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**UNITED STATES OF AMERICA  
BEFORE THE  
FEDERAL ENERGY REGULATORY COMMISSION**

**NORTH AMERICAN ELECTRIC            )       Docket No.  
RELIABILITY CORPORATION            )**

**PETITION FOR APPROVAL OF  
FIVE PROPOSED RELIABILITY STANDARDS  
MOD-025-2, MOD-026-1, MOD-027-1, PRC-019-1 AND PRC-024-1**

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May 30, 2013

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The North American Electric Reliability Corporation (“NERC”)<sup>1</sup> hereby requests the Federal Energy Regulatory Commission (“FERC” or the “Commission”) approve, in accordance with Section 215(d)(1) of the Federal Power Act (“FPA”)<sup>2</sup> and Section 39.5 of the Commission’s regulations, 18 C.F.R. § 39.5 (2012), five proposed Reliability Standards which were approved by the NERC Board of Trustees on February 7, 2013 and May 9, 2013:<sup>3</sup>

- MOD-025-2—Verification and Data Reporting of Generator Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability;
- MOD-026-1—Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions;
- MOD-027-1—Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions;
- PRC-019-1—Coordination of Generating Unit or Plant Capabilities, Voltage Regulating Controls, and Protection; and
- PRC-024-1—Generator Frequency and Voltage Protective Relay Settings.

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<sup>1</sup> NERC has been certified by the Commission as the electric reliability organization (“ERO”) in accordance with Section 215 of the Federal Power Act. The Commission certified NERC as the ERO in its order issued July 20, 2006 in Docket No. RR06-1-000. *North American Electric Reliability Corp.*, 116 FERC ¶ 61,062 (2006) (“ERO Certification Order”).

<sup>2</sup> 16 U.S.C. § 824o (2012).

<sup>3</sup> MOD-025-2, MOD-026-1, MOD-027-1 and PRC-019-1 were approved by the NERC Board of Trustees on February 7, 2013 and PRC-024-1 was approved on May 9, 2013. Unless otherwise designated, all capitalized terms shall have the meaning set forth in the Glossary of Terms Used in NERC Reliability Standards, available here: [http://www.nerc.com/files/Glossary\\_of\\_Terms.pdf](http://www.nerc.com/files/Glossary_of_Terms.pdf).

NERC is hereby requesting approval of the proposed Reliability Standards, the associated implementation plans, Violation Risk Factors (“VRFs”) and Violation Severity Levels (“VSLs”), and retirement of MOD-024-1 – Verification of Generator Gross and Net Real Power Capability and MOD-025-1 – Verification of Generator Gross and Net Reactive Power Capability prior to the effective date of MOD-025-2.

## **I. EXECUTIVE SUMMARY**

The purpose of Project 2007-09, Generator Verification and the proposed Reliability Standards included herein is to ensure (i) that generators will not trip off-line during specified voltage and frequency excursions<sup>4</sup> or as a result of improper coordination between generator protective relays and generator voltage regulator controls and limit functions (such coordination will include the generating unit’s capabilities), and (ii) that generator models accurately reflect the generator’s capabilities and operating characteristics. Four of the five proposed Reliability Standards are new. Existing Reliability Standards MOD-024-1 and MOD-025-1 were combined into a single proposed Reliability Standard, MOD-025-2. Together, these five proposed Reliability Standards address generator verifications needed to support Bulk-Power System reliability and will ensure that accurate data is verified and made available for planning simulations.

Good quality simulation models of power system equipment are beneficial to the reliability of the Bulk-Power System. Model validation ensures the proper performance of the control systems and validates the computer models used for stability analysis. In addition to obtaining model data, the tests performed to gather this information may uncover latent defects

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<sup>4</sup> System frequency reflects the instantaneous balance between generation and load. Reliable operation of a power system depends on maintaining frequency within predetermined boundaries above and below a scheduled value, which is 60 Hertz (“Hz”) in North America.

that could lead to inappropriate unit response during system disturbances, thereby improving the reliability of the unit and the power system.

Power system planning and operational studies require the simulation of the response of synchronous machines and their respective control systems. For these studies, it is essential that the control systems of the synchronous machines be modeled in sufficient detail.<sup>5</sup> The desired models must be suitable for representing the actual equipment performance for large, severe disturbances as well as for small perturbations. To obtain accurate simulation, not only must the models contain an adequate level of detail, but the values of the parameters in the models must also correspond to actual field values. The equipment to be tested and modeled includes the generator and its control systems,<sup>6</sup> excitation systems,<sup>7</sup> power system stabilizers and turbine governors.<sup>8</sup> Protective relay coordination with equipment capabilities and control system limiters is equally important.<sup>9</sup> Collectively, these five proposed Reliability Standards address generator verifications needed to support Bulk-Power System reliability.

**A. Modeling, Data and Analysis Standards: MOD-025-2, MOD-026-1 and MOD-027-1**

The Modeling, Data and Analysis (“MOD”) body of Reliability Standards ensure that power system models accurately reflect the generator’s capabilities and operating characteristics of the power system elements. The models are used in operating and planning studies. The MOD Standards are intended to standardize methodologies and system data needed for

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<sup>5</sup> See IEEE Task Force on Generator Model Validation Testing of the Power System Stability Subcommittee, “Guidelines for Generator Stability Model Validation Testing,” IEEE PES General Meeting 2007, paper 07GM1307.

<sup>6</sup> This equipment is addressed in proposed Reliability Standard MOD-25-2.

<sup>7</sup> The primary function of the excitation system is to regulate voltage and thereby control var flow in the system.

<sup>8</sup> This equipment is addressed in proposed Reliability Standards MOD-026-1 and MOD-027-1.

<sup>9</sup> This equipment is addressed in proposed Reliability Standards PRC-019-1 and PRC-024-1.

traditional transmission system operation and expansion planning, reliability assessment and the calculation of available transfer capability in an open access environment.

Proposed Reliability Standard MOD-025-2 requires verification of Real and Reactive Power of applicable generator and synchronous condenser facilities. The standard drafting team removed the fill-in-the-blank components of the version 1 standards (MOD-024-1 and MOD-025-1) and provided for explicit verification requirements in the proposed MOD-025-2 Standard. This proposed Reliability Standard ensures that accurate information on generator gross and net Real and Reactive Power capability and synchronous condenser Reactive Power capability is available for planning models used to assess Bulk Electric System (“BES”) reliability.

Proposed Reliability Standard MOD-026-1 relates to the generator excitation control system or the plant volt/var control functions. The Generator Owner is required to provide a verified model to the Transmission Planner according to the periodicity specified in the standard. The purpose is to verify that the generator excitation control system or plant volt/var control function model and the model parameters used in dynamic simulations<sup>10</sup> performed by the Transmission Planner accurately represent the generator excitation control system or plant volt/var control function behavior when assessing BES reliability.

