
Project QC-2015-01

Standards MOD-025-2, MOD-026-1 and MOD-027-1

1. ASSESSMENT OF RELEVANCE

The MOD standards are intended to standardize the methodologies and system data required for normal power system operation, planning, reliability assessments and available transfer capability calculations.

The MOD-025-2, MOD-026-1 and MOD-027-1 standards were developed as part of NERC Project 2007-09. They were approved by FERC on March 20, 2014.

The purpose of these standards is to ensure that generators will not trip off-line during specific voltage and frequency excursions or as a result of improper coordination between generator protective relays and generator voltage regulator controls and limit functions, and to ensure that generator models accurately reflect the generator's capabilities and operating characteristics.

More specifically:

- Verify and declare generator Real and Reactive power capability and synchronous condenser Reactive power capability.
- Verify that the generator excitation control system or plant volt/var control function model and model parameters accurately represent the behavior of these systems.
- Verify that the turbine/governor and load control or active power/frequency control model and the model parameters accurately represent the behavior of these systems.

These verifications are required to maintain Bulk Electric System reliability and ensure that specific data is verified and made available for planning simulations.

The models are used in operations and planning studies, which require the simulation of the response of the synchronous machines and their respective control systems. For these studies, the control systems of synchronous machines must be modeled in sufficient detail. The models must be able to represent the actual performance of the equipment during major, severe or minor disturbances.

2. PREREQUISITE FOR ADOPTION

None

3. MODIFICATIONS TO OTHER STANDARDS OR TO GLOSSARY DEFINITIONS

3.1. Standards or requirements to be retired upon enforcement:

None

3.2. New definitions to be added to the glossary:

None

3.3. Definitions to be modified in the glossary:

None

3.4. Definitions to be retired from the glossary:

None

4. APPLICABILITY

Requirements	Applicable Entities		
	Generator Owner (GO)	Transmission Operator (TO) Transmission Owner (TO)	Transmission Planner (TP)
MOD-025-2	x	x	
R1	x		
R2	x		
R3		x	
MOD-026-1	x		x
R1			x
R2	x		x
R3	x		
R4	x		
R5	x		
R6			x
MOD-027-1	x		x
R1			x
R2	x		
R3	x		
R4	x		
R5			x

5. PROVISIONS SPECIFIC TO QUÉBEC

MOD-025-2, MOD-026-1 and MOD-027-1 standards only apply to the facilities of the Main Transmission System (RTP).

For the purposes of Standard MOD-025-2, in Québec, the term “applicable Facility” shall mean any of the following:

- Generating plant/Facility that are part of the RTP ;
- Synchronous condenser that are part of the RTP.

For the purposes of Standards MOD-026-1 and MOD-027-1, in Québec, the term “applicable unit” shall mean generating stations that are part of the RTP with total generation capability greater than 100 MVA (gross aggregate nameplate rating).

6. PROPOSED EFFECTIVE DATES

6.1. MOD-025-2

Entities were given two years to implement Standard MOD-025-2 in the United States. After this time, 40% of all applicable Facilities must comply with all of its requirements. The table below presents the proposed dates for the compliance of all facilities in Québec.

Required level of compliance (all requirements) (%)	Proposed effective date for Québec
At least 40% of applicable Facilities	The first day of the first calendar quarter, one year after the adoption of the standard by the Régie de l'énergie.
At least 60% of applicable Facilities	The first day of the first calendar quarter, 18 months after the adoption of the standard by the Régie de l'énergie.
At least 80% of applicable Facilities	The first day of the first calendar quarter, two years after the adoption of the standard by the Régie de l'énergie.
100% of applicable Facilities	The first day of the first calendar quarter, 30 months after the adoption of the standard by the Régie de l'énergie.

6.2. MOD-026-1 and MOD-027-1

The initial effective date for Standards MOD-026-1 and MOD-027-1 in the United States is July 1st, 2014. The table below presents the proposed dates for Québec.

Requirements and verification percentage of the number of applicable units (%)	Proposed effective date for Québec
R1 and R3 to R6 (MOD-026-1) and R1 and R3 to R6 (MOD-027-1)	The first day of the first calendar quarter one month after the adoption of the standard by the Régie de l'énergie.
R2 for 30% of applicable units (MOD-026-1 and MOD-027-1)	The first day of the first calendar quarter, three years after the adoption of the standard by the Régie de l'énergie.
R2 for 50% of applicable units (MOD-026-1 and MOD-027-1)	The first day of the first calendar quarter, five years after the adoption of the standard by the Régie de l'énergie.
R2 for 100% of applicable units (MOD-026-1 and MOD-027-1)	The first day of the first calendar quarter, eight years after the adoption of the standard by the Régie de l'énergie.

7. PRELIMINARY ASSESSMENT OF THE IMPACT

MOD-025-2	Low	Moderate	High
Standard implementation		X	
Standard maintenance		X	
Compliance monitoring		X	

MOD-026-1	Low	Moderate	High
Standard implementation		X	
Standard maintenance		X	
Compliance monitoring		X	

MOD-027-1	Low	Moderate	High
Standard implementation		X	
Standard maintenance		X	
Compliance monitoring		X	

Legend:

- Low:** Normal industry practice that only requires minor adjustments to existing processes or practices.
- Moderate:** Change that requires allocation of some physical, human or financial resources to implement, maintain or monitor compliance with the proposed standard.
- High:** Change that requires allocation of significant physical, human or financial resources to plan, implement, maintain or monitor compliance with the proposed standard.

8. FINAL IMPACT ASSESSMENT

This section shall be completed upon receipt of the impact assessment forms and at the conclusion of the consultation process prior to filing of the reliability standards with the Régie de l'énergie.

A. Introduction

1. **Title:** Verification and Data Reporting of Generator Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability
2. **Number:** MOD-025-2
3. **Purpose:** To ensure that accurate information on generator gross and net Real and Reactive Power capability and synchronous condenser Reactive Power capability is available for planning models used to assess Bulk Electric System (BES) reliability.
4. **Applicability:**

4.1. Functional entities

4.1.1 Generator Owner

4.1.2 Transmission Owner that owns synchronous condenser(s)

4.2. Facilities:

For the purpose of this standard, the term, “applicable Facility” shall mean any one of the following:

4.2.1 Individual generating unit greater than 20 MVA (gross nameplate rating) directly connected to the Bulk Electric System.

4.2.2 Synchronous condenser greater than 20 MVA (gross nameplate rating) directly connected to the Bulk Electric System.

4.2.3 Generating plant/Facility greater than 75 MVA (gross aggregate nameplate rating) directly connected to the Bulk Electric System.

5. Effective Date:

5.1. In those jurisdictions where regulatory approval is required¹:

5.1.1 By the first day of the first calendar quarter, two calendar years following applicable regulatory approval, or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities, each Generator Owner and Transmission Owner shall have verified at least 40 percent of its applicable Facilities.

5.1.2 By the first day of the first calendar quarter, three calendar years following applicable regulatory approval, or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities, each Generator Owner and Transmission Owner shall have verified at least 60 percent of its applicable Facilities.

5.1.3 By the first day of the first calendar quarter, four calendar years following applicable regulatory approval, or as otherwise made effective pursuant to

¹ Wind Farm Verification - If an entity has two wind sites, and verification of one site is complete, the entity is 50% complete regardless of the number of turbines at each site. A wind site is a group of wind turbines connected at a common point of interconnection or utilizing a common aggregate control system.

the laws applicable to such ERO governmental authorities, each Generator Owner and Transmission Owner shall have verified at least 80 percent of its applicable Facilities.

5.1.4 By the first day of the first calendar quarter, five calendar years following applicable regulatory approval, or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities, each Generator Owner and Transmission Owner shall have verified 100 percent of its applicable Facilities.

5.2. In those jurisdictions where regulatory approval is not required²:

5.2.1 By the first day of the first calendar quarter, two calendar years following Board of Trustees approval, each Generator Owner and Transmission Owner shall have verified at least 40 percent of its applicable Facilities.

5.2.2 By the first day of the first calendar quarter, three calendar years following Board of Trustees approval, each Generator Owner and Transmission Owner shall have verified at least 60 percent of its applicable Facilities.

5.2.3 By the first day of the first calendar quarter, four calendar years following Board of Trustees approval, each Generator Owner and Transmission Owner shall have verified at least 80 percent of its applicable Facilities.

5.2.4 By the first day of the first calendar quarter, five calendar years following Board of Trustees approval, each Generator Owner and Transmission Owner shall have verified 100 percent of its applicable Facilities.

Note: The verification percentage above is based on the number of applicable units owned.

² Wind farm verification - If an entity has two wind sites, and verification of one site is complete, the entity is 50% complete regardless of the number of turbines at each site. A wind site is a group of wind turbines connected at a common point of interconnection or utilizing a common aggregate control system.

Requirements

- R1.** Each Generator Owner shall provide its Transmission Planner with verification of the Real Power capability of its applicable Facilities as follows: *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*
- 1.1.** Verify the Real Power capability of its generating units in accordance with Attachment 1.
 - 1.2.** Submit a completed Attachment 2 (or a form containing the same information as identified in Attachment 2) to its Transmission Planner within 90 calendar days of either (i) the date the data is recorded for a staged test; or (ii) the date the data is selected for verification using historical operational data.
- R2.** Each Generator Owner shall provide its Transmission Planner with verification of the Reactive Power capability of its applicable Facilities as follows: *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*
- 2.1.** Verify, in accordance with Attachment 1, (i) the Reactive Power capability of its generating units and (ii) the Reactive Power capability of its synchronous condenser units.
 - 2.2.** Submit a completed Attachment 2 (or a form containing the same information as identified in Attachment 2) to its Transmission Planner within 90 calendar days of either (i) the date the data is recorded for a staged test; or (ii) the date the data is selected for verification using historical operational data.
- R3.** Each Transmission Owner shall provide its Transmission Planner with verification of the Reactive Power capability of its applicable Facilities as follows: *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*
- 3.1.** Verify, in accordance with Attachment 1, the Reactive Power capability of its synchronous condenser units.
 - 3.2.** Submit a completed Attachment 2 (or a form containing the same information as identified in Attachment 2) to its Transmission Planner within 90 calendar days of either (i) the date the data is recorded for a staged test; or (ii) the date the data is selected for verification using historical operational data.

