

Standard Development Timeline

This section is maintained by the drafting team during the development of the standard and will be removed when the standard is adopted by the NERC Board of Trustees (Board).

Description of Current Draft

This is the first draft of the proposed standard for a formal 45-day comment period.

<u>Completed Actions</u>	<u>Date</u>
<u>Standards Committee approved Standard Authorization Request (SAR) for posting</u>	<u>January 20, 2021</u>
<u>SAR posted for comment</u>	<u>March 4 – April 2, 2021</u>

<u>Anticipated Actions</u>	<u>Date</u>
<u>45-day formal or informal comment period with ballot</u>	<u>September – November 2022</u>
<u>45-day formal or informal comment period with additional ballot</u>	<u>February – April 2023</u>
<u>10-day final ballot</u>	<u>May 2023</u>
<u>Board adoption</u>	<u>August 2023</u>

New or Modified Term(s) Used in NERC Reliability Standards

This section includes all new or modified terms used in the proposed standard that will be included in the *Glossary of Terms Used in NERC Reliability Standards* upon [applicable regulatory approval](#). Terms used in the proposed standard that are already defined and are not being modified can be found in the *Glossary of Terms Used in NERC Reliability Standards*. The new or revised terms listed below will be presented for approval with the proposed standard. Upon Board adoption, this section will be removed.

Term(s):

None.

A. Introduction

1. **Title:** ~~Verification and Data Reporting of Generator of~~ Real and Reactive Power Capability ~~and Synchronous Condenser Reactive Power Capability for BES Facilities~~
2. **Number:** ~~MOD-025-2~~ MOD-025-3
3. **Purpose:** To ensure that accurate information on ~~generator gross and net Bulk Electric System (BES) Facility~~ 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~~ Entities:**
 - 4.1.1 Generator Owner
 - 4.1.2 Transmission Owner ~~that owns synchronous condenser(s)~~
 - 4.1.3 Transmission Planner
 - 4.2. **Facilities:** For the purpose of this standard, the term, “applicable Facility” or “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 resource identified through Inclusion I2 of the BES definition.~~
~~Synchronous condenser greater than 20 MVA (gross nameplate rating) directly connected to the Bulk Electric 4.2.2 System.~~
 - 4.2.2 ~~4.2.3~~ Generating plant/Facility greater than 75 MVA (gross aggregate nameplate rating) directly connected to the Bulk Electric System. Facility identified through Inclusion I2 of the BES definition.
 - 4.2.3 Generating plant/Facility of dispersed power producing resources identified through Inclusion I4 of the BES definition.
 - 4.2.4 Dynamic reactive devices identified through Inclusion I5 of the BES definition with a gross (individual or aggregate) nameplate rating greater than 20 MVA including, but not limited to:
 - 4.2.4.1 Synchronous condenser; and
 - 4.2.4.2 Flexible alternating current transmission system (FACTS) devices.
 - 4.2.5 HVDC terminal equipment including:
 - 4.2.5.1 Voltage source converter (VSC).
5. **Effective Date:** see Project 2021-01 Modifications to MOD-025 and PRC-019 Implementation Plan.

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~~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 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.~~

¹Wind 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.

²Wind 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.

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~~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.

B. Note: The verification percentage above is based on the number of applicable units owned. **Requirements and Measures**

R1. Each Generator Owner shall ~~provide~~ verify the Real Power and Reactive Power capability of its applicable Facilities and inform 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, ~~if applicable,~~ of its generating units applicable Facilities in accordance with Attachment 1.

1.2. ~~Submit a completed Attachment 2~~ Verify the Reactive Power capability (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, of its applicable Facilities~~ 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.~~

1.3. Submit the following information, in accordance with Attachment 2, to the Transmission Planner within 30 calendar days after the verification date:

1.3.1. One-line diagram representing the Facility;

1.3.2. Composite capability curve and associated PQ data table; and

1.3.3. Documentation showing the engineering basis, verification methodology and/or applicable data for the verification method.

~~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~~ Each Generator Owner shall 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~~ verified Real Power and Reactive Power capability of each Facility, such as completed attachments or summary report(s); and have evidence that it submitted the information within ~~90~~ 30 calendar days after the verification date to its Transmission Planner; ~~such as dated electronic mail messages or mail receipts~~ in accordance with Requirement R1.
- R2.** Each Transmission Owner shall verify the Real Power and Reactive Power capability of its applicable Facilities and inform its Transmission Planner as follows: [Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]
- 2.1.** Verify the Real Power capability, if applicable, of its applicable Facilities in accordance with Attachment 1.
- 2.2.** Verify the Reactive Power capability of its applicable Facilities, in accordance with Attachment 1.
- 2.3.** Submit the following information per Attachment 2 to the Transmission Planner within 30 calendar days after the verification date:
- 2.3.1.** One-line diagram representing the Facility;
- 2.3.2.** Composite capability curve and associated PQ data table; and
- 2.3.3.** Documentation showing the engineering basis, verification methodology and/or applicable data for the verification method.
- 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~~ Each Transmission Owner shall have evidence that it verified Real Power and Reactive Power capability of each Facility, such as completed attachments or summary report(s); and have evidence that it submitted the information within ~~90~~ 30 calendar days after the verification date 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.