Proposed Reliability Standard MOD-027-1 relates to the generating unit turbine/governor and load control<sup>11</sup> or active power/frequency control functions.<sup>12</sup> The Generator Owner is required to provide a verified model to the Transmission Planner according to the periodicity specified in the standard. The purpose is to verify that the turbine/governor and load control or

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<sup>10</sup> Dynamic simulations simulate real-life reactions whereas static simulations only take a snapshot in time. Dynamic simulations are intended to show how the power system will react over time to certain events. The models for dynamic simulations are more complicated and involve voltage and frequency response characteristics over a fixed time period. Each event on the grid causes voltages and/or frequency to change. Dynamic simulations are designed to predict these changes.

<sup>11</sup> Turbine/governor and load control applies to conventional synchronous generation.

<sup>12</sup> Active power/frequency control applies to inverter connected generators (often found at variable energy plants).

active power/frequency control model and the model parameters, used in dynamic simulations performed by the Transmission Planner that assess BES reliability, accurately represent generator unit real power response to system frequency variations.<sup>13</sup>

**B. Protection and Control Standards: PRC-019-1 and PRC-024-1**

The Protection and Control (“PRC”) body of Reliability Standards apply to Transmission Operators, Transmission Owners, Generator Operators, Generator Owners, Distribution Providers and Regional Reliability Organizations and cover a wide range of topics related to the protection and control of power systems. Protection and control systems on Bulk-Power System elements are an integral part of reliable grid operation. Protection systems are designed to detect and isolate faulty elements on a system, thereby limiting the severity and spread of system disturbances, and preventing possible damage to protected elements. The function, settings, and limitations of a protection system are critical in establishing System Operating Limits and Interconnection Reliability Operating Limits.

Proposed Reliability Standard PRC-019-1 is a protection Standard that requires the Generator Owner and Transmission Owner<sup>14</sup> to coordinate the voltage regulating system controls with the equipment capabilities and settings of Protection System devices and functions.

Proposed Reliability Standard PRC-024-1 contains requirements for generator protection system performance during frequency and voltage excursions. The proposed Reliability Standard ensures that generating units are not tripped by their protective relays and remain connected during specified frequency and voltage excursions and ensures expected generating

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<sup>13</sup> The proposed implementation plans for MOD-026-1 and MOD-027-1 are of a longer duration due to the complexity of the tasks involved as explained in **Exhibit C**.

<sup>14</sup> Only applicable to Transmission Owners that own synchronous condenser(s). See PRC-019-1, Section 4.1.2.

unit performance during frequency and voltage excursions is communicated to Planning Coordinators and Transmission Planners for accurate system modeling.

## II. NOTICES AND COMMUNICATIONS

Notices and communications with respect to this filing may be addressed to the following:<sup>15</sup>

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## III. BACKGROUND

### A. Regulatory Framework and NERC Reliability Standards Development Procedure

By enacting the Energy Policy Act of 2005,<sup>16</sup> Congress entrusted the Commission with the duties of approving and enforcing rules to ensure the reliability of the Nation’s Bulk-Power System, and with the duty of certifying an ERO that would be charged with developing and enforcing mandatory Reliability Standards, subject to Commission approval. Section 215 of the

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<sup>15</sup> Persons to be included on the Commission’s service list are indicated with an asterisk. NERC requests waiver of 18 C.F.R. § 385.203(b) to permit the inclusion of more than two people on the service list.

<sup>16</sup> 16 U.S.C. § 824o (2012).



FPA states that all users, owners, and operators of the Bulk-Power System in the United States will be subject to Commission-approved Reliability Standards.<sup>17</sup>

Section 215(d)(5) of the FPA authorizes the Commission to order the ERO to submit a new or modified Reliability Standard. Pursuant to Section 215(d)(2) of the FPA and Section 39.5(c)(1) of the Commission's regulations, the Commission will give due weight to the technical expertise of the ERO with respect to the content of a Reliability Standard. In Order No. 693, the Commission noted that it would defer to the "technical expertise" of the ERO with respect to the content of a Reliability Standard and explained that, through the use of directives, it provides guidance but does not dictate an outcome. Rather, the Commission will consider an equivalent alternative approach provided that the ERO demonstrates that the alternative will address the Commission's underlying concern or goal as efficiently and effectively as the Commission's proposal, example, or directive.<sup>18</sup>

Section 39.5(a) of the Commission's regulations requires the ERO to file with the Commission for its approval each Reliability Standard that the ERO proposes to become mandatory and enforceable in the United States, and each modification to a Reliability Standard that the ERO proposes to be made effective. The Commission has the regulatory responsibility to approve standards that protect the reliability of the Bulk-Power System and to ensure that such standards are just, reasonable, not unduly discriminatory or preferential, and in the public interest.

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<sup>17</sup> See Section 215(b)(1) ("All users, owners and operators of the bulk-power system shall comply with reliability standards that take effect under this section.").

<sup>18</sup> See *Mandatory Reliability Standards for the Bulk-Power System*, Order No. 693, FERC Stats. & Regs. ¶ 31,242 at PP 31, 186-187, *order on reh'g*, Order No. 693-A, 120 FERC ¶ 61,053 (2007).

The proposed Reliability Standards were developed in an open and fair manner and in accordance with the Commission-approved Reliability Standard development process.<sup>19</sup> NERC develops Reliability Standards in accordance with Section 300 (Reliability Standards Development) of its Rules of Procedure and the NERC Standard Processes Manual.<sup>20</sup> In its ERO Certification Order, the Commission found that NERC's proposed rules provide for reasonable notice and opportunity for public comment, due process, openness, and a balance of interests in developing Reliability Standards and thus satisfies certain of the criteria for approving Reliability Standards. The development process is open to any person or entity with a legitimate interest in the reliability of the Bulk-Power System. NERC considers the comments of all stakeholders, and a vote of stakeholders and the NERC Board of Trustees is required to approve a Reliability Standard before the Reliability Standard is submitted to the Commission for approval.

#### **IV. JUSTIFICATION FOR APPROVAL OF PROPOSED RELIABILITY STANDARDS**

Provided below is the following: (A) a description of each proposed Reliability Standard and discussion of how applicable Commission directives are satisfied; and (B) justification for the proposed Reliability Standards on a Requirement by Requirement basis.