B. Measures

- M1.** Each Generator Owner will have evidence that it performed the verification, such as a completed Attachment 2 or the Generator Owner form with the same information or dated information collected and used to complete attachments, and will have evidence that it submitted the information within 90 days to its Transmission Planner; such as dated electronic mail messages or mail receipts in accordance with Requirement R1.
- M2.** Each Generator Owner will have evidence that it performed the verification, such as a completed Attachment 2 or the Generator Owner form with the same information, or dated information collected and used to complete attachments and will have evidence that it submitted the information within 90 days to its Transmission Planner; such as dated electronic mail messages or mail receipts in accordance with Requirement R2.

- M3.** Each Transmission Owner will have evidence that it performed the verification, such as a completed Attachment 2 or the Transmission Owner form with equivalent information or dated information collected and used to complete attachments, and will have evidence that it submitted the information within 90 days to its Transmission Planner; such as dated electronic mail messages or mail receipts in accordance with Requirement R3.

C. Compliance

1. Compliance Monitoring Process

1.1. Compliance Enforcement Authority

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

1.2. Evidence Retention

The following evidence retention periods identify a period of time an entity is required to retain specific evidence to demonstrate compliance. For instances where the evidence retention specified below is shorter than the time since the last compliance 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 Owner shall each keep the 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 Generator Owner shall retain the latest MOD-025 Attachment 2 and the data behind Attachment 2 or Generator Owner form with equivalent information and submittal evidence for Requirements R1 and R2, Measures M1 and M2 for the time period since the last compliance audit.
- The Transmission Owner shall retain the latest MOD-025 Attachment 2 and the data behind Attachment 2 or Transmission Owner form with equivalent information and submittal evidence for Requirement R3, Measure M3 for the time period since the last compliance audit.

If a Generator Owner or Transmission Owner is found noncompliant, it shall keep information related to the noncompliance until mitigation is complete 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

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2. Violation Severity Levels

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	<p>The Generator Owner verified and recorded the Real Power capability of its applicable generating unit, but submitted the data to its Transmission Planner more than 90 calendar days, but within 120 calendar days, of the date the data is recorded for a staged test or the date the data is selected for verification using historical operational data.</p> <p>OR</p> <p>The Generator Owner verified the Real Power capability, per Attachment 1 and submitted the data but was missing 1 to less than or equal to 33 percent of the data.</p>	<p>The Generator Owner verified and recorded the Real Power capability of its applicable generating unit, but submitted the data to its Transmission Planner more than 120 calendar days, but within 150 calendar days, of the date the data is recorded for a staged test or the date the data is selected for verification using historical operational data.</p> <p>OR</p> <p>The Generator Owner verified the Real Power capability, per Attachment 1 and submitted the data but was missing more than 33 to 66 percent of the data.</p>	<p>The Generator Owner verified and recorded the Real Power capability of its applicable generating unit, but submitted the data to its Transmission Planner more than 150 calendar days, but within 180 calendar days, of the date the data is recorded for a staged test or the date the data is selected for verification using historical operational data.</p> <p>OR</p> <p>The Generator Owner verified the Real Power capability, per Attachment 1 and submitted the data but was missing from 67 to 99 percent of the data.</p> <p>OR</p>	<p>The Generator Owner verified and recorded the Real Power capability of its applicable generating unit, but submitted the data to its Transmission Planner more than 180 calendar days of the date the data is recorded for a staged test or the date the data is selected for verification using historical operational data.</p> <p>OR</p> <p>The Generator Owner failed to verify the Real Power capability, per Attachment 1 of an applicable generating unit.</p> <p>OR</p> <p>The Generator Owner performed the Real Power verification per Attachment 1, “Periodicity for conducting a new verification” item</p>

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	<p>OR</p> <p>The Generator Owner performed the Real Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1 or item 2 (5 year requirement) but did so in more than 66 calendar months but less than or equal to 69 months.</p> <p>OR</p> <p>The Generator Owner performed the Real Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1, 2 or 3 (12 calendar month requirement) but did so in more than 12 calendar months but less than or equal to 13 calendar months.</p>	<p>OR</p> <p>The Generator Owner performed the Real Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1 or item 2 (5 year requirement) but did so in more than 69 calendar months but less than or equal to 72 months.</p> <p>OR</p> <p>The Generator Owner performed the Real Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1, 2 or 3 (12 calendar month requirement) but did so in more than 13 calendar months but less than or equal to 14 calendar months.</p>	<p>The Generator Owner performed the Real Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1 or item 2 (5 year requirement) but did so in more than 72 calendar months but less than or equal to 75 months.</p> <p>OR</p> <p>The Generator Owner performed the Real Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1, 2 or 3 (12 calendar month requirement) but did so in more than 14 calendar months but less than or equal to 15 calendar months.</p>	<p>1 or item 2 (5 year requirement) but did so in more than 75 calendar months.</p> <p>OR</p> <p>The Generator Owner performed the Real Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1, 2 or 3 (12 calendar month requirement) but did so in more than 15 calendar months.</p>
R2	The Generator Owner verified and recorded the	The Generator Owner verified and recorded the	The Generator Owner verified and recorded the Reactive	The Generator Owner verified and recorded the Reactive Power

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<p>Reactive Power capability of its applicable generating unit or applicable synchronous condenser, but submitted the data to its Transmission Planner more than 90 calendar days, but within 120 calendar days, of the date the data is recorded for a staged test or the date the data is selected for verification using historical operational data.</p> <p>OR</p> <p>The Generator Owner verified the Reactive Power capability, per Attachment 1 and submitted the data but was missing 1 to up to and including 33 percent of the data.</p> <p>OR</p> <p>The Generator Owner performed the Reactive Power verification per</p>	<p>Reactive Power capability of its applicable generating unit or applicable synchronous condenser, but submitted the data to its Transmission Planner more than 120 calendar days, but within 150 calendar days, of the date the data is recorded for a staged test or the date the data is selected for verification using historical operational data.</p> <p>OR</p> <p>The Generator Owner verified the Reactive Power capability, per Attachment 1 and submitted the data but was missing 34 to 66 percent of the data.</p> <p>OR</p> <p>The Generator Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1 or item 2</p>	<p>Power capability of its applicable generating unit or applicable synchronous condenser, but submitted the data to its Transmission Planner more than 150 calendar days, but within 180 calendar days, of the date the data is recorded for a staged test or the date the data is selected for verification using historical operational data.</p> <p>OR</p> <p>The Generator Owner verified the Reactive Power capability, per Attachment 1 and submitted the data but was missing 67 to 99 percent of the data.</p> <p>OR</p> <p>The Generator Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1 or item 2 (5 year requirement) but did so in more than 72</p>	<p>capability of its applicable generating unit or applicable synchronous condenser, but submitted the data to its Transmission Planner more than 180 calendar days of the date the data is recorded for a staged test or the date the data is selected for verification using historical operational data.</p> <p>OR</p> <p>The Generator Owner failed to verify the Reactive Power capability, per Attachment 1 of an applicable generating unit or synchronous condenser unit.</p> <p>OR</p> <p>The Generator Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1 or item 2 (5 year requirement) but did so in more than 75 calendar months.</p> <p>OR</p>
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	<p>Attachment 1, “Periodicity for conducting a new verification” item 1 or item 2 (5 year requirement) but did so in more than 66 calendar months but less than or equal to 69 months.</p> <p>OR</p> <p>The Generator Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1, 2 or 3 (12 calendar month requirement) but did so in more than 12 calendar months but less than or equal to 13 calendar months.</p>	<p>(5 year requirement) but did so in more than 69 calendar months but less than or equal to 72 months.</p> <p>OR</p> <p>The Generator Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1, 2 or 3 (12 calendar month requirement) but did so in more than 13 calendar months but less than or equal to 14 calendar months.</p>	<p>calendar months but less than or equal to 75 months.</p> <p>OR</p> <p>The Generator Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1, 2 or 3 (12 calendar month requirement) but did so in more than 14 calendar months but less than or equal to 15 calendar months.</p>	<p>The Generator Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1, 2 or 3 (12 calendar month requirement) but did so in more than 15 calendar months.</p>
R3	<p>The Transmission Owner verified and recorded the Reactive Power capability of its applicable synchronous condenser, but submitted the data to its Transmission Planner more</p>	<p>The Transmission Owner verified and recorded the Reactive Power capability of its applicable synchronous condenser, but submitted the data to its Transmission Planner more than 120</p>	<p>The Transmission Owner verified and recorded the Reactive Power capability of an applicable synchronous condenser unit, but submitted the data to its Transmission Planner more than 150</p>	<p>The Transmission Owner verified and recorded the Reactive Power capability of its applicable synchronous condenser, but submitted the data to its Transmission Planner more than 180 calendar days of the date the data is</p>