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- R3.** Each Transmission Planner shall review the information submitted by each Generator Owner or Transmission Owner in accordance with Requirement R1, R2, or R4 and provide a written response within 90 calendar days containing one of the following: [Violation Risk Factor: Lower] [Time Horizon: Operations Planning]
- Notification that the Transmission Planner has not identified any technical concerns with the Real and Reactive Power capability information submitted by the Generator Owner or Transmission Owner; or
 - Notification that the Transmission Planner has identified a technical concern, including the basis for the technical concern.
- M3.** Each Transmission Planner shall have evidence, such as a summary of items reviewed and dated correspondence of the notification, that it reviewed the information submitted and provided notification to the Generator Owner or Transmission Owner within 90 calendar days in accordance with Requirement R3.
- R4.** Each Generator Owner or Transmission Owner receiving a notification of a technical concern under Requirement R3 shall provide a written response to its Transmission Planner within 90 calendar days containing one of the following: [Violation Risk Factor: Lower] [Time Horizon: Operations Planning]
- Updated capability information in accordance with Requirements R1 or R2;
 - A mutually agreed upon plan with its Transmission Planner to update the capability information in accordance with Requirements R1 or R2; or
 - Technical justification and supporting evidence for maintaining the existing capability information in accordance with Requirements R1 or R2.
- M4.** Each Generator Owner or Transmission Owner shall have evidence that it responded to the Transmission Planner within 90 calendar days in accordance with Requirement R4.

C. Compliance

1. Compliance Monitoring Process

1.1. Compliance Enforcement Authority: “Compliance Enforcement Authority” means NERC or the Regional Entity, or any entity as otherwise designated by an Applicable Governmental Authority, in their respective roles of monitoring and/or enforcing compliance with mandatory and enforceable Reliability Standards in their respective jurisdictions.

~~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~~

1.0. Evidence Retention: The following evidence retention ~~periods~~ period(s) identify ~~a~~ 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 ~~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~~ The applicable entity shall 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.~~

- Each Generator Owner shall keep data or evidence of Requirement R1 since the most current verification for each applicable BES Facility.
- Each Transmission Owner shall keep data or evidence of Requirement R2 since the most current verification for each applicable BES Facility.
- Each Transmission Planner shall keep data or evidence of Requirement R3 for a rolling 12 month period.

~~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.~~

~~1.1. Compliance Monitoring and Assessment Processes~~

~~Compliance Audit~~

Self-Certification

Spot-Checking

Compliance Investigation

Self-Reporting

Complaint

1.2. Additional Compliance Information

None

- ~~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 Each Generator Owner and Transmission Owner shall keep data or evidence of Requirement R4 for a rolling 12 month period.

1.1. Compliance Monitoring and Enforcement Program: As defined in the NERC Rules of Procedure, “Compliance Monitoring and Enforcement Program” refers to the identification of the processes that will be used to evaluate data or information for the purpose of assessing performance or outcomes with the associated Reliability Standard.

2. Violation Severity Levels

R #	Violation Severity Levels			
	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>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 The applicable entity provided all items in Requirement R1, but did so greater than 270 calendar days after the verification date.</p> <p>OR</p> <p>The applicable entity verified the Real and Reactive Power, but failed to include the</p>

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R #	Violation Severity Levels			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
	<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</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 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</p>	<p>information required in Requirement R1, Part 1.3.2.</p> <p>OR</p> <p>The applicable entity verified the Real and Reactive Power capability per Attachment 1 Section 1 Item 3, but did so in more than 138 calendar months.</p> <p>OR</p> <p>The applicable entity verified the Real and Reactive Power capability per Attachment 1 Section 1 Item 2, 4, or 5, but did so in more than 450 calendar days.</p> <p>OR</p> <p>The applicable entity failed to verify the Real and/or Reactive Power capability, per Attachment 1 of an applicable generating unit.</p> <p>OR</p>

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R #	Violation Severity Levels			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
	<p><u>The applicable entity provided all items in Requirement R1, but did so between 31 and 90 calendar days after the verification date.</u></p> <p>OR</p> <p><u>The applicable entity verified the Real and Reactive Power capability per Attachment 1 Section 1 Item 3, but did so between 10 years (120 calendar months) and 126 calendar months.</u></p> <p>OR</p> <p><u>The applicable entity verified the Real and Reactive Power capability per Attachment 1 Section 1 Item 2, 4, or 5, but did so between 181 and 270 calendar days.</u></p>	<p><u>months but less than or equal to 14 calendar months.</u></p> <p><u>The applicable entity provided all items in Requirement R1, but did so between 91 and 180 calendar days after the verification date.</u></p> <p>OR</p> <p><u>The applicable entity verified the Real and Reactive Power, but failed to include the information required in Requirement R1, Part 1.3.1.</u></p> <p>OR</p> <p><u>The applicable entity verified the Real and Reactive Power capability per Attachment 1 Section 1 Item 3, but did so between 127 and 132 calendar months.</u></p> <p>OR</p> <p><u>The applicable entity verified the Real and Reactive Power capability per Attachment 1 Section 1 Item 2, 4, or 5, but</u></p>	<p><u>months but less than or equal to 15 calendar months.</u></p> <p><u>The applicable entity provided all items in Requirement R1, but did so between 181 and 270 calendar days after the verification date.</u></p> <p>OR</p> <p><u>The applicable entity verified the Real and Reactive Power, but failed to include the information required in Requirement R1, Part 1.3.3.</u></p> <p>OR</p> <p><u>The applicable entity verified the Real and Reactive Power capability per Attachment 1 Section 1 Item 3, but did so between 133 and 138 calendar months.</u></p> <p>OR</p> <p><u>The applicable entity verified the Real and Reactive Power capability per Attachment 1 Section 1 Item 2, 4, or 5, but</u></p>	<p><u>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 75 calendar months.</u></p> <p>OR</p> <p><u>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.</u></p>