##### **A. MOD-025-2 -- Verification and Data Reporting of Generator Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability**

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<sup>19</sup> *Rules Concerning Certification of the Electric Reliability Organization; and Procedures for the Establishment, Approval, and Enforcement of Electric Reliability Standards*, Order No. 672 at P 334, FERC Stats. & Regs. ¶ 31,204, *order on reh'g*, Order No. 672-A, FERC Stats. & Regs. ¶ 31,212 (2006) ("Further, in considering whether a proposed Reliability Standard meets the legal standard of review, we will entertain comments about whether the ERO implemented its Commission-approved Reliability Standard development process for the development of the particular proposed Reliability Standard in a proper manner, especially whether the process was open and fair. However, we caution that we will not be sympathetic to arguments by interested parties that choose, for whatever reason, not to participate in the ERO's Reliability Standard development process if it is conducted in good faith in accordance with the procedures approved by FERC.").

<sup>20</sup> The NERC Rules of Procedure are available here: <http://www.nerc.com/AboutNERC/Pages/Rules-of-Procedure.aspx>. The current NERC Standard Processes Manual is available here: [http://www.nerc.com/files/Appendix\\_3A\\_StandardsProcessesManual\\_20120131.pdf](http://www.nerc.com/files/Appendix_3A_StandardsProcessesManual_20120131.pdf).

Proposed Reliability Standard MOD-025-2 consists of three Requirements and two Attachments. The proposed Reliability Standard is a result of merging two existing Reliability Standards, MOD-024-1 and MOD-025-1, into a single standard and is applicable to Generator Owners and Transmission Owners that own synchronous condenser(s). Attachment 1 is incorporated into all three Requirements (R1.1, R2.1 and R3.1) and specifies: (1) the frequency with which a new verification must be conducted of generator Real and Reactive Power capability and synchronous condenser Reactive Power capability; and (2) the specifications for applicable Facilities, including a requirement to record data for the verifications. Attachment 2 is incorporated into all three Requirements (R1.2, R2.2, and R3.2) and is to be used to report the information identified in Attachment 1.<sup>21</sup>

### **1. Merger of MOD-024-1 and MOD-025-1**

Existing Reliability Standard MOD-024-1, Verification of Generator Gross and Net Real Power Capability, is a fill-in-the-blank standard and requires the regional reliability organization to establish and maintain procedures to address verification of generator gross and net real power capability. It also requires a generator owner to follow its regional reliability organization's procedure for verifying and reporting gross and net real power generating capability.<sup>22</sup>

Existing Reliability Standard MOD-025-1 is also a fill-in-the-blank standard and requires the regional reliability organization to establish and maintain procedures to address verification of generator gross and net reactive power capability.<sup>23</sup>

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<sup>21</sup> Note, if the configuration of the applicable Facility does not lend itself to the use of the diagram, tables or summaries for reporting the required information, changes may be made to the form, provided that all required information is reported.

<sup>22</sup> The Commission neither approved nor remanded MOD-024-1 in Order No. 693 and instead directed NERC to submit additional information.

<sup>23</sup> Existing Reliability Standard MOD-025-1 requires the regional reliability organization to provide its generator gross and net reactive power capability verification and reporting procedures, and any changes to those procedures, to the generator owners, generator operators, transmission operators, planning authorities and transmission planners affected by the procedure within 30 calendar days of approval of the Reliability Standard.

Existing Reliability Standards MOD-024-1 and MOD-025-1 have been combined into a single proposed Reliability Standard, MOD-025-2, that requires verification of Real and Reactive Power of applicable generator and synchronous condenser facilities. The fill-in-the-blank components of the version 1 standards have been removed from proposed Reliability Standard, MOD-025-2, and the Standard contains explicit verification requirements. This proposed Standard ensures that accurate information on generator gross and net Real and Reactive Power capability and synchronous condenser Reactive Power capability is available for planning models used to assess BES reliability.

## **2. Commission Directives**

The Commission issued three directives with respect to MOD-024-1 and MOD-025-1 that are resolved by proposed Reliability Standard MOD-025-2: (1) the Commission expressed a concern in Order No. 693 (at P 1311) that Requirement R2 of MOD-024-1, 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;<sup>24</sup> (2) the Commission directed NERC 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

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Like MOD-024-1, the Commission neither approved nor remanded MOD-025-1 in Order No. 693 and instead directed NERC to submit additional information. *See* Order No. 693 at P 1320. (“The Commission will not approve or remand MOD-025-1 until the ERO submits additional information.”).

<sup>24</sup> The Commission directed NERC to modify the Reliability Standard by adding clarifying information, specifically regarding what approval is required and when the 30-day period starts. Order No. 693 at 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.”).

determined”<sup>25</sup>; and (3) the Commission directed NERC to require verification of Reactive Power capability at multiple points over a unit’s operating range.<sup>26</sup>

The first directive to clarify Requirement R2 of MOD-024-1 is satisfied by Requirement R1, Part 1.2 of proposed Reliability Standard MOD-025-2 , which specifies that a completed Attachment 2 (or a form containing the same information as identified in Attachment 2) must be submitted by a Generator Owner 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.

The Commission’s second directive 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”<sup>27</sup> is satisfied by Part 1.1 of Requirement R1 of proposed Reliability Standard MOD-025-2, which requires entities to verify the Real Power capability of its generating units in accordance with Attachment 1. Section 3.4 of Attachment 1 includes the ambient conditions during a verification period 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.

Therefore, Proposed Reliability Standard MOD-025-2 provides for the determination of the amount of power that can be expected to be delivered from a generator under different conditions, including peak summer conditions, as directed by the Commission in Order No. 693.

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<sup>25</sup> Order No. 693 at P 1310.

<sup>26</sup> Order No. 693 at P 1321. (“The Commission “direct[ed] the ERO to modify MOD-025-1 to require verification of reactive power capability at multiple points over a unit’s operating range.”).

<sup>27</sup> Order No. 693 at P 1310.

Attachment 1 of proposed Reliability Standard MOD-025-2 satisfies the Commission's third directive in Order No. 693 (at P 1321) to require verification of Reactive Power capability at multiple points over a unit's operating range.<sup>28</sup> Sections 2.1 through 2.4 of Attachment 1 require the verification of Reactive Power capability at multiple points over a unit's operating range. For example, Section 2.1 requires the verification of synchronous generating unit's maximum Real Power and lagging Reactive Power for a minimum of one hour.

Section 2.2 requires verification of the Reactive Power capability of all applicable Facilities, other than wind and photovoltaic, for maximum overexcited (lagging) and under-excited (leading) reactive capability under several conditions.<sup>29</sup> Collectively, Sections 2.1 through 2.4 of Attachment 1 satisfy the Commission's directive to require verification of reactive power capability at multiple points over a unit's operating range.

Provided below is a justification of proposed Reliability Standard MOD-025-2 on a Requirement by Requirement basis.