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<p>than 90 calendar days, but within 120 calendar days, of the date the data is recorded for a staged test or the date the data is selected for verification using historical operational data.</p> <p>OR</p> <p>The Transmission Owner verified the Reactive Power capability, per Attachment 1 and submitted the data but was missing 1 to up to and including 33 percent of the data.</p> <p>OR</p> <p>The Transmission Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1 or item 2 (5 year requirement) but did so in more than 66 calendar months but less</p>	<p>calendar days, but within 150 calendar days, of the date the data is recorded for a staged test or the date the data is selected for verification using historical operational data.</p> <p>OR</p> <p>The Transmission Owner verified the Reactive Power capability, per Attachment 1 and submitted the data but was missing 34 to 66 percent of the data.</p> <p>OR</p> <p>The Transmission Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1 or item 2 (5 year requirement) but did so in more than 69 calendar months but less than or equal to 72 months.</p>	<p>calendar days, but within 180 calendar days, of the date the data is recorded for a staged test or the date the data is selected for verification using historical operational data.</p> <p>OR</p> <p>The Transmission Owner verified the Reactive Power capability, per Attachment 1 and submitted the data but was missing 67 to 99 percent of the data.</p> <p>OR</p> <p>The Transmission Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1 or item 2 (5 year requirement) but did so in more than 72 calendar months but less than or equal to 75 months.</p>	<p>recorded for a staged test or the date the data is selected for verification using historical operational data.</p> <p>OR</p> <p>The Transmission Owner failed to verify the Reactive Power capability, per Attachment 1 of an applicable synchronous condenser unit.</p> <p>OR</p> <p>The Transmission Owner performed the verification per Attachment 1, “Periodicity for conducting a new verification” item 1 or item 2 (5 year requirement) but did so in more than 75 calendar months.</p> <p>OR</p> <p>The Transmission Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1, 2 or 3 (12 calendar month requirement) but did so in more than 15calendar months.</p>
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	<p>than or equal to 69 months.</p> <p>OR</p> <p>The Transmission Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1, 2 or 3 (12 calendar month requirement) but did so in more than 12 calendar months but less than or equal to 13 calendar months.</p>	<p>OR</p> <p>The Transmission Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1, 2 or 3 (12 calendar month requirement) but did so in more than 13 calendar months but less than or equal to 14 calendar months.</p>	<p>OR</p> <p>The Transmission Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new verification” item 1, 2 or 3 (12 calendar month requirement) but did so in more than 14 calendar months but less than or equal to 15 calendar months.</p>	
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D. Regional Variances

None

E. Associated Documents

Version History

Version	Date	Action	Change Tracking
1	12/1/2005	1. Changed tabs in footer. 2. Removed comma after 2004 in “Development Steps Completed,” #1. 3. Changed incorrect use of certain hyphens (-) to “en dash” (–) and “em dash (—).” 4. Added “periods” to items where appropriate. 5. Changed apostrophes to “smart” symbols. 6. Changed “Timeframe” to “Time Frame” in item D, 1.2. 7. Lower cased all instances of “regional” in section D.3. 8. Removed the word “less” after 94% in section 3.4. Level 4.	01/20/06
2	February 7, 2013	Adopted by NERC Board of Trustees	Revised per SAR for Project 2007-09 and combined with MOD-024-1
2	March 20, 2014	FERC Order issued approving MOD-025-2. (Order becomes effective on 7/1/16.)	

MOD-025 Attachment 1 – Verification of Generator Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability

Periodicity for conducting a new verification:

The periodicity for performing Real and Reactive Power capability verification is as follows:

1. For staged verification; verify each applicable Facility at least every five years (with no more than 66 calendar months between verifications), or within 12 calendar months of the discovery of a change that affects its Real Power or Reactive Power capability by more than 10 percent of the last reported verified capability and is expected to last more than six months. The first verification for each applicable Facility under this standard must be a staged test.
2. For verification using operational data; verify each applicable Facility at least every five years (with no more than 66 calendar months between verifications), or within 12 calendar months following the discovery that its Real Power or Reactive Power capability has changed by more than 10 percent of the last reported verified capability and is expected to last more than six months. If data for different points is recorded on different days, designate the earliest of those dates as the verification date, and report that date as the verification date on MOD-025, Attachment 2 for periodicity purposes.
3. For either verification method, verify each new applicable Facility within 12 calendar months of its commercial operation date. Existing units that have been in long term shut down and have not been tested for more than five years shall be verified within 12 calendar months.

It is intended that Real Power testing be performed at the same time as full load Reactive Power testing, however separate testing is allowed for this standard. For synchronous condensers, perform only the Reactive Power capability verifications as specified below.

If the Reactive Power capability is verified through test, it is to be scheduled at a time advantageous for the unit being verified to demonstrate its Reactive Power capabilities while the Transmission Operator takes measures to maintain the plant's system bus voltage at the scheduled value or within acceptable tolerance of the scheduled value.

Verification specifications for applicable Facilities:

1. For generating units of 20 MVA or less that are part of a plant greater than 75 MVA in aggregate, record data either on an individual unit basis or as a group. Perform verification individually for every generating unit or synchronous condenser greater than 20 MVA (gross nameplate rating).
2. Verify with all auxiliary equipment needed for expected normal operation in service for both the Real Power and Reactive Power capability verification. Perform verification with the automatic voltage regulator in service for the Reactive Power capability

verification. Operational data from within the two years prior to the verification date is acceptable for the verification of either the Real Power or the Reactive Power capability, as long as a) that operational data meets the criteria in 2.1 through 2.4 below and b) the operational data demonstrates at least 90 percent of a previously staged test that demonstrated at least 50 percent of the Reactive capability shown on the associated thermal capability curve (D-curve). If the previously staged test was unduly restricted (so that it did not demonstrate at least 50 percent of the associated thermal capability curve) by unusual generation or equipment limitations (e.g., capacitor or reactor banks out of service), then the next verification will be by another staged test, not operational data:

- 2.1.** Verify Real Power capability and Reactive Power capability over-excited (lagging) of all applicable Facilities at the applicable Facilities' normal (not emergency) expected maximum Real Power output at the time of the verifications.
 - 2.1.1** Verify synchronous generating unit's maximum real power and lagging reactive power for a minimum of one hour.
 - 2.1.2** Verify variable generating units, such as wind, solar, and run of river hydro, at the maximum Real Power output the variable resource can provide at the time of the verification. Perform verification of Reactive Power capability of wind turbines and photovoltaic inverters with at least 90 percent of the wind turbines or photovoltaic inverters at a site on-line. If verification of wind turbines or photovoltaic inverter Facility cannot be accomplished meeting the 90 percent threshold, document the reasons the threshold was not met and test to the full capability at the time of the test. Reschedule the test of the facility within six months of being able to reach the 90 percent threshold. Maintain, as steady as practical, Real and Reactive Power output during verifications.
- 2.2.** Verify Reactive Power capability of all applicable Facilities, other than wind and photovoltaic, for maximum overexcited (lagging) and under-excited (leading) reactive capability for the following conditions:
 - 2.2.1** At the minimum Real Power output at which they are normally expected to operate collect maximum leading and lagging reactive values as soon as a limit is reached.
 - 2.2.2** At maximum Real Power output collect maximum leading reactive values as soon as a limit is reached.
 - 2.2.3** Nuclear Units are not required to perform Reactive Power verification at minimum Real Power output.
- 2.3.** For hydrogen-cooled generators, perform the verification at normal operating hydrogen pressure.
- 2.4.** Calculate the Generator Step-Up (GSU) transformer losses if the verification measurements are taken from the high side of the GSU transformer. GSU

transformer real and reactive losses may be estimated, based on the GSU impedance, if necessary.

3. Record the following data for the verifications specified above:
 - 3.1. The value of the gross Real and Reactive Power generating capabilities at the end of the verification period.
 - 3.2. The voltage schedule provided by the Transmission Operator, if applicable.
 - 3.3. The voltage at the high and low side of the GSU and/or system interconnection transformer(s) at the end of the verification period. If only one of these values is metered, the other may be calculated.
 - 3.4. The ambient conditions, if applicable, at the end of the verification period that the Generator Owner requires to perform corrections to Real Power for different ambient conditions such as:
 - Ambient air temperature
 - Relative humidity
 - Cooling water temperature
 - Other data as determined to be applicable by the Generator Owner to perform corrections for ambient conditions.
 - 3.5. The date and time of the verification period, including start and end time in hours and minutes.
 - 3.6. The existing GSU and/or system interconnection transformer(s) voltage ratio and tap setting.
 - 3.7. The GSU transformer losses (real or reactive) if the verification measurements were taken from the high side of the GSU transformer.
 - 3.8. Whether the test data is a result of a staged test or if it is operational data.
4. Develop a simplified key one-line diagram (refer to MOD-025, Attachment 2) showing sources of auxiliary Real and Reactive Power and associated system connections for each unit verified. Include GSU and/or system Interconnection and auxiliary transformers. Show Reactive Power flows, with directional arrows.
 - 4.1. If metering does not exist to measure specific Reactive auxiliary load(s), provide an engineering estimate and associated calculations. Transformer Real and Reactive Power losses will also be estimates or calculations. Only output data are required when using a computer program to calculate losses or loads.
5. If an adjustment is requested by the Transmission Planner, then develop the relationships between test conditions and generator output so that the amount of Real Power that can be expected to be delivered from a generator can be determined at different conditions, such as peak summer conditions. Adjust MW values tested to the ambient conditions specified by the Transmission Planner upon request and submit them to the Transmission Planner within 90 days of the request or the date the data was recorded/selected whichever is later.

- Note 1: Under some transmission system conditions, the data points obtained by the Mvar verification required by the standard will not duplicate the manufacturer supplied thermal capability curve (D-curve). However, the verification required by the standard, even when conducted under these transmission system conditions, may uncover applicable Facility limitations; such as rotor thermal instability, improper tap settings or voltage ratios, inaccurate AVR operation, etc., which could be further analyzed for resolution. The Mvar limit level(s) achieved during a staged test or from operational data may not be representative of the unit's reactive capability for extreme system conditions. See Note 2.
- Note 2: While not required by the standard, it is desirable to perform engineering analyses to determine expected applicable Facility capabilities under less restrictive system voltages than those encountered during the verification. Even though this analysis will not verify the complete thermal capability curve (D-curve), it provides a reasonable estimate of applicable Facility capability that the Transmission Planner can use for modeling.
- Note 3: The Reactive Power verification is intended to define the limits of the unit's Reactive Power capabilities. If a unit has no leading capability, then it should be reported with no leading capability; or the minimum lagging capability at which it can operate.
- Note 4: Synchronous Condensers only need to be tested at two points (one over-excited point and one under-excited point) since they have no Real Power output.

