide other evidence to show that it was compliant for the full time period since the last audit.

The Generator Owner and Transmission Planner shall each keep data or evidence to show compliance as identified below unless directed by its Compliance Enforcement Authority to retain specific evidence for a longer period of time as part of an investigation:

- The Transmission Planner shall retain the information/data request and provided response evidence of Requirements R1 and R5, Measures M1 and M5 for 3 calendar years from the date the document was provided.
- The Generator Owner shall retain the latest ~~and previous~~ turbine/governor and load control ~~and/or~~ active power/frequency control system model verification evidence of Requirement R2, Measure M2.
- The Generator Owner shall retain the information/data request and provided response evidence of Requirements R3, and R4 Measures M3 and M4 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 mitigation is complete and 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

Complaint

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 less than or equal to 120 calendar days of receiving a <u>written</u> request.	The Transmission Planner provided the instructions and data to the Generator Owner more than 120 calendar days but less than or equal to 150 calendar days of receiving a <u>written</u> request.	The Transmission Planner provided the instructions and data to the Generator Owner more than 150 calendar days but less than or equal to 180 calendar days of receiving a <u>written</u> request.	The Transmission Planner failed to provide the instructions and data to the Generator Owner within 181 <u>180</u> calendar days of receiving a <u>written</u> request.
R2	<p>The Generator Owner provided its verified model(s) to its Transmission Planner after the periodicity timeframe specified in MOD-027 Attachment 1 but less than or equal to 30<u>90</u> calendar days late;</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner a verified model that omitted one of the five Parts identified in Requirement R2, Subparts 2.1.1, through 2.1.5.</p>	<p>The Generator Owner provided its verified model(s) to its Transmission Planner more than 30<u>90</u> calendar days but less than or equal to 60<u>180</u> calendar days late as specified by the periodicity timeframe in MOD-027 Attachment 1;</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner a verified model that omitted two of the five Parts identified in Requirement R2, Subparts 2.1.1, through 2.1.5.</p>	<p>The Generator Owner provided its verified model(s) to its Transmission Planner more than 60<u>180</u> calendar days but less than or equal to 90<u>270</u> calendar days late as specified by the periodicity timeframe in MOD-027 Attachment 1;</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner verified models that omitted three of the five Parts identified in Requirement R2, Subparts 2.1.1, through 2.1.5.</p>	<p>The Generator Owner provided its verified turbine/governor and load control and active power/frequency control model(s) more than 90<u>270</u> calendar days late or failed to provide the verified model(s) to its Transmission Planner in accordance with the periodicity specified in MOD-027 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, Subp<u>Part</u> 2.1.5;</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner verified model(s) that omitted four or more of the five Parts identified in Requirement R2, Subparts 2.1.1, through 2.1.5.</p>

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R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R3	<p>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. (R3)</p>	<p>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. (R3)</p>	<p>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. (R3)</p>	<p>The Generator Owner failed to provide a written response within 48+180 calendar days of receiving <u>written</u> notice as specified in Requirement R3.</p> <p>OR</p> <p>The Generator Owner's written response was provided within 181 calendar days of receiving written notice. However theThe 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.</p>
R4	<p>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 turbine/governor and load control and/or active power/frequency control system that alter the equipment response characteristic. (R4)</p>	<p>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 turbine/governor and load control and/or active power/frequency control system that alter the equipment response characteristic. (R4)</p>	<p>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 turbine/governor and load control and/or active power/frequency control system that alter the equipment response characteristic. (R4)</p>	<p>The Generator Owner failed to provide revised model data or failed to provide plans to perform model verification within 271+270 calendar days of making changes to the turbine/governor and load control and/or active power/frequency control system that altered the equipment response characteristic as specified in Requirement R3.</p>