### **Proposed Requirements – MOD-025-2**

- R1.** Each Generator Owner shall provide its Transmission Planner with verification of the Real Power capability of its applicable Facilities as follows: [*Violation Risk Factor: Medium*] [*Time Horizon: Long-term Planning*]
- 1.1.** Verify the Real Power capability of its generating units in accordance with Attachment 1.
  - 1.2.** Submit a completed Attachment 2 (or a form containing the same information as identified in Attachment 2) to its Transmission Planner within 90 calendar days of

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<sup>28</sup> See MOD-025-2, Attachment 1, Sections 2.1 through 2.2.

<sup>29</sup> Attachment 1, Section 2.2 provides:

**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.

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.

Requirement R1 addresses Real Power and requires Generator Owners to verify the Real Power capability of its generating units and provide that verification to its Transmission Planner.

**R2.** Each Generator Owner shall provide its Transmission Planner with verification of the Reactive Power capability of its applicable Facilities as follows: *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*

**2.1.** Verify, in accordance with Attachment 1, (i) the Reactive Power capability of its generating units and (ii) the Reactive Power capability of its synchronous condenser units.

**2.2.** Submit a completed Attachment 2 (or a form containing the same information as identified in Attachment 2) to its Transmission Planner within 90 calendar days of either (i) the date the data is recorded for a staged test; or (ii) the date the data is selected for verification using historical operational data.

Requirement R2 addresses Reactive Power and requires Generator Owners to verify the Reactive Power capability of its generating units and provide that verification to its Transmission Planner.

**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.

Like Requirement R2, Requirement R3 addresses Reactive Power, although Requirement R2 applies to Transmission Owners and requires Transmission Owners to verify the Reactive

Power capability of applicable Facilities and provide that verification to its Transmission Planner.

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

Proposed Reliability Standard MOD-026-1 is a new Reliability Standard and consists of six Requirements and an Attachment (Attachment 1, Excitation Control System or Plant Volt/Var Function Model Verification Periodicity). The primary function of the excitation system is to regulate voltage and thereby control var flow in the system. When the behavior of generators is to be simulated accurately in power system stability studies, it is essential that the excitation systems of the generators be modeled in sufficient detail. Proposed Reliability Standard MOD-026-1 ensures that the generator excitation control system or plant volt/var control function model and the model parameters used in dynamic simulations performed by the Transmission Planner accurately represent the generator excitation control system or plant volt/var control function behavior when assessing BES reliability. Proposed Reliability Standard MOD-026-1 is applicable to Generator Owners and Transmission Planners.

**Proposed Requirements – MOD-026-1**

- R1.** Each Transmission Planner shall provide the following requested information to the Generator Owner within 90 calendar days of receiving a written request : [*Violation Risk Factor: Lower*] [*Time Horizon: Operations Planning*]
- Instructions on how to obtain the list of excitation control system or plant volt/var control function models that are acceptable to the Transmission Planner for use in dynamic simulation,
  - Instructions on how to obtain the dynamic excitation control system or plant volt/var control function model library block diagrams and/or data sheets for models that are acceptable to the Transmission Planner, or
  - Model data for any of the Generator Owner’s existing applicable unit specific excitation control system or plant volt/var control function contained in the Transmission Planner’s dynamic database from the current (in-use) models, including generator MVA base.



Requirement R1 of proposed Reliability Standard MOD-026-1 is intended to ensure that the Transmission Planner provides information to the Generator Owner necessary to ensure that they provide a useable model in an acceptable format. This ensures that Generator Owners can comply with Requirement R2 and in turn, provide information to Transmission Planners.

**R2.** Each Generator Owner shall provide for each applicable unit, a verified generator excitation control system or plant volt/var control function model, including documentation and data (as specified in Part 2.1) to its Transmission Planner in accordance with the periodicity specified in MOD-026 Attachment 1. *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*

- 2.1.** Each applicable unit's model shall be verified by the Generator Owner using one or more models acceptable to the Transmission Planner. Verification for individual units less than 20 MVA (gross nameplate rating) in a generating plant (per Section 4.2.1.2, 4.2.2.2, or 4.2.3.2) may be performed using either individual unit or aggregate unit model(s), or both. Each verification shall include the following:
- 2.1.1.** Documentation demonstrating the applicable unit's model response matches the recorded response for a voltage excursion from either a staged test or a measured system disturbance,
  - 2.1.2.** Manufacturer, model number (if available), and type of the excitation control system including, but not limited to static, AC brushless, DC rotating, and/or the plant volt/var control function (if installed),
  - 2.1.3.** Model structure and data including, but not limited to reactance, time constants, saturation factors, total rotational inertia, or equivalent data for the generator,
  - 2.1.4.** Model structure and data for the excitation control system, including the closed loop voltage regulator if a closed loop voltage regulator is installed or the model structure and data for the plant volt/var control function system,
  - 2.1.5.** Compensation settings (such as droop, line drop, differential compensation), if used, and
  - 2.1.6.** Model structure and data for power system stabilizer, if so equipped.

Requirement R2 of proposed Reliability Standard MOD-026-1 ensures that Generator Owners provide Transmission Planners a verified generator excitation control system or plant volt/var control function model. The testing of excitation systems to validate their performance

specifications and to construct models can be a time consuming task<sup>30</sup> and Attachment 1, *Excitation Control System or Plant Volt/Var Function Model Verification Periodicity*, which is incorporated into Requirement R2, reflects these realities. Initial validation testing should be part of equipment commissioning. Initial verification for a new applicable unit or for an existing applicable unit with new excitation control system or plant volt/var control function equipment installed is required by row number 3 of Attachment 1 within 365 calendar days after the commissioning date. Testing of excitation limiters is complicated since it involves verifying that once engaged, the limiter is capable of controlling the excitation level in a stable manner.

The purpose of Requirement R2 is to verify that the generator excitation control system or plant volt/var control function model and the model parameters used in dynamic simulations performed by the Transmission Planner accurately represent the generator excitation control system or plant volt/var control function behavior when assessing BES reliability.

- R3.** Each Generator Owner shall provide a written response to its Transmission Planner within 90 calendar days of receiving one of the following items for an applicable unit:
- Written notification from its Transmission Planner (in accordance with Requirement R6) that the excitation control system or plant volt/var control function model is not usable,
  - Written comments from its Transmission Planner identifying technical concerns with the verification documentation related to the excitation control system or plant volt/var control function model, or
  - Written comments and supporting evidence from its Transmission Planner indicating that the simulated excitation control system or plant volt/var control function model response did not match the recorded response to a transmission system event.

The written response shall contain either the technical basis for maintaining the current model, the model changes, or a plan to perform model verification[FN3] (in accordance with Requirement R2). [*Violation Risk Factor: Lower*] [*Time Horizon: Operations Planning*]

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<sup>30</sup> See IEEE Task Force on Generator Model Validation Testing of the Power System Stability Subcommittee, "Guidelines for Generator Stability Model Validation Testing," at 7, IEEE PES General Meeting 2007, paper 07GM1307.