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MOD-025 Attachment 2

One-line Diagram, Table, and Summary for Verification Information Reporting

Note: If the configuration of the applicable Facility does not lend itself to the use of the diagram, tables, or summaries for reporting the required information, changes may be made to this form, provided that all required information (identified in MOD-025, Attachment 1) is reported.

Company:

Reported By (name):

Plant:

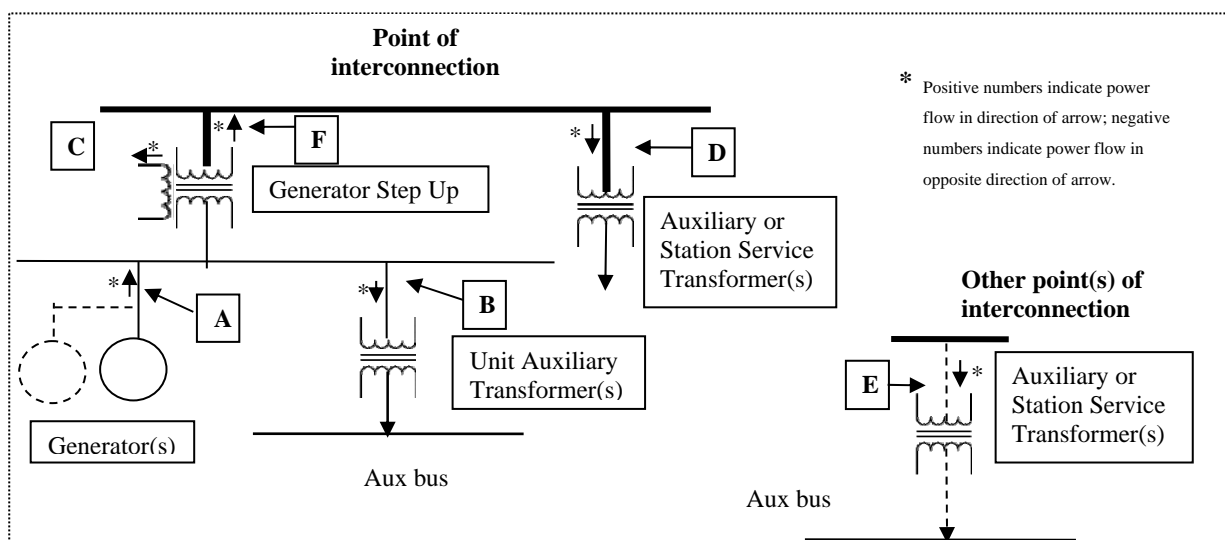
Unit No.:

Date of Report:

Check all that apply:

- ☐ Over-excited Full Load Reactive Power Verification
- ☐ Under-excited Full Load Reactive Power Verification
- ☐ Over-excited Minimum Load Reactive Power Verification
- ☐ Under-excited Minimum Load Reactive Power Verification
- ☐ Real Power Verification
- ☐ Staged Test Data
- ☐ Operational Data

Simplified one-line diagram showing plant auxiliary Load connections and verification data:



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Point	Voltage	Real Power	Reactive Power	Comment
A	kV	MW	Mvar	Sum multiple generators that are verified together or are part of the same unit. Report individual unit values separately whenever the verification measurements were taken at the individual unit. Individual values are required for units or synchronous condensers > 20 MVA.
Identify calculated values, if any:				
B	kV	MW	Mvar	Sum multiple unit auxiliary transformers.
Identify calculated values, if any:				
C	kV	MW	Mvar	Sum multiple tertiary Loads, if any.
Identify calculated values, if any:				
D	kV	MW	Mvar	Sum multiple auxiliary and station service transformers.
Identify calculated values, if any:				
E	kV	MW	Mvar	If multiple points of Interconnection, describe these for accurate modeling; report points individually (sum multiple auxiliary transformers).
F	kV	MW	Mvar	Net unit capability
Identify calculated values, if any:				

Standard MOD-025-2 — Verification and Data Reporting of Generator Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability

MOD-025 -Attachment 2 (continued)

Verification Data

Provide data by unit or Facility, as appropriate

Data Type	Data Recorded	Last Verification (Previous Data; will be blank for the initial verification)
Gross Reactive Power Capability (*Mvar)		
Aux Reactive Power (*Mvar)		
Net Reactive Power Capability (*Mvar) equals Gross Reactive Power Capability (*Mvar) minus Aux Reactive Power connected at the same bus (*Mvar) minus tertiary Reactive Power connected at the same bus(*Mvar)		
Gross Real Power Capability (*MW)		
Aux Real Power (*MW)		
Net Real Power Capability (*MW) equals Gross Real Power Capability (*MW) minus Aux Real Power connected at the same bus (*MW) minus tertiary Real Power connected at the same bus(*MW)		
* Note: Enter values at the end of the verification period.		
GSU losses (only required if verification measurements are taken on the high side of the GSU - Mvar)		

Summary of Verification

- Date of Verification _____, Verification Start Time _____, Verification End Time _____
- Scheduled Voltage _____
- Transformer Voltage Ratio: GSU _____, Unit Aux _____, Station Aux _____, Other Aux _____
- Transformer Tap Setting: GSU _____, Unit Aux _____, Station Aux _____, Other Aux _____
- Ambient conditions at the end of the verification period:

Air temperature: _____

Humidity: _____

Cooling water temperature: _____

Other data as applicable: _____

Standard MOD-025-2 — Verification and Data Reporting of Generator Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability

- Generator hydrogen pressure at time of test (if applicable) _____

Date that data shown in last verification column in table above was taken _____

Remarks :

Note: If the verification value did not reach the thermal capability curve (D-curve), describe the reason.

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Appendix QC-MOD-025-2 Provisions specific to the standard MOD-025-2 applicable in Québec

This appendix establishes specific provisions for the application of the standard in Québec. Provisions of the standard and of its appendix must be read together for the purposes of understanding and interpretation. Where the standard and appendix differ, the appendix shall prevail.

A. Introduction

- 1. Title:** **Verification and Data Reporting of Generator Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability**
- 2. Number:** MOD-025-2
- 3. Purpose:** No specific provision
- 4. Applicability:**
 - 4.1. Functional entities**
No specific provision
 - 4.2. Facilities**
 - 4.2.1** Generating unit that is part of the Main Transmission System (RTP).
 - 4.2.2** Synchronous condenser that is part of the Main Transmission System (RTP).
 - 4.2.3** Generating plant/Facility that is part of the Main Transmission System (RTP).
- 5. Effective Date:**
 - 5.1.** Adoption of the standard by the Régie de l'énergie: Month xx, 201x
 - 5.2.** Adoption of the appendix by the Régie de l'énergie: Month xx, 201x
 - 5.3.** Effective date of the standard and its appendix in Québec: Month xx, 201x

Requirements

No specific provision

B. Measures

No specific provision

C. Compliance

- 1. Compliance Monitoring Process**
 - 1.1. Compliance Enforcement Authority**
The Régie de l'énergie is responsible, in Québec, for compliance monitoring with respect to the reliability standard and its appendix that it adopts.
 - 1.2. Evidence Retention**
No specific provision

Standard MOD-025-2 — Verification and Data Reporting of Generator Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability

Appendix QC-MOD-025-2
Provisions specific to the standard MOD-025-2 applicable in Québec

1.3. Compliance Monitoring and Assessment Processes

No specific provision

1.4. Additional Compliance Information

No specific provision

2. Violation Severity Levels

No specific provision

D. Regional Variances

No specific provision

E. Associated Documents

No specific provision

MOD-025-2 – Attachment 1

No specific provision

MOD-025-2 – Attachment 2

No specific provision

Revision History

Version	Date	Action	Change Tracking
0	Month xx, 201x	New appendix	New

A. Introduction

1. **Title:** Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions
2. **Number:** MOD-026-1
3. **Purpose:** To verify that the generator excitation control system or plant volt/var control function¹ model (including the power system stabilizer model and the impedance compensator model) and the model parameters used in dynamic simulations accurately represent the generator excitation control system or plant volt/var control function behavior when assessing Bulk Electric System (BES) reliability.

4. **Applicability:**

- 4.1. **Functional Entities:**

- 4.1.1 Generator Owner

- 4.1.2 Transmission Planner

- 4.2. **Facilities:**

For the purpose of the requirements contained herein, Facilities that are directly connected to the Bulk Electric System (BES) will be collectively referred as an “applicable unit” that meet the following:

- 4.2.1 Generation in the Eastern or Quebec Interconnections with the following characteristics:

- 4.2.1.1 Individual generating unit greater than 100 MVA (gross nameplate rating).

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

- 4.2.2 Generation in the Western Interconnection with the following characteristics:

- 4.2.2.1 Individual generating unit greater than 75 MVA (gross nameplate rating).

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

¹ Excitation control system or plant volt/var control function:

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

4.2.3 Generation in the ERCOT Interconnection with the following characteristics:

4.2.3.1 Individual generating unit greater than 50 MVA (gross nameplate rating).

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

4.2.4 For all Interconnections:

- A technically justified² unit that meets NERC registry criteria but is not otherwise included in the above Applicability sections 4.2.1, 4.2.2, or 4.2.3 and is requested by the Transmission Planner.