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R #	Violation Severity Levels			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
		<u>did so between 271 and 360 calendar days.</u>	<u>did so between 361 and 450 calendar days.</u>	
R2 R2.	<p>The Generator Owner verified and recorded the 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><u>OR</u></p> <p>The Generator Owner verified the<u>The applicable entity provided all items in Requirement R2, but did so between 31 and 90 calendar days after the verification date.</u></p> <p><u>OR</u></p> <p><u>The applicable entity verified the Real and Reactive Power capability per Attachment 1</u></p>	<p>The Generator Owner verified and recorded the 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><u>OR</u></p> <p>The Generator Owner verified the<u>The applicable entity provided all items in Requirement R2, but did so between 91 and 180 calendar days after the verification date.</u></p> <p><u>OR</u></p> <p><u>The applicable entity verified the Real and Reactive Power, but failed to include the</u></p>	<p>The Generator Owner verified and recorded the Reactive 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><u>OR</u></p> <p>The Generator Owner verified the<u>The applicable entity provided all items in Requirement R2, but did so between 181 and 270 calendar days after the verification date.</u></p> <p><u>OR</u></p> <p><u>The applicable entity verified the Real and Reactive Power, but failed to include the</u></p>	<p>The Generator Owner verified and recorded the Reactive Power 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><u>OR</u></p> <p>The Generator Owner failed to verify the<u>The applicable entity provided all items in Requirement R2, but did so greater than 270 calendar days after the verification date.</u></p> <p><u>OR</u></p> <p><u>The applicable entity verified the Real and Reactive Power, but failed to include the</u></p>

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R #	Violation Severity Levels			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
	<p><u>Section 1 Item 3, but did between 10 years (120 calendar months) and 126 calendar months.</u></p> <p><u>OR</u></p> <p><u>The applicable entity verified the Real and Reactive Power capability, per Attachment 1 and submitted the data but was missing 1 to up to and including 33 percent of the data. Section 1 Item 2, 4, or 5, but did so between 181 and 270 calendar days.</u></p> <p><u>OR</u></p> <p><u>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 66 calendar months but less than or equal to 69 months.</u></p>	<p><u>information required in Requirement R2, Part 2.3.1.</u></p> <p><u>OR</u></p> <p><u>The applicable entity verified the Real and Reactive Power capability, per Attachment 1 and submitted the data but was missing 34 to 66 percent of the data. per Attachment 1 Section 1 Item 3, but did so between 127 and 132 calendar months.</u></p> <p><u>OR</u></p> <p><u>The applicable entity verified the Real and Reactive Power capability per Attachment 1 Section 1 Item 2, 4, or 5, but did so between 271 and 360 calendar days.</u></p> <p><u>OR</u></p> <p><u>The Generator Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new</u></p>	<p><u>information required in Requirement R2, Part 2.3.3.</u></p> <p><u>OR</u></p> <p><u>The applicable entity verified the Real and Reactive Power capability, per Attachment 1 and submitted the data but was missing 67 to 99 percent of the data. per Attachment 1 Section 1 Item 3, but did so between 133 and 138 calendar months.</u></p> <p><u>OR</u></p> <p><u>The applicable entity verified the Real and Reactive Power capability per Attachment 1 Section 1 Item 2, 4, or 5, but did so between 361 and 450 calendar days.</u></p> <p><u>OR</u></p> <p><u>The Generator Owner performed the Reactive Power verification per Attachment 1, “Periodicity for conducting a new</u></p>	<p><u>information required in Requirement R2, Part 2.3.2.</u></p> <p><u>OR</u></p> <p><u>The applicable entity verified the Real and Reactive Power capability, per Attachment 1 of an applicable generating unit or synchronous condenser unit. OR The Generator Owner performed the Reactive Power verification per Attachment 1 Section 1 Item 3, “Periodicity for conducting a new verification” item 1 or item 2 (5-year requirement) but did so in more than 75-138 calendar months.</u></p> <p><u>OR</u></p> <p><u>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</u></p>

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	<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>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 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>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 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>more than 15 calendar months.</p> <p><u>The applicable entity verified the Real and Reactive Power capability per Attachment 1 Section 1 Item 2, 4, or 5, but did so in more than 450 calendar days.</u></p> <p><u>OR</u></p> <p><u>The applicable entity failed to verify the Real and/or Reactive Power capability.</u></p>
R3R3.	<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 90</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 calendar days, but within 150</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 calendar days, but within 180</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</p>

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R #	Violation Severity Levels			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
	<p>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; provided a written response to the submitter, but it was provided between 91 to 120 calendar days after receiving the verified model information.</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</p>	<p>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</p>	<p>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</p>	<p>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 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>

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R #	Violation Severity Levels			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
	<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 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>months but less than or equal to 72 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>The Transmission Planner provided a written response to the submitter, but it was provided between 121 to 150 calendar days after receiving the verified model information.</p>	<p>months but less than or equal to 75 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> <p>The Transmission Planner provided a written response to the submitter, but it was provided between 151 to 180 calendar days after receiving the verified model information.</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 15 calendar months.</p> <p>The Transmission Planner failed to provide a written response to the submitter.</p> <p>OR</p> <p>The Transmission Planner provided a written response to the submitter but it was provided more than 180 calendar days after receiving the verified model information.</p>
R4.	<p>The applicable entity provided a written response to its Transmission Planner, but it was provided between 91 to</p>	<p>The applicable entity provided a written response to its Transmission Planner, but it was provided between 121 to</p>	<p>The applicable entity provided a written response to its Transmission Planner, but it was provided between 151 to</p>	<p>The applicable entity failed to provide a written response to its Transmission Planner.</p>

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R #	<u>Violation Severity Levels</u>			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
	<u>120 calendar days after receiving a notification of technical concern.</u>	<u>150 calendar days after receiving a notification of technical concern.</u>	<u>180 calendar days after receiving a notification of technical concern.</u>	<u>OR</u> <u>The applicable entity provided a written response to its Transmission Planner, but it was provided greater than 180 calendar days after receiving a notification of technical concern.</u>

D. Regional Variances

None.

