

Project 2007-09 Generator Verification Consideration of Issues and Directives

Project 2007-09 Generator Verification — MOD-024 and MOD-025		
Issue or Directive	Source	Consideration of Issue or Directive
<p>Clarify requirement R2 that specifies that the regional reliability organization shall provide generator gross and net real power capability verification within 30 calendar days of approval. The confusion centers on “approval” and when the 30-day period starts.</p> <p>1311. We repeat our concern that Requirement R2, which specifies that the “regional reliability organization shall provide generator gross and net real power capability verification within 30 calendar days of approval,” is not clear. The requirement lacks a definition of what approval is required and when the 30-day period starts. Therefore, we direct the ERO to modify this Reliability Standard by adding information that will clarify this requirement.</p> <p>Document test conditions and the relationships between test conditions and generator output so that the amount of power that can be expected to be delivered from a generator at different conditions</p>	<p>MOD-024-1; FERC Order 693</p>	<p>The GVSDT has combined MOD-024 and MOD-025 into a single standard. The original R2 from MOD-024 maps to Requirements R1 and R2 of the proposed MOD-025-2. Fill in the blank components of the standard have been eliminated and the Generator Owner must report the required data to its Transmission Planner.</p> <p>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]</p> <ol style="list-style-type: none"> 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 <u>(i)</u> the date the data is recorded for a staged test; or <u>(ii)</u> the date the data is selected for verification using historical

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<p>can be determined.</p> <p>1309. The Commission remains concerned that the Reliability Standard is not sufficiently clear because it does not define the test conditions and methodologies for calculating de-rating factors. The Commission does not agree with APPA that NERC should consider modifying this Reliability Standard to provide requirements for this information on an Interconnection-wide basis, in the same manner that IRO-006-3 sets the requirements for transmission loading relief in each Interconnection. We believe, however, that while the overall methodology for verification of generator gross and net real power capability should be the same, test conditions (such as ambient temperature, river water temperature, etc.) can vary.</p> <p>1310. In the NOPR, the Commission stated that the Reliability Standard could be improved by defining test conditions, e.g., ambient temperature, river water temperature, and methodologies for calculating de-rating factors for conditions such as higher ambient temperatures than the test temperature. With the test information and methodologies, the generator output that can be expected to be available at forecasted weather</p>		<p>operational data.</p> <p>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]</p> <p>2.1. Verify, <u>in accordance with Attachment 1, (i)</u> the Reactive Power capability of its generating units and shall verify(ii) the Reactive Power capability of its synchronous condenser units <u>in accordance with Attachment 1.</u></p> <p>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 <u>(i)</u> the date the data is recorded for a staged test; or <u>(ii)</u> the date the data is selected for verification using historical operational data.</p> <p>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]</p> <p>3.1. Verify, <u>in accordance with Attachment 1,</u> the Reactive Power capability of its synchronous</p>

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<p>conditions can be determined. The Commission agrees with Northern Indiana that testing all units at the same time is not feasible. However, the Commission did not propose simultaneous testing. Rather, we direct the ERO to develop appropriate requirements to document test conditions and the relationships between test conditions and generator output so that the amount of power that can be expected to be delivered from a generator at different conditions, such as peak summer conditions, can be determined. Similarly, we respond to Constellation that any modification of the Levels of Non-Compliance in this Reliability Standard should be reviewed in the ERO Reliability Standards development process.</p>		<p>condenser units in accordance with Attachment 1.</p> <p>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 <u>(i)</u> the date the data is recorded for a staged test; or <u>(ii)</u> the date the data is selected for verification using historical operational data.</p>
<p>Document test conditions and the relationships between test conditions and generator output so that the amount of power that can be expected to be delivered from a generator at different conditions can be determined.</p> <p>1309. The Commission remains concerned that the Reliability Standard is not sufficiently clear because it does not define the test conditions and methodologies for calculating de-rating factors. The</p>	<p><u>MOD-024-1;</u> <u>FERC Order 693</u></p>	<p>The GVSDT has combined MOD-024 and MOD-025 into a single standard. Fill in the blank components of the standard have been eliminated and the Generator Owner must report the required data to its Transmission Planner, including test conditions. Section 3 of Attachment is:</p> <p>3. Record the following data for the verifications specified above:</p> <p>3.1. The value of the gross Real and Reactive Power generating</p>