5. Effective Date:

5.1. For Requirements R1, and R3 through R6, the first day of the first calendar quarter beyond the date that this standard is approved by applicable regulatory authorities or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities. In those jurisdictions where regulatory approval is not required, the standard shall become effective on the first day of the first calendar quarter beyond the date this standard is approved by the NERC Board of Trustees, or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.

5.2. For Requirement R2, 30 percent of the entity's applicable unit gross MVA for each Interconnection on the first day of the first calendar quarter that is four years following applicable regulatory approval or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities, or in those jurisdictions where no regulatory approval is required, on the first day of the first calendar quarter that is four years following NERC Board of Trustees adoption or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.

5.3. For Requirement R2, 50 percent of the entity's applicable unit gross MVA for each Interconnection on first day of the first calendar quarter that is six years following applicable regulatory approval or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities, or in those jurisdictions where no regulatory approval is required, on the first day of the first calendar quarter that is six years following NERC Board of Trustees adoption or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.

5.4. For Requirement R2, 100 percent of the entity's applicable unit gross MVA for each Interconnection on the first day of the first calendar quarter that is 10 years

² Technical justification is achieved by the Transmission Planner demonstrating that the simulated unit or plant response does not match the measured unit or plant response.

following applicable regulatory approval or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities, or in those jurisdictions where no regulatory approval is required, on the first day of the first calendar quarter that is 10 years following NERC Board of Trustees adoption or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.

B. Requirements

- R1.** Each Transmission Planner shall provide the following requested information to the Generator Owner within 90 calendar days of receiving a written request : *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*
- Instructions on how to obtain the list of excitation control system or plant volt/var control function models that are acceptable to the Transmission Planner for use in dynamic simulation,
 - Instructions on how to obtain the dynamic excitation control system or plant volt/var control function model library block diagrams and/or data sheets for models that are acceptable to the Transmission Planner, or
 - Model data for any of the Generator Owner's existing applicable unit specific excitation control system or plant volt/var control function contained in the Transmission Planner's dynamic database from the current (in-use) models, including generator MVA base.
- R2.** Each Generator Owner shall provide for each applicable unit, a verified generator excitation control system or plant volt/var control function model, including documentation and data (as specified in Part 2.1) to its Transmission Planner in accordance with the periodicity specified in MOD-026 Attachment 1. *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*
- 2.1.** Each applicable unit's model shall be verified by the Generator Owner using one or more models acceptable to the Transmission Planner. Verification for individual units less than 20 MVA (gross nameplate rating) in a generating plant (per Section 4.2.1.2, 4.2.2.2, or 4.2.3.2) may be performed using either individual unit or aggregate unit model(s), or both. Each verification shall include the following:
- 2.1.1.** Documentation demonstrating the applicable unit's model response matches the recorded response for a voltage excursion from either a staged test or a measured system disturbance,
 - 2.1.2.** Manufacturer, model number (if available), and type of the excitation control system including, but not limited to static, AC brushless, DC rotating, and/or the plant volt/var control function (if installed),
 - 2.1.3.** Model structure and data including, but not limited to reactance, time constants, saturation factors, total rotational inertia, or equivalent data for the generator,

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- 2.1.4. Model structure and data for the excitation control system, including the closed loop voltage regulator if a closed loop voltage regulator is installed or the model structure and data for the plant volt/var control function system,
- 2.1.5. Compensation settings (such as droop, line drop, differential compensation), if used, and
- 2.1.6. Model structure and data for power system stabilizer, if so equipped.

R3. Each Generator Owner shall provide a written response to its Transmission Planner within 90 calendar days of receiving one of the following items for an applicable unit:

- Written notification from its Transmission Planner (in accordance with Requirement R6) that the excitation control system or plant volt/var control function model is not usable,
- Written comments from its Transmission Planner identifying technical concerns with the verification documentation related to the excitation control system or plant volt/var control function model, or
- Written comments and supporting evidence from its Transmission Planner indicating that the simulated excitation control system or plant volt/var control function model response did not match the recorded response to a transmission system event.

The written response shall contain either the technical basis for maintaining the current model, the model changes, or a plan to perform model verification³ (in accordance with Requirement R2). *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

R4. Each Generator Owner shall provide revised model data or plans to perform model verification⁴ (in accordance with Requirement R2) for an applicable unit to its Transmission Planner within 180 calendar days of making changes to the excitation control system or plant volt/var control function that alter the equipment response characteristic.⁵ *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

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

⁴ Ibid

⁵ Exciter, voltage regulator, plant volt/var or power system stabilizer control replacement including software alterations that alter excitation control system equipment response, plant digital control system addition or replacement, plant digital control system software alterations that alter excitation control system equipment response, plant volt/var function equipment addition or replacement (such as static var systems, capacitor banks, individual unit excitation systems, etc), a change in the voltage control mode (such as going from power factor control to automatic voltage control, etc), exciter, voltage regulator, impedance compensator, or power system stabilizer settings change. Automatic changes in settings that occur due to changes in operating mode do not apply to Requirement R4.

- R5.** Each Generator Owner shall provide a written response to its Transmission Planner, within 90 calendar days following receipt of a technically justified⁶ unit request from the Transmission Planner to perform a model review of a unit or plant that includes one of the following: [*Violation Risk Factor: Lower*] [*Time Horizon: Operations Planning*]
- Details of plans to verify the model (in accordance with Requirement R2), or
 - Corrected model data including the source of revised model data such as discovery of manufacturer test values to replace generic model data or updating of data parameters based on an on-site review of the equipment.
- R6.** Each Transmission Planner shall provide a written response to the Generator Owner within 90 calendar days of receiving the verified excitation control system or plant volt/var control function model information in accordance with Requirement R2 that the model is usable (meets the criteria specified in Parts 6.1 through 6.3) or is not usable.
- 6.1.** The excitation control system or plant volt/var control function model initializes to compute modeling data without error,
- 6.2.** A no-disturbance simulation results in negligible transients, and
- 6.3.** For an otherwise stable simulation, a disturbance simulation results in the excitation control and plant volt/var control function model exhibiting positive damping.

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

C. Measures

- M1.** The Transmission Planner must have and provide the dated request for instructions or data, the transmitted instructions or data, and dated evidence of a written transmittal (e.g., electronic mail message, postal receipt, or confirmation of facsimile) as evidence that it provided the request within 90 calendar days in accordance with Requirement R1.
- M2.** The Generator Owner must have and provide dated evidence it verified each generator excitation control system or plant volt/var control function model according to Part 2.1 for each applicable unit and a dated transmittal (e.g., electronic mail message, postal receipt, or confirmation of facsimile) as evidence it provided the model, documentation, and data to its Transmission Planner, in accordance with Requirement R2.
- M3.** Evidence for Requirement R3 must include the Generator Owner's dated written response containing the information identified in Requirement R3 and dated evidence

⁶ Technical justification is achieved by the Transmission Planner demonstrating that the simulated unit or plant response does not match the measured unit or plant response.

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

- M4.** Evidence for Requirement R4 must include, for each of the Generator Owner's applicable units for which system changes specified in Requirement R4 were made, a dated revised model data or plans to perform a model verification and dated evidence (e.g., electronic mail message, postal receipt, or confirmation of facsimile) it provided the revised model and data or plans within 180 calendar days of making changes.
- M5.** Evidence for Requirement R5 must include the Generator Owner's dated written response containing the information identified in Requirement R5 and dated evidence (e.g., electronic mail message, postal receipt, or confirmation of facsimile) it provided a written response within 90 calendar days following receipt of a technically justified request.
- M6.** Evidence of Requirement R6 must include, for each model received, the dated response indicating the model was usable or not usable according to the criteria specified in Parts 6.1 through 6.3 and for a model that is not usable, a technical description; and dated evidence of transmittal (e.g., electronic mail message, postal receipt, or confirmation of facsimile) that the Generator Owner was notified within 90 calendar days of receipt of model information.

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance Enforcement Authority

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

1.2. Data Retention

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

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

- The Transmission Planner shall retain the information/data request and provided response evidence of Requirements R1 and R6, Measures M1 and M6 for three calendar years from the date the document was provided.

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- The Generator Owner shall retain the latest excitation control system or plant volt/var control function model verification evidence of Requirement R2, Measure M2.
- The Generator Owner shall retain the information/data request and provided response evidence of Requirements R3 through R5, and Measures M3 through M5 for three calendar years from the date the document was provided.

If a Generator Owner or Transmission Planner is found non-compliant, it shall keep information related to the non-compliance until mitigation is complete or approved or for the time specified above, whichever is longer.

The Compliance Enforcement Authority shall keep the last audit records and all requested and submitted subsequent audit records.