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

Requirement R3 of proposed Reliability Standard MOD-026-1 provides response requirements for a Generator Owner when it receives certain requests from the Transmission Planner. This communication ensures that Generator Owners have an obligation to respond in a timely fashion when there are demonstrated problems with a model that was provided by the Generator Owner in accordance with Requirement R2.

**R4.** Each Generator Owner shall provide revised model data or plans to perform model verification[FN4] (in accordance with Requirement R2) for an applicable unit to its Transmission Planner within 180 calendar days of making changes to the excitation control system or plant volt/var control function that alter the equipment response characteristic.[FN5] [*Violation Risk Factor: Lower*] [*Time Horizon: Operations Planning*]

[FN 4: Ibid]

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

Requirement R4 of proposed Reliability Standard MOD-026-1 ensures that when a Generator Owner makes a change to an applicable unit that would affect the model provided in accordance with Requirement R2, the Generator Owner then has an obligation to determine whether there is an impact on the model and to provide the Transmission Planner with revised model data or plans to perform model verification.

- R5.** Each Generator Owner shall provide a written response to its Transmission Planner, within 90 calendar days following receipt of a technically justified[FN6] unit request from the Transmission Planner to perform a model review of a unit or plant that includes one of the following: *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*
- Details of plans to verify the model (in accordance with Requirement R2), or
  - Corrected model data including the source of revised model data such as discovery of manufacturer test values to replace generic model data or updating of data parameters based on an on-site review of the equipment.
- [FN 6: Technical justification is achieved by the Transmission Planner demonstrating that the simulated unit or plant response does not match the measured unit or plant response.

Requirement R5 of proposed Reliability Standard MOD-026-1 ensures that there is a process for Transmission Planners to request a model review for technically justified units not specified in the standard Applicability section but that meet or exceed the Registry Criteria unit MVA thresholds. Footnote 2 clarifies that technical justification is achieved by the Transmission Planner demonstrating that the simulated unit or plant response does not match the measured unit or plant response. Requirement R5 allows Generator Owners 90 days to provide Transmission Planners with: (1) its plans to verify the model or (2) corrected model data.

- R6.** Each Transmission Planner shall provide a written response to the Generator Owner within 90 calendar days of receiving the verified excitation control system or plant volt/var control function model information in accordance with Requirement R2 that the model is usable (meets the criteria specified in Parts 6.1 through 6.3) or is not usable.
- 6.1.** The excitation control system or plant volt/var control function model initializes to compute modeling data without error,
  - 6.2.** A no-disturbance simulation results in negligible transients, and
  - 6.3.** For an otherwise stable simulation, a disturbance simulation results in the excitation control and plant volt/var control function model exhibiting positive damping.

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

Requirement R6 of proposed Reliability Standard MOD-026-1 requires the Transmission Planner to inform the Generator Owner within 90 calendar days whether a model is useable or not. The response from the Transmission Planner verifies that the Transmission Planner has sufficient information and ensures that the verification process is complete.

### **C. MOD-027-1 – Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions**

Proposed Reliability Standard MOD-027-1 is a new Reliability Standard and consists of five Requirements. The purpose of proposed Reliability Standard MOD-027-1 is to verify that the turbine/governor and load control or active power/frequency control model and the model parameters, used in dynamic simulations that assess BES reliability, accurately represent generator unit Real Power response to system frequency variations.

#### **Proposed Requirements MOD-027-1**

- R1.** Each Transmission Planner shall provide the following requested information to the Generator Owner within 90 calendar days of receiving a written request: *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*
- Instructions on how to obtain the list of turbine/governor and load control or active power/frequency control system models that are acceptable to the Transmission Planner for use in dynamic simulation,
  - Instructions on how to obtain the dynamic turbine/governor and load control or active power/frequency control function model library block diagrams and/or data sheets for models that are acceptable to the Transmission Planner, or
  - Model data for any of the Generator Owner's existing applicable unit specific turbine/governor and load control or active power/frequency control system contained in the Transmission Planner's dynamic database from the current (in-use) models.

Requirement R1 of proposed Reliability Standard MOD-027-1 requires Transmission Planners to provide information to Generator Owners upon written request within 90 calendar days. This information ensures that Generator Owners can provide Transmission Planners the information required in Requirements R2 and R4 of proposed Reliability Standard MOD-027-1.

**R2.** Each Generator Owner shall provide, for each applicable unit, a verified turbine/governor and load control or active power/frequency control model, including documentation and data (as specified in Part 2.1) to its Transmission Planner in accordance with the periodicity specified in MOD-027 Attachment 1. [*Violation Risk Factor: Medium*] [*Time Horizon: Long-term Planning*]

**2.1.** Each applicable unit's model shall be verified by the Generator Owner using one or more models acceptable to the Transmission Planner. Verification for individual units rated less than 20 MVA (gross nameplate rating) in a generating plant (per Section 4.2.1.2, 4.2.2.2, or 4.2.3.2) may be performed using either individual unit or aggregate unit model(s) or both. Each verification shall include the following:

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

- A frequency excursion from a system disturbance that meets MOD-027 Attachment 1 Note 1 with the applicable unit on-line,
- A speed governor reference change with the applicable unit online, or
- A partial load rejection test,[FN 2]

**2.1.2.** Type of governor and load control or active power control/frequency control equipment,

[FN2: Differences between the control mode tested and the final simulation model must be identified, particularly when analyzing load rejection data. Most controls change gains or have a set point runback which takes effect when the breaker opens. Load or set point controls will also not be in effect once the breaker opens. Some method of accounting for these differences must be presented if the final model is not validated from on-line data under the normal operating conditions under which the model is expected to apply.]

Requirement R2 of proposed Reliability Standard MOD-027-1 requires Generator Owners to provide Transmission Planners information and documentation as specified in Attachment 1. Attachment 1, *Turbine/Governor and Load Control or Active Power/Frequency Control Model Periodicity*, is a table that lists verification conditions and the accompanying required actions. In addition to obtaining model data, the tests performed to gather this information may uncover latent defects that could lead to inappropriate unit response during system disturbances and thereby improve reliability.<sup>31</sup>

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

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<sup>31</sup> See IEEE Task Force on Generator Model Validation Testing of the Power System Stability Subcommittee, "Guidelines for Generator Stability Model Validation Testing," at 1, IEEE PES General Meeting 2007, paper 07GM1307.

- Written notification, from its Transmission Planner (in accordance with Requirement R5) that the turbine/governor and load control or active power/frequency control model is not “usable,”
- Written comments from its Transmission Planner identifying technical concerns with the verification documentation related to the turbine/governor and load control or active power/frequency control model, or
- Written comments and supporting evidence from its Transmission Planner indicating that the simulated turbine/governor and load control or active power/frequency control response did not approximate the recorded response for three or more transmission system events.