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<p>Commission does not agree with APPA that NERC should consider modifying this Reliability Standard to provide requirements for this information on an Interconnection-wide basis, in the same manner that IRO-006-3 sets the requirements for transmission loading relief in each Interconnection. We believe, however, that while the overall methodology for verification of generator gross and net real power capability should be the same, test conditions (such as ambient temperature, river water temperature, etc.) can vary.</p> <p>1310. In the NOPR, the Commission stated that the Reliability Standard could be improved by defining test conditions, e.g., ambient temperature, river water temperature, and methodologies for calculating de-rating factors for conditions such as higher ambient temperatures than the test temperature. With the test information and methodologies, the generator output that can be expected to be available at forecasted weather conditions can be determined. The Commission agrees with Northern Indiana that testing all units at the same time is not feasible. However, the Commission did not propose simultaneous testing. Rather, we direct the ERO to develop appropriate</p>		<p>capabilities at the end of the verification period.</p> <p>3.2. The voltage schedule provided by the Transmission Operator, if applicable.</p> <p>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.</p> <p>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:</p> <ul style="list-style-type: none"> • Ambient air temperature • Relative humidity • Cooling water temperature • <u>Other data as determined to be applicable by the Generator Owner to perform corrections for ambient conditions.</u> <p>3.5. The date and time of the verification period, including start and end time in hours and minutes.</p> <p>3.6. The existing GSU and/or system Interconnection transformer(s) <u>voltage ratio and</u> tap setting.</p> <p>3.7. The GSU transformer losses (real or reactive) if the verification measurements were taken from the high side of the</p>

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<p>requirements to document test conditions and the relationships between test conditions and generator output so that the amount of power that can be expected to be delivered from a generator at different conditions, such as peak summer conditions, can be determined. Similarly, we respond to Constellation that any modification of the Levels of Non-Compliance in this Reliability Standard should be reviewed in the ERO Reliability Standards development process.</p>		<p>GSU transformer.</p> <p>3.8. Whether the test data is a result of a staged test or if it is operational data.</p>
<p>Review MOD-024 and MOD-025 concurrently to transition to uniform North American standards.</p>	<p>MOD-024-1, Fill-in-the-blank team</p>	<p>The GVSDT has combined MOD-024 and MOD-025 into a single standard, MOD-025-2.</p>
<p>Remove the fill-in-the-blank aspects (correct reference to “...Regional Reliability Organization’s procedures...”).</p>	<p>MOD-024-1, Fill-in-the-blank team</p>	<p>The GVSDT has combined MOD-024 and MOD-025 into a single standard. Fill in the blank components of the standard have been eliminated and the Generator Owner must report the required data to its Transmission Planner. See Requirements R1 and R2 above.</p>
<p>Goal is uniform North American standards for real and reactive power verification. Look at regional requirements and identify the best practice, commonalities and differences, and whether differences are needed for reliability.</p>	<p>MOD-024-1, Fill-in-the-blank team</p>	<p>The GVSDT has combined MOD-024 and MOD-025 into a single standard. Fill in the blank components of the standard have been eliminated and the Generator Owner must report the required data to its Transmission Planner. See Requirements R1 and R2 above.</p>

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Issue or Directive	Source	Consideration of Issue or Directive
No requirement for the RRO to demonstrate that its procedures result in accurate information of gross and net real power capability of generators for steady state models	MOD-024-1; Phase III/IV Team	The GVSDT has combined MOD-024 and MOD-025 into a single standard. Fill in the blank components of the standard have been eliminated and all required testing and data information is contained in Attachment 1 of the proposed MOD-025-2.
It is not clear in R3 to whom the Generator Owner will report the information.	MOD-024-1; Phase III/IV Team	The GVSDT has combined MOD-024 and MOD-025 into a single standard. The original R3 from MOD-024 maps to Requirements R1 and R2 of the proposed MOD-025-2. Fill in the blank components of the standard have been eliminated and the Generator Owner must report the required data to its Transmission Planner. See Requirements R1 and R2 above.
Non compliance levels are too strict. A small utility with 15-20 units will be L4 noncompliant if they miss one unit	MOD-024-1; Phase III/IV Team	The Standard now utilizes Violation Risk Factors, Time Horizons and Violation Severity Levels. The issue is addressed through the CMEP. The standard is written such that each generator must be tested. Failure to test a single unit results in a single violation for a requirement.
Provide clarity where the Planning Authority is mentioned	MOD-024-1, Team Comments	The GVSDT has written the requirements such that the Transmission Planner receives the information from the Generator Owner.
Require verification of reactive power capability at multiple points over a unit's operating range. 1321. We disagree with commenters that verifying	MOD-025-1, FERC Order 693	Attachment 1 of MOD-025-2 addresses this directive. 2. Verify with all auxiliary equipment needed for expected normal operation in service for both the Real Power and Reactive