1.3. Compliance Monitoring and Assessment Processes

Compliance Audit

Self-Certification

Spot Checking

Compliance Investigation

Self-Reporting

Complaints

1.4. Additional Compliance Information

None

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2. Violation Severity Levels

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	The Transmission Planner provided the instructions and data to the Generator Owner more than 90 calendar days but less than or equal to 120 calendar days of receiving a written request.	The Transmission Planner provided the instructions and data to the Generator Owner more than 120 calendar days but less than or equal to 150 calendar days of receiving a written request.	The Transmission Planner provided the instructions and data to the Generator Owner more than 150 calendar days but less than or equal to 180 calendar days of receiving a written request.	The Transmission Planner failed to provide the instructions and data to the Generator Owner within 180 calendar days of receiving a written request.
R2	<p>The Generator Owner provided its verified model(s), including documentation and data to its Transmission Planner after the timeframe specified in MOD-026 Attachment 1 but less than or equal to 90 calendar days late;</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner verified models that omitted one of the six Parts identified in Requirement R2, Parts 2.1.1 through 2.1.6.</p>	<p>The Generator Owner provided its verified model(s), including documentation and data to its Transmission Planner more than 90 calendar days but less than or equal to 180 calendar days late as specified by the periodicity timeframe in MOD-026 Attachment 1.</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner verified models that omitted two of the six Parts identified in Requirement R2, Parts 2.1.1 through 2.1.6.</p>	<p>The Generator Owner provided its verified model(s), including documentation and data to its Transmission Planner more than 180 calendar days but less than or equal to 270 calendar days late as specified by the periodicity timeframe in MOD-026 Attachment 1.</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner verified models that omitted three of the six Parts identified in Requirement R2, Parts 2.1.1 through 2.1.6.</p>	<p>The Generator Owner provided its verified model(s), including documentation and data more than 270 calendar days late to its Transmission Planner in accordance with the periodicity specified in MOD-026 Attachment 1.</p> <p>OR</p> <p>The Generator Owner failed to use model(s) acceptable to the Transmission Planner as specified in Requirement R2, Part 2.1.</p> <p>OR</p> <p>The Generator Owner provided the Transmission Planner verified model(s) but omitted four or more of the six parts identified in Requirement R2, Subparts 2.1.1 through 2.1.6.</p>

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R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R3	The Generator Owner provided a written response more than 90 calendar days but less than or equal to 120 calendar days of receiving written notice.	The Generator Owner provided a written response more than 120 calendar days but less than or equal to 150 calendar days of receiving written notice.	The Generator Owner provided a written response more than 150 calendar days but less than or equal to 180 calendar days of receiving written notice.	The Generator Owner failed to provide a written response within 180 calendar days of receiving written notice. OR The Generator Owner's written response failed to contain either the technical basis for maintaining the current model, or a list of future model changes, or a plan to perform another model verification.
R4	The Generator Owner provided revised model data or plans to perform model verification more than 180 calendar days but less than or equal to 210 calendar days of making changes to the excitation control system or plant volt/var control function that altered the equipment response characteristic.	The Generator Owner provided revised model data or plans to perform model verification more than 210 calendar days but less than or equal to 240 calendar days of making changes to the excitation control system or plant volt/var control function that altered the equipment response characteristic.	The Generator Owner provided revised model data or plans to perform model verification more than 240 calendar days but less than or equal to 270 calendar days of making changes to the excitation control system or plant volt/var control function that altered the equipment response characteristic.	The Generator Owner failed to provide revised model data or failed to provide plans to perform model verification within 270 calendar days of making changes to the excitation control system or plant volt/var control function that altered the equipment response characteristic.
R5	The Generator Owner provided a written response more than 90 calendar days but less than or equal to 120 calendar days to the Transmission Planner following receipt of a technically justified request to perform a model review of an applicable unit.	The Generator Owner provided a written response more than 120 calendar days but less than or equal to 150 calendar days to the Transmission Planner following receipt of a technically justified request to perform a model review of an applicable unit.	The Generator Owner provided a written response more than 150 calendar days but less than or equal to 180 calendar days to the Transmission Planner following receipt of a technically justified request to perform a model review of an applicable unit.	The Generator Owner failed to provide a written response to the Transmission Planner within 180 calendar days following receipt of a technically justified request to perform a model review of an applicable unit. OR The Generator Owner's written response failed to include one of the sub bullets of Requirement R5.

Standard MOD-026-1 — Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions

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

E. Regional Variances

None.

F. Associated Documents

None.

Version History

Version	Date	Action	Change Tracking
1	February 7, 2013	Adopted by NERC Board of Trustees	New
1	March 20, 2014	FERC Order issued approving MOD-026-1. (Order becomes effective for R1, R3, R4, R5, and R6 on 7/1/14. R2 becomes effective on 7/1/18.)	

G. References

The following documents contain technical information beyond the scope of this Standard on excitation control system functionality, modeling, and testing.

1. IEEE 421.1 Definitions for Excitation Systems for Synchronous Machines
2. IEEE 421.2 Guide for Identification, Testing, and Evaluation of the Dynamic Performance of Excitation Control Systems
3. IEEE 421.5 IEEE Recommended Practice for Excitation System Models for Power System Stability Studies
4. K. Clark, R.A. Walling, N.W. Miller, "Solar Photovoltaic (PV) Plant Models in PSLF," IEEE/PES General Meeting, Detroit, MI, July 2011
5. M. Asmine, J. Brochu, J. Fortmann, R. Gagnon, Y. Kazachkov, C.-E. Langlois, C. Larose, E. Muljadi, J. MacDowell, P. Pourbeik, S. A. Seman, and K. Wiens, "Model Validation for Wind Turbine Generator Models", IEEE Transactions on Power System, Volume 26, Issue 3, August 2011
6. A. Ellis, E. Muljadi, J. Sanchez-Gasca, Y. Kazachkov, "Generic Models for Simulation of Wind Power Plants in Bulk System Planning Studies," IEEE PES General Meeting 2011, Detroit, MI, July 24-28
7. N.W. Miller, J. J. Sanchez-Gasca, K. Clark, J.M. MacDowell, "Dynamic Modeling of GE Wind Plants for Stability Simulations," IEEE PES General Meeting 2011, Detroit, MI, July 24-28
8. A. Ellis, Y. Kazachkov, E. Muljadi, P. Pourbeik, J.J. Sanchez-Gasca, Working Group Joint Report – WECC Working Group on Dynamic Performance of Wind Power Generation & IEEE Working Group on Dynamic Performance of Wind Power Generation, "Description and Technical Specifications for Generic WTG Models – A Status Report," Proc. IEEE PES 2011 Power Systems Conference and Exposition (PSCE), March 2011, Phoenix, AZ
9. K. Clark, N.W. Miller, R.A. Walling, "Modeling of GE Solar Photovoltaic (PV) Plants for Grid Studies," version 1.1, April 2010
10. K. Clark, N.W. Miller, J. J. Sanchez-Gasca, "Modeling of GE Wind Turbine-Generators for Grid Studies," version 4.5, April 16, 2010, Available from GE Energy
11. R.J. Piwko, N.W. Miller, J.M. MacDowell, "Field Testing & Model Validation of Wind Plants," in Proc. IEEE PES General Meeting, Pittsburg, PA, July 2008
12. N. Miller, K. Clark, J. MacDowell and W. Barton, "Experience with Field and Factory Testing for Model Validation of GE Wind Plants," in Proc. Eur. Wind Energy Conf. Exhib., Brussels, Belgium, March/April 2008

13. IEEE Task Force on Generator Model Validation Testing of the Power System Stability Subcommittee, “Guidelines for Generator Stability Model Validation Testing,” IEEE PES General Meeting 2007, paper 07GM1307
14. W.W. Price and J. J. Sanchez-Gasca, “Simplified Wind Turbine Generator Aerodynamic Models for Transient Stability Studies,” in PROC IEEE PES 2006 Power Systems Conf. Expo. (PSCE), Atlanta, GA, October 1, 2006, p. 986-992
15. J.J. Sanchez-Gasca, R.J. Piwko, N. W. Miller, W. W. Price, “On the Integration of Wind Power Plants in Large Power Systems,” Proc. X Symposium of Specialists in Electric and Expansion Planning (SEPOPE), Florianopolis, Brazil, May 2006
16. N. W. Miller, J. J. Sanchez-Gasca, W. W. Price, R. W. Delmerico, “Dynamic Modeling of GE 1.5 and 3.6 MW Wind Turbine-Generators for Stability Simulations,” Proc. IEEE Power Engineering Society General Meeting, Toronto, Ontario, July 2003
17. P. Pourbeik, C. Pink and R. Bisbee, “Power Plant Model Validation for Achieving Reliability Standard Requirements Based on Recorded On-Line Disturbance Data”, Proceedings of the IEEE PSCE, March, 2011

MOD-026 Attachment 1 Excitation Control System or Plant Volt/Var Function Model Verification Periodicity		
Row Number	Verification Condition	Required Action
1	Establishing the initial verification date for an applicable unit. (Requirement R2)	Transmit the verified model, documentation and data to the Transmission Planner on or before the Effective Date. Row 4 applies when calculating generation fleet compliance during the 10-year implementation period. See Section A5 for Effective Dates.
2	Subsequent verification for an applicable unit. (Requirement R2)	Transmit the verified model, documentation and data to the Transmission Planner on or before the 10-year anniversary of the last transmittal (per Note 1).
3	Initial verification for a new applicable unit or for an existing applicable unit with new excitation control system or plant volt/var control function equipment installed. (Requirement R2)	Transmit the verified model, documentation and data to the Transmission Planner within 365 calendar days after the commissioning date.

Standard MOD-026-1 — Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions

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

Standard MOD-026-1 — Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions

MOD-026 Attachment 1 Excitation Control System or Plant Volt/Var Function Model Verification Periodicity		
Row Number	Verification Condition	Required Action
6	<p>New or existing applicable unit does not include an active closed loop voltage or reactive power control function.</p> <p>(Requirement R2)</p>	<p>Requirement 2 is met with a written statement to that effect transmitted to the Transmission Planner.</p> <p>Perform verification per the periodicity specified in Row 3 for a “New Generating Unit” (or new equipment) only if active closed loop function is established.</p> <p>See Footnote 1 (see Section A.3) for clarification of what constitutes an active closed loop function for both conventional synchronous machines (reference Footnote 1a) and aggregate generating plants (reference Footnote 1b).</p>
7	<p>Existing applicable unit has a current average net capacity factor over the most recent three calendar years, beginning on January 1 and ending on December 31 of 5% or less.</p> <p>(Requirement R2)</p>	<p>Requirement 2 is met with a written statement to that effect transmitted to the Transmission Planner.</p> <p>At the end of this 10-year timeframe, the current average three year net capacity factor (for years 8, 9, and 10) can be examined to determine if the capacity factor exemption can be declared for the next 10-year period. If not eligible for the capacity factor exemption, then model verification must be completed within 365 calendar days of the date the capacity factor exemption expired.</p> <p>For the definition of net capacity factor, refer to Appendix F of the GADS Data Reporting Instructions on the NERC website.</p>

MOD-026 Attachment 1		
Excitation Control System or Plant Volt/Var Function Model Verification Periodicity		
Row Number	Verification Condition	Required Action
NOTES: NOTE 1: Establishing the recurring 10-year unit verification period start date: The start date is the actual date of submittal of a verified model to the Transmission Planner for the most recently performed unit verification. NOTE 2: Consideration for early compliance: Existing generator excitation control system or plant volt/var control function model verification is sufficient for demonstrating compliance for a 10-year period from the actual transmittal date if either of the following applies: <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-026-1 — Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions

Appendix QC-MOD-026-1 Provisions specific to the standard MOD-026-1 applicable in Québec

This appendix establishes specific provisions for the application of the standard in Québec. Provisions of the standard and of its appendix must be read together for the purposes of understanding and interpretation. Where the standard and appendix differ, the appendix shall prevail.