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R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R5	<p>The Transmission Planner provided a written response to the Generator Owner indicating whether the model is useable or not useable, (including a technical description if the model is not useable), more than 90 calendar days but less than <u>or equal to</u> 120 calendar days of receiving verified model information. (R5);</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 <u>or equal to</u> 150 calendar days of receiving the verified model information. (R5);</p> <p>OR</p> <p>The Transmission Planner provided a written response within 181 calendar days to the Generator Owner <u>Planner's</u> written response omitted confirmation for one of the specified model criteria listed in Requirement R5, Parts 5.1 through 5.3.</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 <u>or equal to</u> 180 calendar days of receiving the verified model information. (R5);</p> <p>OR</p> <p>The Transmission Planner provided a written response within 181 calendar days to the Generator Owner <u>Planner's</u> written response omitted confirmation for two of the specified model criteria listed in Requirement R5, Parts 5.1 through 5.3.</p>	<p>The Transmission Planner failed to provide a written response to the Generator Owner within 181<u>180</u> calendar days of receiving the verified model information as specified in Requirement R5;</p> <p>OR</p> <p>The Transmission Planner provided a written response without including confirmation of all specified model criteria listed in Requirement R5, Parts 5.1 through 5.3.</p>

E. Regional Variances

None.

F. Associated Documents

None.

Version History

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

G. References

The following documents contain technical information beyond the scope of this Standard on turbine/governor and load control ~~and/or~~ active power/frequency control system functionality, modeling, and testing.

- 1) 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
- 2) L. Pereira "New Thermal Governor Model Development: Its Impact on Operation and Planning Studies on the Western Interconnection" IEEE POWER AND ENERGY MAGAZINE, MAY/JUNE 2005
- 3) D.M. Cabbell, S. Rueckert, B.A. Tuck, and M.C. Willis, "The New Thermal Governor Model Used in Operating and Planning Studies in WECC," in Proc. IEEE PES General Meeting, Denver, CO, 2004
- 4) S. Patterson, "Importance of Hydro Generation Response Resulting from the New Thermal Modeling-and Required Hydro Modeling Improvements," in Proc. IEEE PES General Meeting, Denver, CO, 2004
- 5) L. Pereira, D. Kosterev, D. Davies, and S. Patterson, "New Thermal Governor Model Selection and Validation in the WECC," IEEE Trans. Power Syst., vol. 19, no. 1, pp. 517-523, February 2004
- 6) L. Pereira, J. Undrill, D. Kosterev, D. Davies, and S. Patterson, "A New Thermal Governor Modeling Approach in the WECC," IEEE Trans. Power Syst., vol. 18, no. 2, pp. 819-829, May 2003
- 7) P. Pourbeik, C. Pink and R. Bisbee, "Power Plant Model Validation for Achieving Reliability Standard Requirements Based on Recorded On-Line Disturbance Data", Proceedings of the IEEE PSCE, March, 2011

MOD-027 Attachment 1

Turbine/Governor and Load Control and Active Power/Frequency Control Model Periodicity

Periodicity Determination Supporting Criteria <u>MOD-027 Attachment 1</u> <u>Turbine/Governor and Load Control or Active Power/Frequency Control Model Periodicity</u>		
<u>Row Number</u>	<u>Verification Condition</u>	<u>Required Action</u>
<u>1</u>	<u>Establishing the initial verification date for an applicable unit.</u> <u>(Requirement R2)</u>	<u>Transmit the verified model, documentation and data to the Transmission Planner on or before the Effective Date.</u> <u>Row 5 applies when calculating generation fleet compliance during the 10year implementation period.</u> <u>See Section A5 for Effective Dates.</u>
<u>2</u>	<u>Subsequent verification for an applicable unit.</u> <u>(Requirement R2)</u>	<u>Transmit the verified model, documentation and data to the Transmission Planner on or before the 10-year anniversary of the last transmittal (per Note 2).</u>
<u>3</u>	<u>Applicable unit is not subjected to a frequency excursion per Note 1 by the date otherwise required to meet the dates per Rows 1, 2, 4, or 6.</u> <u>(This row is only applicable if a frequency excursion from a system disturbance that meets Note 1 is selected for the verification method and the ability to record the applicable unit's real power response to a frequency excursion is installed and expected to be available).</u> <u>(Requirement R2)</u>	<u>Requirement 2 is met with a written statement to that effect transmitted to the Transmission Planner. Transmit the verified model, documentation and data to the Transmission Planner on or before 365 calendar days after a frequency excursion per Note 1 occurs and the recording equipment captures the applicable unit's real power response as expected.</u>