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Issue or Directive	Source	Consideration of Issue or Directive
<p>generator reactive capability is a particularly difficult issue. The capability of generators to produce reactive power is essential for real-time analysis and planning. The Reliability Standard addressing this issue requires a generator to verify reactive capability only at the unit’s full MW loading. However, other than baseload units, most generating units rarely operate at full MW loading. It is unclear what reactive capability is available throughout a unit’s real power (MW) operating range. Therefore, we believe a clearer standard would require a verification of MVAR capability throughout a unit’s real power (MW) operating range. However, we share concern with several commenters that such a requirement for all generators may not be necessary. Therefore, we adjust the proposal in the NOPR and direct the ERO to modify MOD-025-1 to require verification of reactive power capability at multiple points over a unit’s operating range.</p>		<p>Power capability verification. Perform verification with the automatic voltage regulator in service for the Reactive Power capability verification (see Note 3 if the automatic voltage regulator is not available). 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 that operational data meets the criteria in 2.1 through 2.5 below. A Reactive capability test must demonstrate 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 by unusual generation or equipment limitations (e.g., capacitor or reactor banks out of service), then the next verification shall<u>will</u> be by another staged test, not operational data:</p> <p>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.</p> <p>2.1.1 Verify synchronous generating unit’s maximum real power and lagging reactive power for a minimum of one hour.</p> <p>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.</p>

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Issue or Directive	Source	Consideration of Issue or Directive
		<p>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.</p> <p>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:</p> <p>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.</p> <p>2.2.2 At maximum Real Power output collect maximum leading reactive values as soon as a limit is reached.</p> <p>2.2.3 Nuclear Units are not required to perform Reactive Power verification at minimum Real Power output.</p> <p>2.3. For hydrogen-cooled generators, perform the verification at normal operating hydrogen pressure.</p>

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		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.
Clarify requirement R2 that specifies that the regional reliability organization shall provide generator gross and net reactive power capability verification within 30 calendar days of approval. The confusion centers on “approval” and when the 30-day period starts. 1322. We maintain the concern we expressed in the NOPR that Requirement R2 provides that the “regional reliability organization shall provide generator gross and net reactive power capability verification within 30 calendar days of approval” and note that it is not clear what approval is required and when the 30-day period starts. We direct the ERO to provide clarification on this requirement.	MOD-025-1, FERC Order 693	The GVSDT has combined MOD-024 and MOD-025 into a single standard. The original R2 from MOD-024 maps to Requirement R1 of the proposed MOD-025-2. Fill in the blank components of the standard have been eliminated and the Generator Owner must report the required data to its Transmission Planner. See Requirements R1, R2 and R3 above.
Remove the fill-in-the-blank aspects (correct reference to “... Regional Reliability Organization’s procedures...”).	MOD-025-1, Fill-in-the-blank Team	The GVSDT has combined MOD-024 and MOD-025 into a single standard. Fill in the blank components of the standard have been eliminated and all required testing and data information is contained in Attachment 1 of the proposed MOD-025-2.
Refer to MOD-024.	MOD-025-1, Fill-	The GVSDT has combined MOD-024 and MOD-025 into a single