A. Introduction

1. **Title:** **Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions**
2. **Number:** MOD-026-1
3. **Purpose:** No specific provision
4. **Applicability:**
 - 4.1. **Functional entities**
No specific provision
 - 4.2. **Facilities**
For the purpose of the requirements contained herein, Facilities that form part of the Main Transmission System (RTP) will be collectively referred as an “applicable unit” that meet the following:
 - 4.2.1 No specific provision
 - 4.2.1.1 No specific provision
 - 4.2.1.2 Individual generating plant consisting of multiple generating units that is part of the Main Transmission System (RTP) with total generation greater than 100 MVA (gross aggregate nameplate rating).
 - 4.2.2 No specific provision
 - 4.2.3 No specific provision
 - 4.2.4 No specific provision
5. **Effective Date:**
 - 5.1. Adoption of the standard by the Régie de l'énergie: Month xx, 201x
 - 5.2. Adoption of the appendix by the Régie de l'énergie: Month xx, 201x
 - 5.3. Effective date of the standard and its appendix in Québec: Month xx, 201x

B. Requirements

No specific provision

C. Measures

No specific provision

Standard MOD-026-1 — Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions

Appendix QC-MOD-026-1
Provisions specific to the standard MOD-026-1 applicable in Québec

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance Enforcement Authority

The Régie de l'énergie is responsible, in Québec, for compliance monitoring with respect to the reliability standard and its appendix that it adopts.

1.2. Evidence Retention

No specific provision

1.3. Compliance Monitoring and Assessment Processes

No specific provision

1.4. Additional Compliance Information

No specific provision

2. Violation Severity Levels

No specific provision

E. Regional Variances

No specific provision

F. Associated Documents

No specific provision

G. References

No specific provision

MOD-026-1 – Attachment 1

No specific provision

Revision History

Version	Date	Action	Change Tracking
0	xx/xx/201x	New appendix	New

A. Introduction

1. **Title:** Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions
2. **Number:** MOD-027-1
3. **Purpose:** To verify that the turbine/governor and load control or active power/frequency control¹ model and the model parameters, used in dynamic simulations that assess Bulk Electric System (BES) reliability, 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 the requirements contained herein, Facilities that are directly connected to the Bulk Electric System (BES) will be collectively referred to as an “applicable unit” that meet the following:

- 4.2.1 Generation in the Eastern or Quebec Interconnections with the following characteristics:

- 4.2.1.1 Individual generating unit greater than 100 MVA (gross nameplate rating).

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

- 4.2.2 Generation in the Western Interconnection with the following characteristics:

- 4.2.2.1 Individual generating unit greater than 75 MVA (gross nameplate rating).

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

- 4.2.3 Generation in the ERCOT Interconnection with the following characteristics:

¹ Turbine/governor and load control 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).

4.2.3.1 Individual generating unit greater than 50 MVA (gross nameplate rating).

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

5. Effective Date:

- 5.1.** For Requirements R1, and R3 through R5, the first day of the first calendar quarter beyond the date that this standard is approved by applicable regulatory authorities or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities. In those jurisdictions where regulatory approval is not required, the standard shall become effective on the first day of the first calendar quarter beyond the date this standard is approved by the NERC Board of Trustees, or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.
- 5.2.** For Requirement R2, 30 percent of the entity's applicable unit gross MVA for each Interconnection on the first day of the first calendar quarter that is four years following applicable regulatory approval or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities, or in those jurisdictions where no regulatory approval is required, on the first day of the first calendar quarter that is four years following NERC Board of Trustees adoption or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.
- 5.3.** For Requirement R2, 50 percent of the entity's applicable unit gross MVA for each Interconnection on first day of the first calendar quarter that is six years following applicable regulatory approval or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities, or in those jurisdictions where no regulatory approval is required, on the first day of the first calendar quarter that is six years following NERC Board of Trustees adoption or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.
- 5.4.** For Requirement R2, 100 percent of the entity's applicable unit gross MVA for each Interconnection on the first day of the first calendar quarter that is 10 years following applicable regulatory approval or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities, or in those jurisdictions where no regulatory approval is required, on the first day of the first calendar quarter that is 10 years following NERC Board of Trustees adoption or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities.

B. Requirements

- R1.** Each Transmission Planner shall provide the following requested information to the Generator Owner within 90 calendar days of receiving a written request: *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*
- Instructions on how to obtain the list of turbine/governor and load control 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 dynamic turbine/governor and load control or active power/frequency control function model library block diagrams and/or data sheets for models that are acceptable to the Transmission Planner, or
 - Model data for any of the Generator Owner's existing applicable unit specific turbine/governor and load control or active power/frequency control system contained in the Transmission Planner's dynamic database from the current (in-use) models.
- R2.** Each Generator Owner shall provide, for each applicable unit, a verified turbine/governor and load control or active power/frequency control model, including documentation and data (as specified in Part 2.1) to its Transmission Planner in accordance with the periodicity specified in MOD-027 Attachment 1. *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*
- 2.1.** Each applicable unit's model shall be verified by the Generator Owner using one or more models acceptable to the Transmission Planner. Verification for individual units rated less than 20 MVA (gross nameplate rating) in a generating plant (per Section 4.2.1.2, 4.2.2.2, or 4.2.3.2) may be performed using either individual unit or aggregate unit model(s) or both. Each verification shall include the following:
- 2.1.1.** Documentation comparing the applicable unit's MW model response to the recorded MW response for either:
- A frequency excursion from a system disturbance that meets MOD-027 Attachment 1 Note 1 with the applicable unit on-line,
 - A speed governor reference change with the applicable unit on-line, or
 - A partial load rejection test,²
- 2.1.2.** Type of governor and load control or active power control/frequency control³ equipment,

² 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.

³ Turbine/governor and load control or active power/frequency control:

- 2.1.3. A description of the turbine (e.g. for hydro 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),
 - 2.1.4. Model structure and data for turbine/governor and load control or active power/frequency control, and
 - 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.
- R3.** Each Generator Owner shall provide a written response to its Transmission Planner within 90 calendar days of receiving one of the following items for an applicable unit.
- Written notification, from its Transmission Planner (in accordance with Requirement R5) that the turbine/governor and load control or active power/frequency control model is not “usable,”
 - Written comments from its Transmission Planner identifying technical concerns with the verification documentation related to the turbine/governor and load control or active power/frequency control model, or
 - Written comments and supporting evidence from its Transmission Planner indicating that the simulated turbine/governor and load control 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 verification⁴ (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 verification⁵ (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 or active power/frequency control system that alter the equipment response characteristic⁶. [*Violation Risk Factor: Lower*] [*Time Horizon: Operations Planning*]

-
- 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).

⁴ If verification is performed, the 10 year period as outlined in MOD-027 Attachment 1 is reset.

⁵ Ibid.

⁶ 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).

- R5.** Each Transmission Planner shall provide a written response to the Generator Owner within 90 calendar days of receiving the turbine/governor and load control or active power/frequency control system verified model information in accordance with Requirement R2 that the model is usable (meets the criteria specified in Parts 5.1 through 5.3) or is not usable.
- 5.1.** The turbine/governor and load control or active power/frequency control function model initializes to compute modeling data without error,
- 5.2.** A no-disturbance simulation results in negligible transients, and
- 5.3.** For an otherwise stable simulation, a disturbance simulation results in the turbine/governor and load control or active power/frequency control model exhibiting positive damping.