E. Associated Documents

None.

Version History

Version	Date	Action	Change Tracking
1	12/1/2005	<ol style="list-style-type: none"> 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.)	
<u>3</u>	<u>TBD</u>	<u>Adopted by NERC Board of Trustees</u>	<u>Revised per SAR for Project 2021-01</u>

MOD-025 MOD-025-3 Attachment 1

~~—Verification of Generator Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability~~

Section I. Periodicity for conducting a new of verification:

The periodicity ~~for performing to verify the~~ Real and Reactive Power capability ~~verification for~~ each applicable BES Facility is as follows:

1. ~~The applicable entity designates the verification date and notates the verification date in a summary report (refer to Attachment 2). The verification date should represent the date that the engineering review or engineering analysis is complete. The verification date is the basis of the recurring periodicity.~~
2. ~~Verify each new applicable Facility within 180 calendar days of its commercial operation date.~~
3. ~~Verify each existing applicable Facility at a periodicity not to exceed ten years from the last verification date.~~
4. ~~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. Verify an existing applicable Facility within 180 calendar days of the discovery of a change that affects its Real Power or Reactive Power capability by more than a 10 percent of the last reported verified capability increase or decrease of the nameplate rating and is expected to last more than six months. The first verification for each applicable Facility under this standard must be a staged test. 180 calendar days.~~
5. ~~Verify an existing applicable Facility within 180 calendar days of its return to service date, if the Facility has a planned or unplanned outage of 180 calendar days or more which overlaps its scheduled verification date and has not had its capability verified within the past ten years.~~
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.~~

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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.

Section II. 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. For individual devices or generators greater than 20 MVA (gross nameplate rating) perform verification on an individual basis.~~
 - 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.~~
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~~

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~~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. 2.1.2 Verify variable generating units, such as wind, solar, and run-of river hydro, For individual devices or generators 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. 20 MVA (gross nameplate rating) or less that are part of an applicable Facility greater than 75 MVA (gross nameplate rating) in aggregate, perform verification on an individual unit basis or in the aggregate, considering applicable modeling expectations of the respective Transmission Planner.~~

~~3. Create a simplified key one-line diagram representing the Facility (refer to Attachment 2). The one-line diagram shall designate where the composite capability curve created in Section II, Items 6-8 is represented.~~

~~3.1. 3.3. The voltage at the high and low side of the GSU. The one-line representing the Facility shall include all auxiliary equipment expected to be in-service for normal operation, including dynamic and static reactive devices and auxiliary load, 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., unit auxiliary transformer(s), and station services auxiliary transformer(s).~~

~~4. If an applicable Facility has no leading or lagging capability, then it should be reported with no leading or lagging capability.~~

~~5. The Generator Owner or Transmission Owner shall utilize and document one or more of the following methodologies to verify the Facility capability for all equipment expected to be in-service for normal operation. The engineering review or~~

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engineering analysis shall include underlying assumptions, design criteria, and methods used to create the Facility capability curve under Section II, Items 6-8.

- Perform an engineering review of all Real and Reactive Power Facility capability information including but not limited to in-service equipment design limitations, excitation limiter settings, and operational limitations;
 - Utilize staged testing data, in accordance with Section III, obtained from a date within 365 calendar days prior to verification date, and perform engineering analysis as needed per Note 1, that validates the generator capability; or
 - Utilize operational data, in accordance with Section III, obtained from a date within 365 calendar days prior to verification date, and perform engineering analysis as needed per Note 1, that validates the generator capability.
6. For an applicable Facility as identified in Section 4.2.1, 4.2.2, or 4.2.4.1, when performing verification on an individual unit basis, create a graphical representation of the steady-state composite capability curve (CCC) for the Real Power and Reactive Power. The steady-state CCC shall include at a minimum the following:
- 6.1. The generator steady-state Real Power and Reactive Power capability curve, or the synchronous condenser steady-state Reactive Power capability curve, provided by the equipment manufacturer.
 - 6.1.1 The curve shall represent generator/synchronous condenser capability at a nominal voltage of 1.0 per unit at the generator/synchronous condenser terminal; and
 - 6.1.2 The curve shall notate the operating conditions that dictate the power capability, for example H2 pressure, ambient temperature, or other conditions.
 - 6.2. Excitation limiters, if more restrictive than the equipment manufacturer's capability curve, at nominal voltage 1.0 per unit;
 - 6.3. Identification of any Real Power or Reactive Power operational limitations¹, if applicable;
 - 6.4. Identification of the steady-state minimum (P_{min}) and maximum (P_{max}) Real Power output at the generator terminal(s), based on the least restrictive seasonal or operating conditions; and
 - 6.5. Identification of final PQ curve, which defines the normal operating region.

¹ Such as generator cooling, vibration, de-rated rotor, de-rated GSU transformer, generator bus de-rating, software limitations, or distributed control system (DCS) setpoints (outer-loop control system paths). This excludes fuel availability, such as water levels for hydro, cloud cover for PV, wind speed, or river level for run of river.