<u>Periodicity Determination Supporting Criteria</u> MOD-027 Attachment 1		
<u>Turbine/Governor and Load Control or Active Power/Frequency Control Model Periodicity</u>		
<u>Row Number</u>	<u>Verification Condition</u>	<u>Required Action</u>
4	<p><u>Initial verification for a new applicable unit or for an existing applicable unit with new turbine/governor and load control or active power/frequency control equipment installed.</u></p> <p>(Requirement R2)</p>	<p><u>Transmit the verified model, documentation and data to the Transmission Planner within 365 calendar days after the commissioning date.</u></p>
5	<p><u>Existing applicable unit that is equivalent to another applicable unit(s) at the same physical location;</u></p> <p><u>AND</u></p> <p><u>Each applicable unit has the same MVA nameplate rating;</u></p> <p><u>AND</u></p> <p><u>The nameplate rating is \leq 350 MVA;</u></p> <p><u>AND</u></p> <p><u>Each applicable unit has the same components and settings;</u></p> <p><u>AND</u></p> <p><u>The model for one of these equivalent applicable units has been verified.</u></p> <p>(Requirement R2)</p>	<p><u>Document circumstance with a written statement and include with the verified model, documentation and data provided to the Transmission Planner for the verified equivalent unit.</u></p> <p><u>Verify a different equivalent unit during each 10-year verification period.</u></p> <p><u>Applies to Row 1 when calculating generation fleet compliance during the 10-year implementation period.</u></p>
6	<p><u>The Generator Owner has submitted a verification plan.</u></p> <p>(Requirement R3 or R4)</p>	<p><u>Transmit the verified model, documentation and data to the Transmission Planner within 365 calendar days after the submittal of the verification plan.</u></p>

<u>Periodicity Determination Supporting Criteria</u> MOD-027 Attachment 1		
<u>Turbine/Governor and Load Control or Active Power/Frequency Control Model Periodicity</u>		
<u>Row Number</u>	<u>Verification Condition</u>	<u>Required Action</u>
7	<p><u>Applicable unit is not responsive to both over and under frequency excursion events (The applicable unit does not operate in a frequency control mode, except during normal start up and shut down, that would result in a turbine/governor and load control or active power/frequency control mode response.);</u></p> <p><u>OR</u></p> <p><u>Applicable unit either does not have an installed frequency control system or has a disabled frequency control system.</u></p> <p><u>(Requirement R2)</u></p>	<p><u>Requirement 2 is met with a written statement to that effect transmitted to the Transmission Planner.</u></p> <p><u>Perform verification per the periodicity specified in Row 4 for a “New Generating Unit” (or new equipment) only if responsive control mode operation for connected operations is established.</u></p>
8	<p><u>Existing applicable unit has a current average net capacity factor over the most recent three calendar years, beginning on January 1 and ending on December 31 of 5% or less.</u></p> <p><u>(Requirement R2)</u></p>	<p><u>Requirement 2 is met with a written statement to that effect transmitted to the Transmission Planner.</u></p> <p><u>At the end of this 10 calendar 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 calendar year period. If not eligible for the capacity factor exemption, then model verification must be completed within 365 calendar days of the date the capacity factor exemption expired.</u></p> <p><u>For the definition of net capacity factor, refer to Appendix F of the GADS Data Reporting Instructions on the NERC website.</u></p>

~~Periodicity Determination Supporting Criteria~~ **MOD-027 Attachment 1**
Turbine/Governor and Load Control or Active Power/Frequency Control Model Periodicity