The written response shall contain either the technical basis for maintaining the current model, the model changes, or a plan to perform model verification[FN 3] (in accordance with Requirement R2). [*Violation Risk Factor: Lower*] [*Time Horizon: Operations Planning*]

[FN3: If verification is performed, the 10 year period as outlined in MOD-027 Attachment 1 is reset.]

Requirement R3 of proposed Reliability Standard MOD-027-1 ensures that there is appropriate communication between Generator Owners and Transmission Planners when an issue is identified with a model or where there is a difference between the model and actual recorded events for three or more transmission system events. The evidence of compliance with Requirement R3, included in Measure M3,<sup>32</sup> would consist of the Generator Owner’s dated written response containing the information identified in Requirement R3 and dated evidence of the transmittal of the response.

**R4.** Each Generator Owner shall provide revised model data or plans to perform model Verification[FN 4] (in accordance with Requirement R2) for an applicable unit to its Transmission Planner within 180 calendar days of making changes to the turbine/governor and load control or active power/frequency control system that alter the equipment response characteristic[FN 5]. [*Violation Risk Factor: Lower*] [*Time Horizon: Operations Planning*]

[FN4: Ibid.]

[FN5: Control replacement or alteration including software alterations or plant digital control system addition or replacement, plant digital control system software alterations

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<sup>32</sup> Measures identify the evidence or types of evidence needed to demonstrate compliance with the associated Requirement. See NERC Standard Processes Manual, available here: <http://www.nerc.com/pa/Stand/Resources/Documents/Appendix3AStandardsProcessesManual.pdf>.

that alter droop, and/or dead band, and/or frequency response and/or a change in the frequency control mode (such as going from droop control to constant MW control, etc).]

Requirement R4 of proposed Reliability Standard MOD-027-1 ensures that Generator Owners provide Transmission Planners with updated information when changes occur; this ensures that the information in Requirement R2 is updated when necessary (*i.e.*, when changes are made to the turbine/governor and load control or active power/frequency control system that alter the equipment response characteristic). The evidence of compliance for Requirement R4, included in Measure M4, would consist of dated revised model data or dated plans to perform a model verification and dated evidence of transmittal.

**R5.** Each Transmission Planner shall provide a written response to the Generator Owner within 90 calendar days of receiving the turbine/governor and load control or active power/frequency control system verified model information in accordance with Requirement R2 that the model is usable (meets the criteria specified in Parts 5.1 through 5.3) or is not usable.

**5.1.** The turbine/governor and load control or active power/frequency control function model initializes to compute modeling data without error,

**5.2.** A no-disturbance simulation results in negligible transients, and

**5.3.** For an otherwise stable simulation, a disturbance simulation results in the turbine/governor and load control or active power/frequency control model exhibiting positive damping.

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

Requirement R5 of proposed Reliability Standard MOD-027-1 requires Transmission Planners to provide verification to Generator Owners that the model provided (pursuant to Requirement R2 or R4) is useable. This is necessary to ensure that there is appropriate communication between Generator Owners and Transmission Planners and ensures that if the model provided by the Generator Owner is not useable, the Generator Owner has an appropriate technical explanation of the issue. Generator Owners are also then obligated to provide a written response, pursuant to Requirement R3, within 90 calendar days.



## **D. PRC-019-1 – Coordination of Generating Unit or Plant Capabilities, Voltage Regulating Controls, and Protection**

Proposed Reliability Standard PRC-019-1 is a new Reliability Standard and consists of two Requirements. The purpose of the proposed Reliability Standard is to verify coordination of generating unit Facility or synchronous condenser voltage regulating controls, limit functions, equipment capabilities and Protection System settings. Proposed Reliability Standard PRC-019-1 is applicable to Generator Owners and Transmission Owners that own synchronous condenser(s).

### **Proposed Requirements – PRC-019-1**

**R1.** At a maximum of every five calendar years, each Generator Owner and Transmission Owner with applicable Facilities shall coordinate the voltage regulating system controls, (including in-service[FN 1] limiters and protection functions) with the applicable equipment capabilities and settings of the applicable Protection System devices and functions. *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*

**1.1.** Assuming the normal automatic voltage regulator control loop and steady-state system operating conditions, verify the following coordination items for each applicable Facility:

**1.1.1.** The in-service limiters are set to operate before the Protection System of the applicable Facility in order to avoid disconnecting the generator unnecessarily.

**1.1.2.** The applicable in-service Protection System devices are set to operate to isolate or de-energize equipment in order to limit the extent of damage when operating conditions exceed equipment capabilities or stability limits.

[FN 1: Limiters or protection functions that are installed and activated on the generator or synchronous condenser.]

Requirement R1 of proposed Reliability Standard PRC-019-1 requires Generator Owners and Transmission Owners to coordinate voltage regulating system controls with the equipment of the applicable Protection System devices and functions. Measure M1 states that each Generator Owner and Transmission Owner should have evidence that it coordinated the voltage regulating system controls and examples of coordination are provided in the Reference section of the

standard. The Reference Section of proposed Reliability Standard PRC-019-1 states that evidence of coordination associated with Requirement R1 may be in the form of:

- P-Q Diagram (Example in Attachment 1), or
- R-X Diagram (Example in Attachment 2), or
- Inverse Time Diagram (Example in Attachment 3) or,
- Equivalent tables or other evidence

This evidence should include the equipment capabilities and the operating region for the limiters and protection functions. Equipment limits, types of limiters and protection functions which could be coordinated include (but are not limited to):

- Field over-excitation limiter and associated protection functions.
- Inverter over current limit and associated protection functions.
- Field under-excitation limiter and associated protection functions.
- Generator or synchronous condenser reactive capabilities.
- Volts per hertz limiter and associated protection functions.
- Stator over-voltage protection system settings.
- Generator and transformer volts per hertz capability.
- Time vs. field current or time vs. stator current.

**(NOTE:** This listing is for reference only. This standard does not require the installation or activation of any of the above limiter or protection functions.)

**R2.** Within 90 calendar days following the identification or implementation of systems, equipment or setting changes that will affect the coordination described in Requirement R1, each Generator Owner and Transmission Owner with applicable Facilities shall perform the coordination as described in Requirement R1. These possible systems, equipment or settings changes include, but are not limited to the following [*Violation Risk Factor: Medium*] [*Time Horizon: Long-term Planning*]:

- Voltage regulating settings or equipment changes;
- Protection System settings or component changes;
- Generating or synchronous condenser equipment capability changes; or
- Generator or synchronous condenser step-up transformer changes.