7. For an applicable Facility as identified in Section 4.2.2 or Section 4.2.3, when performing verification in aggregate, create a graphical representation of the steady-state composite capability curve (CCC) for the Real Power and Reactive Power. The steady-state CCC shall include at a minimum the following:
 - 7.1. The steady-state Real and Reactive Power capability curve represented as an aggregate.
 - 7.1.1 The curve shall represent Facility capability at a steady-state nominal voltage of 1.0 per unit at the common point of connection; and
 - 7.1.2 The curve shall notate the operating conditions that dictate the power capability, for example H2 pressure, ambient temperature, or other conditions.
 - 7.2. Aggregate Facility capability includes all auxiliary equipment expected to be in-service for normal operation, including dynamic and static reactive resources and auxiliary loads;
 - 7.3. Identification of any Real Power or Reactive Power operational limitations, if applicable;
 - 7.4. For inverter based resources, a description of all power plant controller and inverter control functions during normal operating conditions that dictate the aggregate Facility capability;
 - 7.5. Identification of the steady-state minimum (P_{min}) and maximum (P_{max}) Real Power output at the common point of connection, based on the least restrictive seasonal or operating conditions; and
 - 7.6. Identification of final PQ curve, which defines the normal operating region.
8. For an applicable Facility as identified in Section 4.2.4.2 and Section 4.2.5.1, create a graphical representation of the steady-state composite capability curve (CCC) for the Real Power and Reactive Power. The steady-state CCC shall include at a minimum the following:
 - 8.1. The HVDC steady-state Real Power and Reactive Power capability curve, or the FACTS device steady-state Reactive Power capability, provided by the equipment manufacturer.
 - 8.1.1 The curve shall represent Facility capability at a steady-state nominal voltage of 1.0 per unit at the common point of connection ; and
 - 8.1.2 The curve shall notate the operating conditions that dictate the power capability, for example ambient temperature or other conditions.
 - 8.2. Any limiters, if more restrictive than the equipment manufacturer's capability curve(s), at nominal voltage 1.0 per unit;

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- 8.3. Identification of any Real Power or Reactive Power operational limitations, if applicable;
- 8.4. A description of all control functions during normal operating conditions and a description of any Facility overload capabilities that dictate the aggregate Facility capability;
- 8.5. Identification of the steady-state minimum (P_{\min}) and maximum (P_{\max}) Real Power output at the common point of connection, based on the least restrictive seasonal or operating conditions; and
- 8.6. Identification of final PQ curve, which defines the normal operating region.

Section III. Staged test and operational data specifications

1. Section III applies when a staged test and/or operational data verification methodology is utilized. If utilizing multiple methodologies to verify the Facility capability, not all data points outlined in Section III, Item 6, 7, 8, or 9 need to be recorded.
- ~~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.~~
2. ~~4.1. If metering does not exist to measure specific Reactive auxiliary load(s) Record any staged test or operational data in Attachment 3 (or a form containing the same information). If metering does not exist to measure specific values listed in~~

Attachment 3, 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. Refer to the associated labels depicted in the one-line diagram created in Section II, Item 4. Record any additional data deemed necessary to perform engineering analysis per Note 1.~~

3. Staged testing or operating conditions should be maintained constant for a sufficient time in order to ensure that the applicable Facility can perform at that level of Real and Reactive Power during steady-state conditions.
4. All auxiliary equipment is expected to be in service for normal operation.
5. The automatic voltage regulating equipment is in automatic voltage regulating mode.
6. For an applicable Facility with Real Power capability, record measurements at the following four points:
 - 6.1. Maximum lagging Reactive Power at maximum Real Power until a limit is reached;²
 - 6.2. Maximum leading Reactive Power at maximum Real Power until a limit is reached;
 - 6.3. Maximum lagging Reactive Power at minimum Real Power until a limit is reached;
 - 6.4. Maximum leading Reactive Power at minimum Real Power until a limit is reached.
7. For an applicable Facility with no Real Power capability, record measurements at the following two points (one over-excited point and one under-excited point):
 - 7.1. Maximum lagging Reactive Power until a limit is reached;
 - 7.2. Maximum leading Reactive Power until a limit is reached.
8. For an applicable Facility with equal minimum and maximum Real Power output during normal operation, such as a nuclear unit, record measurements at the two points in Items 8.1 and 8.2 below. The Facility need only perform staged testing or provide operational data for Reactive Power at maximum Real Power output. If applicable, provide the theoretical Reactive Power capability at minimum Real Power output in accordance with Attachment 2.
 - 8.1. Maximum lagging Reactive Power at normal operating Real Power until a limit is reached;

² In addition, consider steady state thermal or mechanical limitations of Facility equipment to determine whether it limits the Reactive Power capability during a staged test.

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8.2. Maximum leading Reactive Power at normal operating Real Power until a limit is reached.

9. For variable generating resources, such as wind, solar, or run-of-river hydro, and non-variable generating resources, such as battery energy storage systems, staged testing or operational data should be recorded with at least 90 percent of the inverters/generators at a Facility on-line. If staged testing or operational data capture of a Facility cannot be accomplished while meeting the 90 percent inverter/generator threshold, document the reason(s) the threshold was not met and test to the full available capability at the time of the test. Maintain, as steady as practical, the maximum Real Power output that the resource can provide at the time of the verification. Record measurements at the two points in Items 9.1 and 9.2 below at the maximum Real Power output the variable resource can provide at the time of the staged test or operational data.