<u>Row Number</u>	<u>Verification Condition</u>	<u>Required Action</u>
<p>Criteria NOTES:</p> <p>NOTE 1: Unit Model Verification Frequency Excursion Criteria <u>model verification frequency excursion criteria</u>:</p> <ul style="list-style-type: none"> • ≥ 0.05 hertz deviation (<u>nadir point</u>) from scheduled frequency for the Eastern Interconnection with the applicable unit operating in a frequency responsive mode • ≥ 0.10 hertz deviation (<u>nadir point</u>) from scheduled frequency for the ERCOT and Western Interconnections with the applicable unit operating in a frequency responsive mode • ≥ 0.15 hertz deviation (<u>nadir point</u>) from scheduled frequency for the Quebec Interconnection with the applicable unit operating in a frequency responsive mode <p>Criteria NOTE 2: Establishing the Initial Ten Year Unit Verification Period Start Date:</p> <p>For each applicable recurring ten year unit, the initial verification period start date is set to either of the 25 percent, 50 percent, 75 percent, or 100 percent Standard Implementation Effective Dates established for compliance in accordance with the nine calendar year transition period.</p> <p>Criteria 3: Establishing the Recurring Ten Year Unit Verification Period Start Date:</p> <ul style="list-style-type: none"> • The start date is the actual data collection date <u>date of submittal of a verified model to the Transmission Planner</u> for the most recently performed applicable unit verification. <p>Criteria 4: For the purpose of calculating the initial ten year unit verification period 25 percent, 50 percent, 75 percent or 100 percent threshold for generation fleet compliance, equivalent unit MVA is included (reference 4th row in the following table).</p> <p>NOTE 3: Consideration for Early Compliance <u>early compliance</u>:</p> <p>Existing turbine/governor and load control and/or active power/frequency control model verification is sufficient for demonstrating compliance for a ten <u>10</u> year period from the actual verification <u>transmittal</u> date if either of the following applies:</p> <ul style="list-style-type: none"> • ———— The Generator Owner has a verified model that is compliant with the applicable regional policies, guidelines or criteria existing at the time of model verification. • ———— The Generator Owner has an existing verified model that is compliant with the requirements of this standard. 		

Standard MOD-027-1 — Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions

Event Triggering Verification	Verification Periodicity	Comments
<p>Establishing the initial verification period (Criteria 2) for an applicable unit (Requirement R2)</p>	<p>Record unit Real Power response to the first frequency excursion event that meets Criteria 1 on or after the Standard Implementation Effective Date.</p> <p>OR</p> <p>Record unit Real Power response for an on-line speed governor reference change test or a partial load rejection test before or on the Standard Implementation Effective Date</p>	<p>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.</p> <p>Criteria 4 applies when calculating generation fleet compliance during the 9-year transition period</p>
<p>Subsequent verification for an existing applicable unit</p>	<p>Record unit Real Power response for a frequency excursion event that meets Criteria 1 within one year of the applicable unit's ten-year anniversary date of the collection of the recorded unit Real Power response used for the current validation.</p> <p>OR</p> <p>Record unit Real Power response for an on-line speed governor reference change test or a partial load rejection test on or before the applicable unit's ten-year anniversary date of the collection of the recorded unit Real Power response used for the current validation.</p>	<p>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.</p>
<p>Initial verification for a new applicable unit or for an existing applicable unit with new turbine/governor and load control or active power/frequency control equipment installed with settings final</p>	<p>Record unit Real Power response to the first frequency excursion event that meets Criteria 1</p>	<p>Transmit the verified model and documentation and data to the Transmission Planner no more than 365 calendar days from the date that</p>

Standard MOD-027-1 — Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions

Event Triggering Verification	Verification Periodicity	Comments
<p>(Requirement R2)</p>	<p>OR</p> <p>Record unit Real Power response for an on-line speed-governor reference change test or a partial load rejection test no more than 365 calendar days from the commissioning date</p>	<p>the response was recorded.</p>
<p>Existing applicable unit that is equivalent to another operating unit(s) at the same physical location</p> <p>AND</p> <p>Each equivalent applicable unit has the same MVA nameplate rating.</p> <p>AND</p> <p>The nameplate rating is ≤ 350 MVA.</p> <p>AND</p> <p>Each equivalent applicable unit has identical applicable components and settings.</p> <p>AND</p> <p>The model for one of these equivalent applicable units has been verified.</p> <p>(Requirement R2)</p>	<p>Verify a different equivalent unit during each ten-year verification period.</p>	<p>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.</p> <p>Criteria 4 applies when calculating generation fleet compliance during the 9-year transition period.</p>
<p>Existing applicable unit does not experience an acceptable frequency excursion event during the ten-year unit verification period</p> <p>AND</p> <p>Neither an on-line speed-governor reference test nor a partial load rejection test was performed.</p> <p>(Requirement R2)</p>	<p>Record unit Real Power response to the first frequency excursion event that meets Criteria 1 after the ten-year verification period</p>	<p>Document circumstance with a written statement.</p> <p>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.</p>