Requirement R2 of proposed Reliability Standard PRC-019-1 applies when there are equipment or setting changes. Collectively, Requirements R1 and R2 ensure an appropriate level of coordination between Generator Owners and Transmission Owners. The evidence of

compliance with Requirement R2 (included in Measure M2) would consist of dated documentation that demonstrates that the specified intervals in Requirement R2 have been met.

#### **E. PRC-024-1 – Generator Frequency and Voltage Protective Relay Settings**

Proposed Reliability Standard PRC-024-1 is a new Reliability Standard and consists of four Requirements and two Attachments. The purpose of proposed Reliability Standard PRC-024-1 is to ensure that Generator Owners set their generator protective relays such that generating units remain connected during defined frequency and voltage excursions.

Attachment 1 is the Off Nominal Frequency Capability Curve and establishes a “no trip zone;” it is incorporated into the language of Requirement R1 of proposed Reliability Standard PRC-024-1. The X-axis of the Attachment 1 curve represents time and the scale is logarithmic. The Y-axis of the Attachment 1 curve represents the frequency of the specific Interconnection. The “no trip zone” does not include the colored lines delineating the zones illustrated in Attachment 1. The curve data points provided in the tables of Attachment 1 detail the exact points on the curve for each Interconnection and represent the amount of time a generator needs to stay connected at specific defined frequency excursions. For the Eastern Interconnection, the relays for each generator are expected to be set to remain online between frequencies of greater than (and not including) 60.5 hz and less than (and not including) 59.5 hz. For all other Interconnections, the relays for each generator are expected to be set to remain online between frequencies of greater than (and not including) 60.6 hz and less than (and not including) 59.4 hz. For example, in the Western Interconnection if the frequency drops to 58.0 hz the relays are required to be set such that they do not trip the generating units for up to (and not including) 12 seconds. For time periods of 12 seconds and beyond, the proposed Standard allows for the relays to be set to trip the generating units.

Attachment 2 is the Voltage Ride-Through Time Duration Curve and is incorporated into the language of Requirement R2 of proposed Reliability Standard PRC-024-1.

### **1. Commission Directives**

Proposed Reliability Standard PRC-024-1 satisfies two Commission directives from Paragraph 1787 of Order No. 693.

1787. In the NOPR, the Commission identified an implicit assumption in the TPL Reliability Standards that all generators are required to ride through the same types of voltage disturbances and remain in service after the fault is cleared. This implicit assumption should be made explicit. Commenters agree with the proposed requirement for all generators to ride through the same set of Category B and C events as required for wind generators. The Commission understands that [United States Nuclear Regulatory Commission (“NRC”)] has both degraded voltage and loss of voltage requirements. The degraded voltage requirement allows the voltage at the auxiliary power system busses to go below the minimum value for a time frame that is usually much longer than normal fault clearing time. If a specific nuclear power plant has an NRC requirement that would force it to trip off-line if its auxiliary power system voltage was depressed below some minimum voltage, the simulation should include the tripping of the plant in addition to the faulted facilities. In this regard, the Commission agrees that NRC requirements should be used when implementing the Reliability Standards. Using NRC requirements as input will assure that there is consistency between the Reliability Standards and the NRC requirement that the system is accurately modeled. Accordingly, the Commission directs the ERO to modify the Reliability Standard to explicitly require either that all generators are capable of riding through the same set of Category B and C contingencies, as required by wind generators in Order No. 661, or that those generators that cannot ride through be simulated as tripping. If a generator trips due to low voltage from a single contingency, the initial trip of the faulted element and the resulting trip of the generator would be governed by Category B contingencies and performance criteria.<sup>33</sup>

Requirement R2 and Attachment 2 (which is incorporated), of proposed Reliability Standard PRC-024-1 satisfy the Commission’s directive in Order No. 693 to “explicitly require either that all generators are capable of riding through the same set of Category B and C

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<sup>33</sup> Order No. 693 at P 1787(internal citation omitted)(emphasis added).

contingencies, as required by wind generators in Order No. 661, or that those generators that cannot ride through be simulated as tripping.”<sup>34</sup>

The technical basis for the curves in Attachment 2 of NERC Standard PRC-024-1 comes principally from *The Technical Basis for the New WECC Voltage Ride-Through (VRT) Standard*, a whitepaper developed by the WECC Wind Generation Task Force (“WGTF”).<sup>35</sup>

During the process of drafting the proposed Reliability Standard PRC-024-1, a comparison was done by a utility company between the results of fault recordings and studies from their region with the curves in Attachment 2 and this demonstrated that the curves properly bounded the voltage profiles actually experienced. It should be noted that, unlike a number of other regulatory requirements for voltage ride-through, the proposed WECC curves (and subsequently the curves in PRC-024-1 Attachment 2) contain requirements for the high voltage excursions that occur following clearing of a fault on the transmission system. The standard drafting team reviewed these curves to ensure they did not compromise equipment safety due to overexcitation of magnetic circuits as described in IEEE<sup>36</sup> and ANSI<sup>37</sup> standards. The standard drafting team also had the benefit of input from a manufacturer of power conversion electronic equipment to ensure the curves were realistic from their perspective.

Requirement R3 allows NRC requirements to supersede portions of the voltage and frequency ride through criteria in proposed Reliability Standard PRC-024-1. Requirement R3 allows generators an exemption from portions of the ride through curves for documented regulatory limitations. The standard drafting team asserts that NRC requirements qualify as

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<sup>34</sup> Order No. 693 at P 1787.

<sup>35</sup> Available here: [http://www.wecc.biz/Standards/Development/WECC-60/Shared Documents/The Technical Basis for the New WECC Voltage Ride-Through \(VRT\).doc](http://www.wecc.biz/Standards/Development/WECC-60/Shared Documents/The Technical Basis for the New WECC Voltage Ride-Through (VRT).doc). In developing the whitepaper, the WGTF examined the voltage profiles of various line faults in the Western Electricity Coordinating Council (“WECC”) region and drew a voltage vs. time envelope around that encompassed all of the normally cleared faults. The WGTF also reviewed various international voltage ride-through standards and found the proposed WECC curves.

<sup>36</sup> Institute of Electrical and Electronics Engineers (“IEEE”).

<sup>37</sup> American National Standards Institute (“ANSI”).

regulatory limitations for the purposes of proposed Reliability Standard PRC-024-1 and therefore, Requirement R3 satisfies the Commission’s guidance that “NRC requirements should be used when implementing the Reliability Standards.”<sup>38</sup>

### **Proposed Requirements – PRC-024-1**

**R1.** Each Generator Owner that has generator frequency protective relaying[FN1] activated to trip its applicable generating unit(s) shall set its protective relaying such that the generator frequency protective relaying does not trip the applicable generating unit(s) within the “no trip zone” of PRC-024 Attachment 1, subject to the following exceptions:  
*[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*

- Generating unit(s) may trip if the protective functions (such as out-of-step functions or loss-of-field functions) operate due to an impending or actual loss of synchronism or, for asynchronous generating units, due to instability in power conversion control equipment.
- Generating unit(s) may trip if clearing a system fault necessitates disconnecting (a) generating unit(s).
- Generating unit(s) may trip within a portion of the “no trip zone” of PRC-024 Attachment 1 for documented and communicated regulatory or equipment limitations in accordance with Requirement R3.