9.1. Maximum lagging Reactive Power at normal operating Real Power until a limit is reached;

9.2. Maximum leading Reactive Power at normal operating Real Power until a limit is reached.

~~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~~ Note 1: Under restrictive transmission system conditions, the data points obtained from a staged test or operational data might not duplicate the manufacturer supplied thermal capability curve (D-curve). When the applicable Facility's reactive capability is not fully demonstrated, perform a simulation or engineering analysis to determine expected applicable Facility capabilities capability 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

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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

MOD-025-3 Attachment 2 – BES Facility Capability Report

A completed report shall contain the following information at a minimum per Requirement R1 and R2:

- Section I: One-line diagram of the applicable Facility
- Section II: Composite capability curve
- Section III: Associated PQ data table
- Section IV: Documentation showing the engineering basis and verification methodology

If the configuration of the applicable Facility does not lend itself to the use of the one-line diagram, capability curve, and data tables for reporting the required information, changes may be made to this form, provided that all required information (identified in MOD-025-3, Attachment 1) is reported. An example report is provided below.

Company:

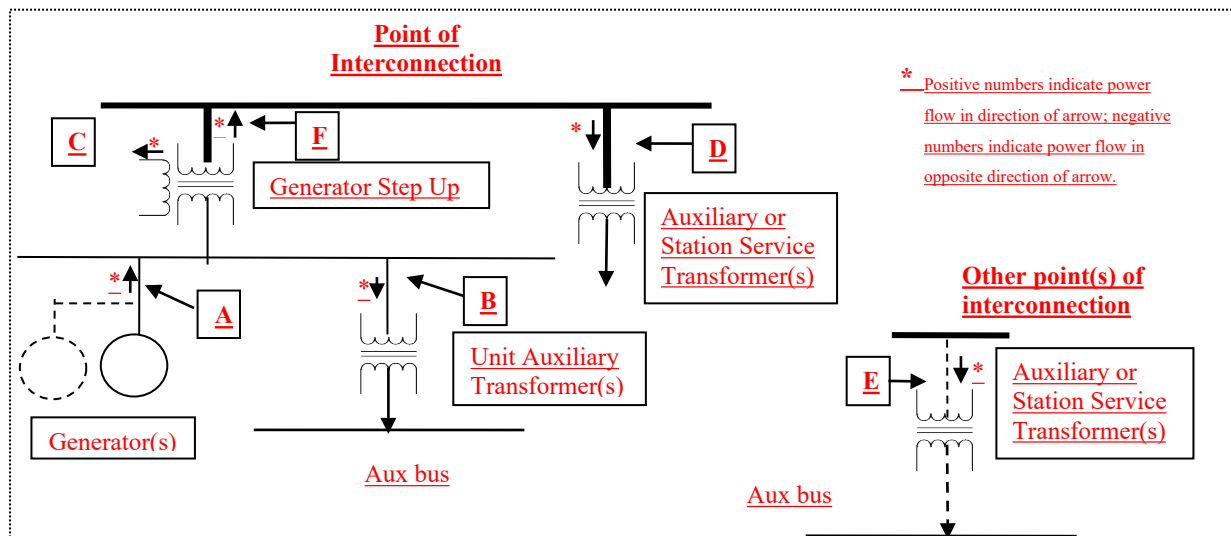
Reported By (name):

Plant:

Unit No.:

Date of Verification:

Section I. Provide simplified one-line diagram of the applicable Facility showing plant auxiliary Load connections.



The composite capability curve provided below is applied at Point (XX) in the one-line diagram shown above.

Section II. Provide composite capability curve as defined in Attachment 1, Section II