Standard MOD-027-1 — Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions

Event Triggering Verification	Verification Periodicity	Comments
<p>Existing applicable unit control system response is altered resulting in an alteration of the response of the turbine/governor and load control or active power/frequency control model</p> <p>AND</p> <p>The Generator Owner has submitted a verification plan (Requirement R4)</p>	<p>Record unit Real Power response to the first frequency excursion event that meets Criteria 1.</p> <p>OR</p> <p>Record unit Real Power response for an on-line speed governor reference change test or a partial load rejection test no more than 365 calendar days from the date of the submitted verification plan.</p>	<p>Transmit the verified model and documentation and data to the Transmission Planner no more than 365 calendar days from the date that the response was recorded.</p>
<p>The Generator Owner receives written comments including dated electronic or hard copy evidence indicating that the recorded turbine/governor and load control or active power/frequency control response for three or more transmission system events did not match the predicted control system model response.</p> <p>AND</p> <p>The Generator Owner has submitted a verification plan (Requirement R3)</p>	<p>Record unit Real Power response to the first frequency excursion event that meets Criteria 1.</p> <p>OR</p> <p>Record unit Real Power response for an on-line speed governor reference change test or a partial load rejection test no more than 365 calendar days from the date of the submitted verification plan</p>	<p>Transmit the verified model and documentation and data to the Transmission Planner no more than 365 calendar days from the date that the unit Real Power response was provided as part of the dated evidence.</p>
<p>The Generator Owner receives written comments detailing technical concerns with the Generator Owner's turbine/governor and load control and active power/frequency control model verification documentation.</p> <p>AND</p> <p>The Generator Owner has submitted a verification plan (Requirement R3)</p>	<p>Record unit Real Power response to the first frequency excursion event that meets Criteria 1.</p> <p>OR</p> <p>Record unit Real Power response for an on-line speed governor reference change test or a partial load rejection test no more than 365 calendar days from the date of the submitted verification plan</p>	<p>Transmit the verified model and documentation and data to the Transmission Planner no more than 365 calendar days from the date that the response was recorded.</p>

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Event Triggering Verification	Verification Periodicity	Comments
<p>The Turbine/governor and load control and active power/frequency control model identified as unusable by the Transmission Planner.</p> <p>AND</p> <p>The Generator Owner has submitted a verification plan.</p> <p>(Requirement R3)</p>	<p>Record unit Real Power response to the first frequency excursion event that meets Criteria 1.</p> <p>OR</p> <p>Record unit Real Power response for an on-line speed governor reference change test or a partial load rejection test no more than 365 calendar days from the date that of the submitted verification plan</p>	<p>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.</p>
<p>New or existing applicable unit is not responsive to a frequency excursion event (The unit does not operate in a control mode, except during normal start up and shut down, that would result in a turbine/governor and load control or active power/frequency control mode response.)</p> <p>OR</p> <p>New or existing applicable unit has a disabled control system</p>	<p>Not required until responsive control mode operation for connected operations is established.</p>	<p>Document circumstance with a written statement.</p> <p>Perform verification per the periodicity specified in Row 3 for a “New Generating Unit” (or new equipment) once responsive control mode operation for connected operations is established.</p>
<p>New or existing applicable unit does not have an installed control system</p>	<p>Not required until unit has an installed control system</p>	<p>Document circumstance with a written statement.</p> <p>Perform verification per the periodicity specified in Row 3 for a “New Generating Unit” (or new equipment) once responsive control mode operation for connected operations is established.</p>