[FN1: Each Generator Owner is not required to have frequency or voltage protective relaying (including but not limited to frequency and voltage protective functions for discrete relays, volts per hertz relays evaluated at nominal frequency, multi-function protective devices or protective functions within control systems that directly trip or provide tripping signals to the generator based on frequency or voltage inputs) installed or activated on its unit.]

Requirement R1 of proposed Reliability Standard PRC-024-1 ensures that generating units remain connected during frequency excursions.

**R2.** Each Generator Owner that has generator voltage protective relaying[FN 1] activated to trip its applicable generating unit(s) shall set its protective relaying such that the generator voltage protective relaying does not trip the applicable generating unit(s) as a result of a voltage excursion (at the point of interconnection[FN 2]) caused by an event on the transmission system external to the generating plant that remains within the “no trip zone” of PRC-024 Attachment 2. If the Transmission Planner allows less stringent voltage relay settings than those required to meet PRC-024 Attachment 2, then the Generator Owner shall set its protective relaying within the voltage recovery characteristics of a location-specific Transmission Planner’s study. Requirement R2 is

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<sup>38</sup> *Id.*

subject to the following exceptions: *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*

- Generating unit(s) may trip in accordance with a Special Protection System (SPS) or Remedial Action Scheme (RAS).
- Generating unit(s) may trip if clearing a system fault necessitates disconnecting (a) generating unit(s).
- Generating unit(s) may trip by action of protective functions (such as out-of-step functions or loss-of-field functions) that operate due to an impending or actual loss of synchronism or, for asynchronous generating units, due to instability in power conversion control equipment.
- Generating unit(s) may trip within a portion of the “no trip zone” of PRC-024 Attachment 2 for documented and communicated regulatory or equipment limitations in accordance with Requirement R3.

[FN1 Each Generator Owner is not required to have frequency or voltage protective relaying (including but not limited to frequency and voltage protective functions for discrete relays, volts per hertz relays evaluated at nominal frequency, multi-function protective devices or protective functions within control systems that directly trip or provide tripping signals to the generator based on frequency or voltage inputs) installed or activated on its unit.

[FN2 For the purposes of this standard, point of interconnection means the transmission (high voltage) side of the generator step-up or collector transformer.]

Requirement R2 and Attachment 2 (which is incorporated), of proposed Reliability Standard PRC-024-1 satisfy the Commission’s directive in Order No. 693 to “explicitly require either that all generators are capable of riding through the same set of Category B and C contingencies, as required by wind generators in Order No. 661, or that those generators that cannot ride through be simulated as tripping.”<sup>39</sup> Requirement R2 ensures that generating unit protection systems do not disconnect the generator from the grid during the voltage excursions defined in Attachment 2. The standard drafting team believes the voltage profile described in Attachment 2 covers excursions that would be expected under Category B and C contingencies.

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<sup>39</sup> Order No. 693 at P 1787.

**R3.** Each Generator Owner shall document each known regulatory or equipment limitation[FN3] that prevents an applicable generating unit with generator frequency or voltage protective relays from meeting the relay setting criteria in Requirements R1 or R2 including (but not limited to) study results, experience from an actual event, or manufacturer’s advice. *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*

- 3.1.** The Generator Owner shall communicate the documented regulatory or equipment limitation, or the removal of a previously documented regulatory or equipment limitation, to its Planning Coordinator and Transmission Planner within 30 calendar days of any of the following:
- Identification of a regulatory or equipment limitation.
  - Repair of the equipment causing the limitation that removes the limitation.
  - Replacement of the equipment causing the limitation with equipment that removes the limitation.
  - Creation or adjustment of an equipment limitation caused by consumption of the cumulative turbine life-time frequency excursion allowance.

[FN 3: Excludes limitations that are caused by the setting capability of the generator frequency and voltage protective relays themselves but does not exclude limitations originating in the equipment that they protect.]

Requirement R3 of proposed Reliability Standard PRC-024-1 requires Generator Owners to document known regulatory or equipment limitations and to communicate these limitations to Planning Coordinators and Transmissions within 30 days of identifying a limitation or repair or replacement of the equipment causing the limitation. This allows the Transmission Planners to properly simulate the performance of the protection systems of those generators that must have their protection systems set to operate within the No Trip Zones described in Requirements R1 and R2.

**R4.** Each Generator Owner shall provide its applicable generator protection trip settings associated with Requirements R1 and R2 to the Planning Coordinator or Transmission Planner that models the associated unit within 60 calendar days of receipt of a written request for the data and within 60 calendar days of any change to those previously requested trip settings unless directed by the requesting Planning Coordinator or Transmission Planner that the reporting of relay setting changes is not required. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*



Requirement R4 of proposed Reliability Standard PRC-024-1 requires Generator Owners to provide its protection trip settings associated with Requirements R1 and R2 to the Planning Coordinator or Transmission Planner within 60 days of (1) a written request for that information or (2) a change to any previously requested trip settings.

#### **F. Enforceability of the Proposed Reliability Standards**

The proposed Reliability Standards include Violation Risk Factors (“VRFs”) and Violation Severity Levels (“VSLs”). The VSLs provide guidance on the way that NERC will enforce the Requirements of the proposed Reliability Standard. The VRFs and VSLs for the proposed Reliability Standards comport with NERC and Commission guidelines related to their assignment. For a detailed review of the VRFs, the VSLs, and the analysis of how the VRFs and VSLs were determined using these guidelines, please see **Exhibit E**.

The proposed Reliability Standards also include Measures that support each Requirement by clearly identifying what is required and how the Requirement will be enforced. These Measures help ensure that the Requirements will be enforced in a clear, consistent, and non-preferential manner and without prejudice to any party.<sup>40</sup>

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<sup>40</sup> Order No. 672 at P 327 (“There should be a clear criterion or measure of whether an entity is in compliance with a proposed Reliability Standard. It should contain or be accompanied by an objective measure of compliance so that it can be enforced and so that enforcement can be applied in a consistent and non-preferential manner.”).

## V. CONCLUSION

For the reasons set forth above, NERC respectfully requests that the Commission:

- approve the proposed Reliability Standards and associated elements included in **Exhibit A**, effective as proposed herein;
- approve the implementation plan included in **Exhibit B**; and
- approve the retirement of Reliability Standards, effective as proposed herein.

Respectfully submitted,

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