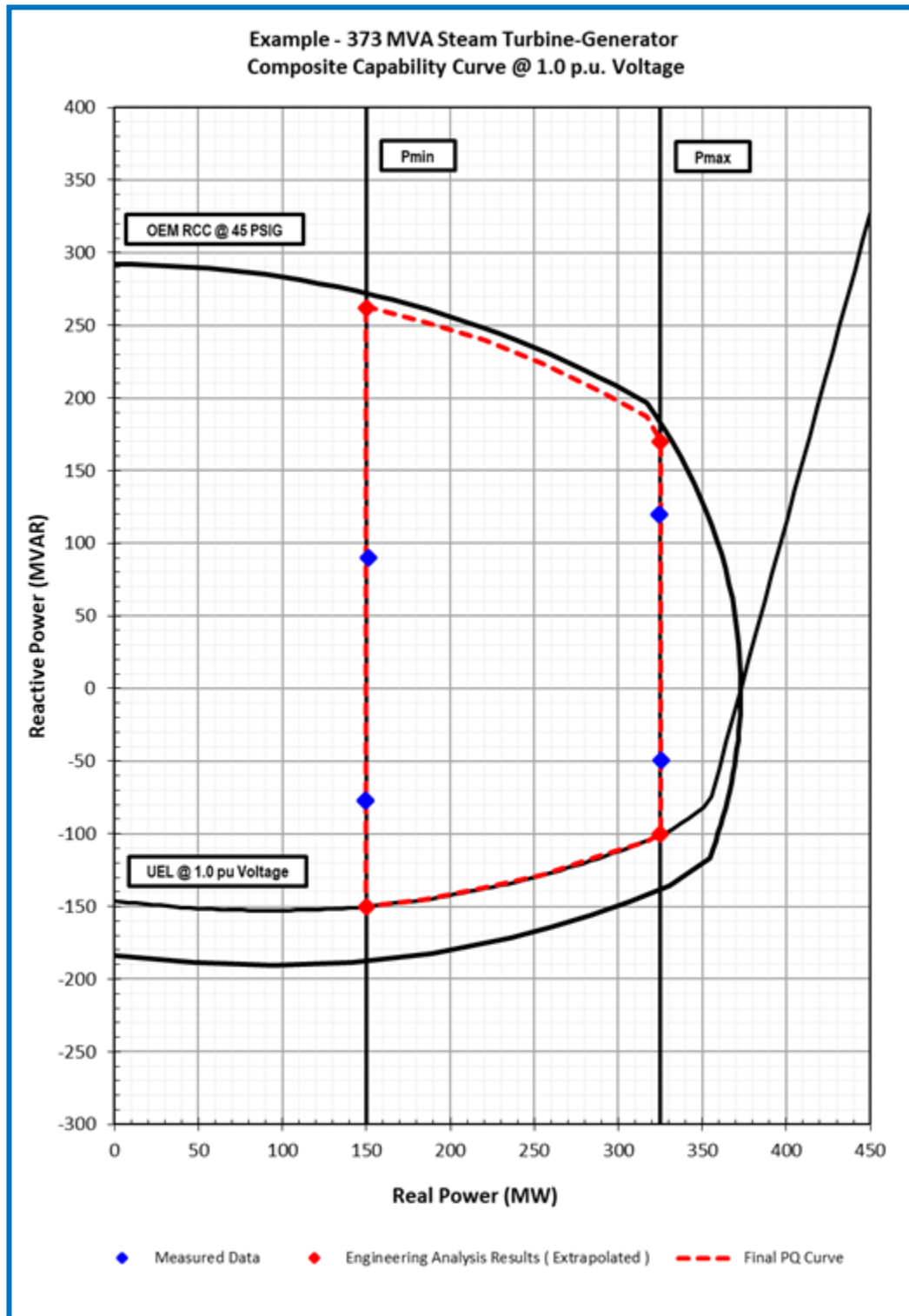


Figure 1: Example Composite Capability Curve for Synchronous Generator

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Section III. Provided PQ curve data table associated with Figure 1.X composite capability curve

	<u>P (MW)</u>	<u>Qmin (MVar)</u>	<u>Qmax (MVar)</u>	<u>Qmin Limit</u>	<u>Qmax Limit</u>
<u>Pmin</u>	<u>150.0</u>	<u>-150.0</u>	<u>263.0</u>	<u>UEL @ 1.0 Vterm</u>	<u>lfd Rated</u>
<u>Pmin + 20% of range</u>	<u>185.0</u>	<u>-145.0</u>	<u>252.0</u>	<u>UEL @ 1.0 Vterm</u>	<u>lfd Rated</u>
<u>Pmin + 40% of range</u>	<u>220.0</u>	<u>-137.0</u>	<u>240.0</u>	<u>UEL @ 1.0 Vterm</u>	<u>lfd Rated</u>
<u>Pmin + 60% of range</u>	<u>255.0</u>	<u>-128.0</u>	<u>224.0</u>	<u>UEL @ 1.0 Vterm</u>	<u>lfd Rated</u>
<u>Pmin + 80% of range</u>	<u>290.0</u>	<u>-115.0</u>	<u>204.0</u>	<u>UEL @ 1.0 Vterm</u>	<u>lfd Rated</u>
<u>Breakpoint</u>	<u>317.1</u>	<u>-105.0</u>	<u>187.0</u>	<u>UEL @ 1.0 Vterm</u>	<u>lfd Rated</u>
<u>Pmax</u>	<u>325.0</u>	<u>-100.0</u>	<u>170.0</u>	<u>UEL @ 1.0 Vterm</u>	<u>lfd Rated</u>

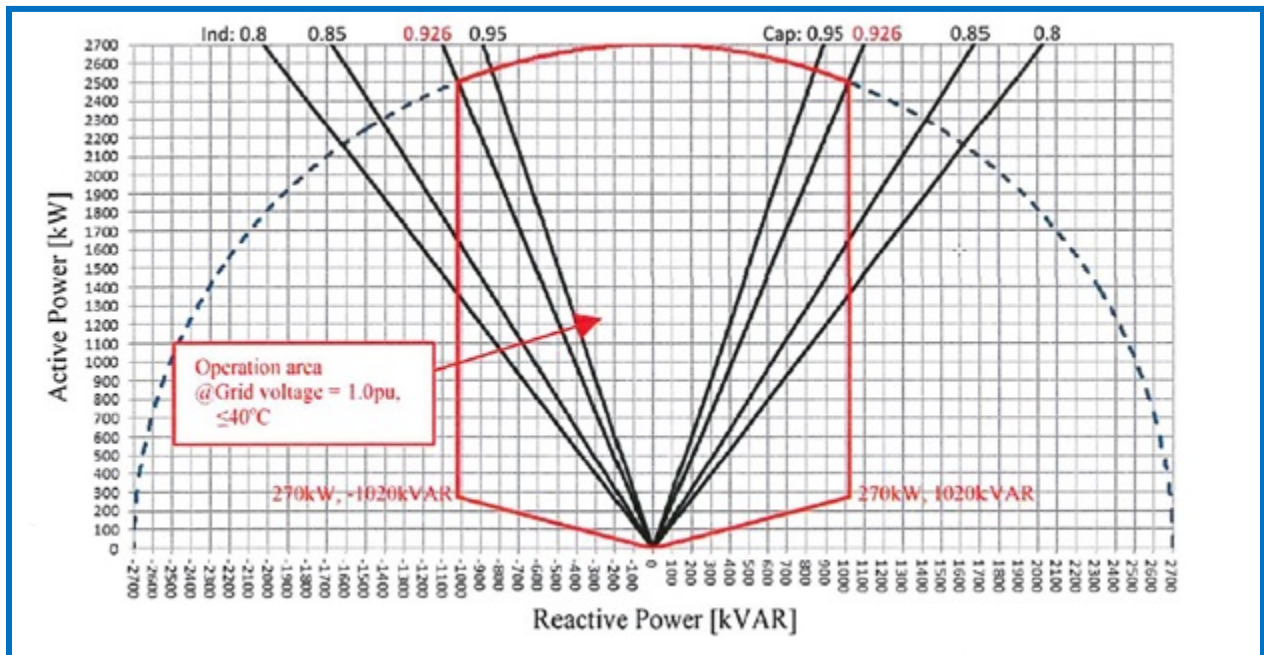


Figure 2: Example Composite Capability Curve for IBR Facility

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PQ Curve Data Table (template)