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	in-the-blank Team	standard, MOD-025-2.
Review MOD-024 and MOD-025 concurrently to transition to uniform North American standards	MOD-025-1, Fill-in-the-blank Team	The GVSDT has combined MOD-024 and MOD-025 into a single standard, MOD-025-2.
These standards do not provide for uniform testing of generator capability. The determination of which units are tested, how frequently they are tested, and the criteria used for determining capability are left to individual regions.	MOD-025-1, Phase III/IV Team	The GVSDT has combined MOD-024 and MOD-025 into a single standard. Fill in the blank components of the standard have been eliminated and all required testing and data information is contained in Attachment 1 of the proposed MOD-025-2.
R1.5.1: The benefit of verifying maximum capability of generators to absorb VARs at seasonal real power generation capability is unclear, particularly if this standard applies to virtually all generators. For the vast majority of units, the need to absorb VARs occurs during low-load conditions, when unit real power production is below maximum capability and the unit's ability to absorb VARs is greater. Therefore, the single datum for unit VAR absorption capability determined pursuant to this standard seems to be of little practical use, except for relatively few generators in a limited set of circumstances.	MOD-025-1, Phase III/IV Team	<p>The Standard no longer references "seasonal capability." Attachment 1 of MOD-025-2 describes the required testing.</p> <p>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 (see Note 3 if the automatic voltage regulator is not available). 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 that operational data meets the criteria in 2.1 through 2.5 below. A Reactive capability test must demonstrate at least 90 percent of a previously staged test that</p>

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		<p>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 by unusual generation or equipment limitations (e.g., capacitor or reactor banks out of service), then the next verification shall<u>will</u> be by another staged test, not operational data:</p> <p>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.</p> <p>2.1.1 Verify synchronous generating unit’s maximum real power and lagging reactive power for a minimum of one hour.</p> <p>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</p>

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		<p>during verifications.</p> <p>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:</p> <p>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.</p> <p>2.2.2 At maximum Real Power output collect maximum leading reactive values as soon as a limit is reached.</p> <p>2.2.3 Nuclear Units are not required to perform Reactive Power verification at minimum Real Power output.</p> <p>2.3. For hydrogen-cooled generators, perform the verification at normal operating hydrogen pressure.</p> <p>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.</p>
It is not clear in R3 to whom the Generator Owner will report the information.	MOD-025-1, Phase III/IV Team	The GVSDT has combined MOD-024 and MOD-025 into a single standard. The original R3 from MOD-024 maps to Requirement R1 of the proposed MOD-025-2. Fill in the blank components of the standard have been eliminated and the Generator Owner

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		must report the required data to its Transmission Planner. Please see Requirements R1, R2 and R3 above.
Non compliance levels are too strict. A small utility with 15-20 units will be L4 noncompliant if they miss one unit.	MOD-025-1, Phase III/IV Team	The Standard now utilizes Violation Risk Factors, Time Horizons and Violation Severity Levels. The issue is addressed through the CMEP. The standard is written such that each generator must be tested. Failure to test a single unit results in a single violation for a requirement.
Severity of non-compliance should be based on the percentage of the generator owner’s total generation capability comprised of units required to be verified, rather than on the percentage (number) of generating units. Exempt units should be excluded from the total generation capability for determining level of non-compliance.	MOD-025-1, Phase III/IV Team	The Standard now utilizes Violation Risk Factors, Time Horizons and Violation Severity Levels. The issue is addressed through the CMEP. The standard is written such that each generator must be tested. Failure to test a single unit results in a single violation for a requirement.
There is no clear reason for regional variations in capability testing. A generator in Georgia does not have more or less capability than an identical unit applied across the Florida line, despite the fact that one is in SERC and the other in FRCC.	MOD-025-1, Phase III/IV Team	The GVSDT has combined MOD-024 and MOD-025 into a single standard. Fill in the blank components of the standard as well as regional variances have been eliminated and all required testing and data information is contained in Attachment 1 of the proposed MOD-025-2.
Fundamental guidelines outlining some basic requirements (e.g., all units over 20 MW shall be tested annually under conditions that permit full net	MOD-025-1, Phase III/IV Team	The GVSDT has combined MOD-024 and MOD-025 into a single standard. All required testing and data information is contained in Attachment 1 of the proposed MOD-025-2.

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output of the unit for normal operation) are lacking.		
Provide clarity where the Planning Authority is mentioned	MOD-025-1; Team Comments	The GVSDT has written the requirements such that the Transmission Planner receives the information from the Generator Owner.