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

C. Measures

- M1.** The Transmission Planner must have and provide the dated request for instructions or data, the transmitted instruction or data, and dated evidence of a written transmittal (e.g., electronic mail message, postal receipt, or confirmation of facsimile) as evidence that it provided the request within 90 calendar days in accordance with Requirement R1.
- M2.** The Generator Owner must have and provide dated evidence it verified each generator turbine/governor and load control or active power/frequency control model according to Part 2.1 for each applicable unit and a dated transmittal (e.g., electronic mail message, postal receipt, or confirmation of facsimile) as evidence it provided the model, documentation, and data to its Transmission Planner, in accordance with Requirement R2.
- M3.** Evidence for Requirement R3 must include the Generator Owner's dated written response containing the information identified in Requirement R3 and dated evidence of transmittal (e.g., electronic mail message, postal receipt, or confirmation of facsimile) of the response.
- M4.** Evidence for Requirement R4 must include, for each of the Generator Owner's applicable units for which system changes specified in Requirement R4 were made, dated revised model data or dated plans to perform a model verification and dated evidence of transmittal (e.g., electronic mail message, postal receipt, or confirmation of facsimile) within 180 calendar days of making changes.
- M5.** Evidence of Requirement R5 must include, for each model received, the dated response indicating the 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 (e.g., electronic mail messages, postal receipts, or confirmation of facsimile) 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

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 turbine/governor and load control 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

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

2. Violation Severity Levels

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	The Transmission Planner provided the instructions and data to the Generator Owner more than 90 calendar days but less than or equal to 120 calendar days of receiving a written request.	The Transmission Planner provided the instructions and data to the Generator Owner more than 120 calendar days but less than or equal to 150 calendar days of receiving a written request.	The Transmission Planner provided the instructions and data to the Generator Owner more than 150 calendar days but less than or equal to 180 calendar days of receiving a written request.	The Transmission Planner failed to provide the instructions and data to the Generator Owner within 180 calendar days of receiving a written request.
R2	<p>The Generator Owner provided its verified model(s) to its Transmission Planner after the periodicity timeframe specified in MOD-027 Attachment 1 but less than or equal to 90 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 90 calendar days but less than or equal to 180 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 180 calendar days but less than or equal to 270 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 model(s) more than 270 calendar days late 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, Part 2.1;</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>

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

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R3	The Generator Owner provided a written response more than 90 calendar days but less than or equal to 120 calendar days of receiving written notice.	The Generator Owner provided a written response more than 120 calendar days but less than or equal to 150 calendar days of receiving written notice.	The Generator Owner provided a written response more than 150 calendar days but less than or equal to 180 calendar days of receiving written notice.	The Generator Owner failed to provide a written response within 180 calendar days of receiving written notice; OR The Generator Owner's written response failed to contain either the technical basis for maintaining the current model, or a list of future model changes, or a plan to perform another model verification.
R4	The Generator Owner provided revised model data or plans to perform model verification more than 180 calendar days but less than or equal to 210 calendar days of making changes to the turbine/governor and load control or active power/frequency control system that alter the equipment response characteristic.	The Generator Owner provided revised model data or plans to perform model verification more than 210 calendar days but less than or equal to 240 calendar days of making changes to the turbine/governor and load control or active power/frequency control system that alter the equipment response characteristic.	The Generator Owner provided revised model data or plans to perform model verification more than 240 calendar days but less than or equal to 270 calendar days of making changes to the turbine/governor and load control or active power/frequency control system that alter the equipment response characteristic.	The Generator Owner failed to provide revised model data or failed to provide plans to perform model verification within 270 calendar days of making changes to the turbine/governor and load control or active power/frequency control system that altered the equipment response characteristic.

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R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R5	The Transmission Planner provided a written response to the Generator Owner indicating whether the model is usable or not usable, including a technical description if the model is not usable, more than 90 calendar days but less than or equal to 120 calendar days of receiving verified model information;	<p>The Transmission Planner provided a written response to the Generator Owner indicating whether the model is usable or not usable, including a technical description if the model is not usable, more than 120 calendar days but less than or equal to 150 calendar days of receiving the verified model information;</p> <p>OR</p> <p>The Transmission Planner's written response omitted confirmation for one of the specified model criteria listed in Requirement 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 usable or not usable, including a technical description if the model is not usable, more than 150 calendar days but less than or equal to 180 calendar days of receiving the verified model information;</p> <p>OR</p> <p>The Transmission Planner's written response omitted confirmation for two of the specified model criteria listed in Requirement R5, Parts 5.1 through 5.3.</p>	<p>The Transmission Planner failed to provide a written response to the Generator Owner within 180 calendar days of receiving the verified model information;</p> <p>OR</p> <p>The Transmission Planner 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
1	February 7, 2013	Adopted by NERC Board of Trustees	New
1	March 20, 2014	FERC Order issued approving MOD-027-1. (Order becomes effective for R1, R3, R4, and R5 on 7/1/14. R2 becomes effective 7/1/18.)	

G. References

The following documents contain technical information beyond the scope of this Standard on turbine/governor and load control 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

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

MOD-027 Attachment 1 Turbine/Governor and Load Control or Active Power/Frequency Control Model Periodicity		
Row Number	Verification Condition	Required Action
1	Establishing the initial verification date for an applicable unit. (Requirement R2)	Transmit the verified model, documentation and data to the Transmission Planner on or before the Effective Date. Row 5 applies when calculating generation fleet compliance during the 10year implementation period. See Section A5 for Effective Dates.
2	Subsequent verification for an applicable unit. (Requirement R2)	Transmit the verified model, documentation and data to the Transmission Planner on or before the 10-year anniversary of the last transmittal (per Note 2).
3	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. (This row is only applicable if a frequency excursion from a systemdisturbance 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). (Requirement R2)	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.
4	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. (Requirement R2)	Transmit the verified model, documentation and data to the Transmission Planner within 365 calendar days after the commissioning date.

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

MOD-027 Attachment 1 Turbine/Governor and Load Control or Active Power/Frequency Control Model Periodicity		
Row Number	Verification Condition	Required Action
5	<p>Existing applicable unit that is equivalent to another applicable unit(s) at the same physical location;</p> <p>AND</p> <p>Each 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 applicable unit has the same 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>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.</p> <p>Verify a different equivalent unit during each 10-year verification period.</p> <p>Applies to Row 1 when calculating generation fleet compliance during the 10-year implementation period.</p>
6	<p>The Generator Owner has submitted a verification plan.</p> <p>(Requirement R3 or R4)</p>	<p>Transmit the verified model, documentation and data to the Transmission Planner within 365 calendar days after the submittal of the verification plan.</p>

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

MOD-027 Attachment 1 Turbine/Governor and Load Control or Active Power/Frequency Control Model Periodicity		
Row Number	Verification Condition	Required Action
7	<p>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.);</p> <p>OR</p> <p>Applicable unit either does not have an installed frequency control system or has a disabled frequency control system.</p> <p>(Requirement R2)</p>	<p>Requirement 2 is met with a written statement to that effect transmitted to the Transmission Planner.</p> <p>Perform verification per the periodicity specified in Row 4 for a “New Generating Unit” (or new equipment) only if responsive control mode operation for connected operations is established.</p>
8	<p>Existing applicable unit has a current average net capacity factor over the most recent three calendar years, beginning on January 1 and ending on December 31 of 5% or less.</p> <p>(Requirement R2)</p>	<p>Requirement 2 is met with a written statement to that effect transmitted to the Transmission Planner.</p> <p>At the end of this 10 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.</p> <p>For the definition of net capacity factor, refer to Appendix F of the GADS Data Reporting Instructions on the NERC website.</p>

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

MOD-027 Attachment 1		
Turbine/Governor and Load Control or Active Power/Frequency Control Model Periodicity		
Row Number	Verification Condition	Required Action
<p>NOTES:</p> <p>NOTE 1: Unit model verification frequency excursion criteria:</p> <ul style="list-style-type: none"> • ≥ 0.05 hertz deviation (nadir point) from scheduled frequency for the Eastern Interconnection with the applicable unit operating in a frequency responsive mode • ≥ 0.10 hertz deviation (nadir point) from scheduled frequency for the ERCOT and Western Interconnections with the applicable unit operating in a frequency responsive mode • ≥ 0.15 hertz deviation (nadir point) from scheduled frequency for the Quebec Interconnection with the applicable unit operating in a frequency responsive mode <p>NOTE 2: Establishing the recurring ten year unit verification period start date:</p> <ul style="list-style-type: none"> • The start date is the actual date of submittal of a verified model to the Transmission Planner for the most recently performed unit verification. <p>NOTE 3: Consideration for early compliance:</p> <p>Existing turbine/governor and load control or active power/frequency control model verification is sufficient for demonstrating compliance for a 10 year period from the actual transmittal date if either of the following applies:</p> <ul style="list-style-type: none"> • The Generator Owner has a verified model that is compliant with the applicable regional policies, guidelines or criteria existing at the time of model verification • The Generator Owner has an existing verified model that is compliant with the requirements of this standard 		

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

Appendix QC-MOD-027-1 Provisions specific to the standard MOD-027-1 applicable in Québec

This appendix establishes specific provisions for the application of the standard in Québec. Provisions of the standard and of its appendix must be read together for the purposes of understanding and interpretation. Where the standard and appendix differ, the appendix shall prevail.

A. Introduction

- 1. Title:** **Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions**
- 2. Number:** MOD-027-1
- 3. Purpose:** No specific provision
- 4. Applicability:**
 - 4.1. Functional entities**
No specific provision
 - 4.2. Facilities**
For the purpose of the requirements contained herein, Facilities that form part of the Main Transmission System (RTP) will be collectively referred as an “applicable unit” that meet the following:
 - 4.2.1** No specific provision
 - 4.2.1.1** No specific provision
 - 4.2.1.2** Individual generating plant consisting of multiple generating units that is part of the Main Transmission System (RTP) with total generation greater than 100 MVA (gross aggregate nameplate rating).
 - 4.2.2** No specific provision
 - 4.2.3** No specific provision
 - 4.2.4** No specific provision
- 5. Effective Date:**
 - 5.1.** Adoption of the standard by the Régie de l'énergie: Month xx, 201x
 - 5.2.** Adoption of the appendix by the Régie de l'énergie: Month xx, 201x
 - 5.3.** Effective date of the standard and its appendix in Québec: Month xx, 201x

B. Requirements

No specific provision

C. Measures

No specific provision

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

Appendix QC-MOD-027-1

Provisions specific to the standard MOD-027-1 applicable in Québec

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance Enforcement Authority

The Régie de l'énergie is responsible, in Québec, for compliance monitoring with respect to the reliability standard and its appendix that it adopts.

1.2. Evidence Retention

No specific provision

1.3. Compliance Monitoring and Assessment Processes

No specific provision

1.4. Additional Compliance Information

No specific provision

2. Violation Severity Levels

No specific provision

E. Regional Variances

No specific provision

F. Associated Documents

No specific provision

G. References

No specific provision

MOD-027-1 – Attachment 1

No specific provision

Revision History

Version	Date	Action	Change Tracking
0	xx/xx/201x	New appendix	New