<u>Description</u>	<u>P_{max}</u> <u>(MW)</u>	<u>Q_{max}</u> <u>(MVAR)</u>	<u>Q_{min}</u> <u>(MVAR)</u>	<u>Q_{max}</u> <u>Limiting Factor</u>	<u>Q_{min}</u> <u>Limiting Factor</u>
<u>P_{min}</u>					
<u>P_{min} ±</u> <u>(0.20*Range)</u> <u>Range = (P_{max} -</u> <u>P_{min})</u>					
<u>P_{min} ±</u> <u>(0.40*Range)</u>					
<u>P_{min} ±</u> <u>(0.60*Range)</u>					
<u>P_{min} ±</u> <u>(0.80*Range)</u>					
<u>P_{max}</u>					
<u>Additional data</u> <u>points such as</u> <u>breakpoints are</u> <u>optional.</u>					

1. Limiting factor: UEL/OEL, field current rating, distributed control system (DCS) limit, etc.

Section IV. Supplemental documentation of engineering basis and verification methodology

MOD-025 Attachment 3

One-line Diagram, Table, Data Table and Summary for Verification Information Reporting of Staged Test or Operational Data

Note: Reference Attachment 2 one-line diagram measurement points and direction of flow arrows when recording Real and Reactive Power in data table. 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:

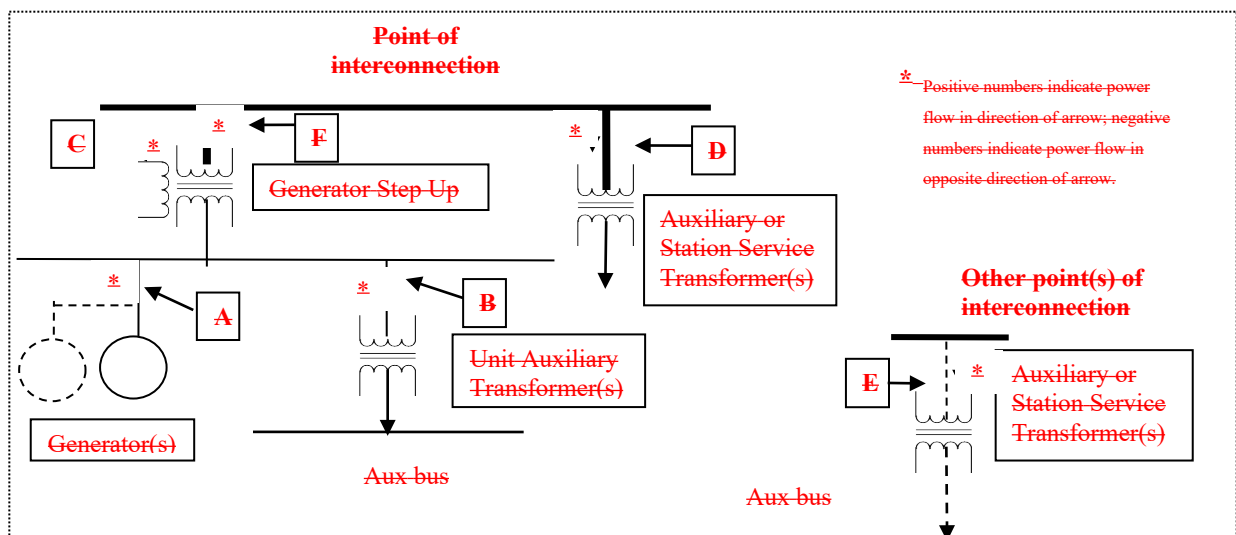
Unit No.:

Date of Report:

Check all that apply:

- Over-excited Full Maximum Load Reactive Power Verification
- Under-excited Full Maximum 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:



Standard MOD-025-2 MOD-025-3 — Verification and Data Reporting of Generator of Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability for BES Facilities

Data Table for Recording Measurements

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 MOD-025-3 — Verification and Data Reporting of Generator of Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability for BES Facilities

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.		
GSM losses (only required if verification measurements are taken on the high side of the GSM – Mvar)		

Summary of Verification Test / Operational Data

- Date of Staged Test (or oldest Date of Operational Data): _____
- Date of Verification _____, Verification Start Time _____, Verification End Time _____, Staged Test or Operational Data _____
 - Scheduled Voltage _____
- Transformer Voltage Ratio: GSM _____, Unit Aux _____, Station Aux _____, Other Aux _____
- Transformer Tap Setting: GSM _____, Unit Aux _____, Station Aux _____, Other Aux _____
- Transformer Impedance: GSM _____ ; Transformer X/R ratio: GSM _____

Standard MOD-025-2 MOD-025-3 — Verification and Data Reporting of Generator of Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability for BES Facilities

- Generator or Exciter Field Current (synchronous only): Start _____, End _____
- Ambient conditions at the end of the verification period:
Air or inlet temperature: _____ Humidity: _____
Cooling water temperature: _____ Stator temperature: _____
Other data as applicable: _____
- Generator hydrogen-cooling gas 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-staged test/operational data~~ did not reach ~~the thermal~~-capability curve (D-curve), describe the ~~reason~~limiting factor.

Testing Remarks: