UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

North American Electric Reliability Corporation	**)** **)**	**Docket No. _____**

PETITION OF THE NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION FOR APPROVAL OF PROPOSED RELIABILITY STANDARD PRC-005-3 (PROTECTION SYSTEM MAINTENANCE)

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Pursuant to Section 215(d)(1) of the Federal Power Act ("FPA")[1] and Section 39.5[2] of the Federal Energy Regulatory Commission's ("FERC" or "Commission") regulations, the North American Electric Reliability Corporation ("NERC")[3] hereby submits for Commission approval:

- proposed Reliability Standard PRC-005-3 (Protection System Maintenance) (**Exhibit A**);
- one new (Automatic Reclosing) and five revised definitions (Unresolved Maintenance Issue, Segment, Component Type, Component, and Countable Event)[4];
- the implementation plan for proposed Reliability Standard PRC-005-3 ("Implementation Plan") (**Exhibit B**); and
- the Violation Risk Factors ("VRFs") and the revised Violation Severity Levels ("VSLs") for proposed PRC-005-3 (**Exhibit A and Exhibit G**).

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1 16 U.S.C. § 824o (2012).

2 18 C.F.R. § 39.5 (2014).

3 The Commission certified NERC as the electric reliability organization ("ERO") in accordance with Section 215 of the FPA on July 20, 2006. *N. Am. Elec. Reliability Corp.*, 116 FERC ¶ 61,062 (2006).

4 These terms were approved as PRC-005 specific definitions along with the approval of Reliability Standard PRC-005-2. *See Protection System Maintenance Reliability Standard*, Order No. 793, 145 FERC ¶ 61,253 (2013). The definitions can be found in the posted PRC-005-2 Reliability Standard. Once approved, the revised versions of the definitions will located in the posted version of proposed PRC-005-3.

NERC requests that the Commission approve the proposed Reliability Standard and find that it is just, reasonable, not unduly discriminatory or preferential, and in the public interest.[5] NERC also requests approval of the retirement of Reliability Standard PRC-005-2[6] as detailed in the Implementation Plan.

As required by Section 39.5(a)[7] of the Commission's regulations, this petition presents the technical basis and purpose of proposed Reliability Standard PRC-005-3, a summary of the development history (**Exhibit H**), and a demonstration that the proposed Reliability Standard meets the criteria identified by the Commission in Order No. 672[8] (**Exhibit C**). Proposed Reliability Standard PRC-005-3 was approved by the NERC Board of Trustees on November 7, 2013.

I. EXECUTIVE SUMMARY

In Order No. 758, the Commission directed NERC to include maintenance and testing of reclosing relays that can affect the Reliable Operation of the Bulk-Power System in Reliability Standard PRC-005. Reclosing relays are applied to facilitate automatic restoration of system components following a Protection System operation.[9] In certain circumstances the misoperation of reclosing relays can impact the reliability of the Bulk-Power System.

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5 Unless otherwise designated, all capitalized terms shall have the meaning set forth in the *Glossary of Terms Used in NERC Reliability Standards*, *available at* http://www.nerc.com/files/Glossary_of_Terms.pdf

6 Reliability Standard PRC-005-2 was approved by the Commission on December 19, 2013. *See* Order No. 793, 145 FERC ¶ 61,253.

7 18 C.F.R. § 39.5(a) (2013).

8 The Commission specified in Order No. 672 certain general factors it would consider when assessing whether a particular Reliability Standard is just and reasonable. *See Rules Concerning Certification of the Electric Reliability Organization; and Procedures for the Establishment, Approval, and Enforcement of Electric Reliability Standards*, Order No. 672, FERC Stats. & Regs. ¶ 31,204, at P 262, 321-37, *order on reh'g*, Order No. 672-A, FERC Stats. & Regs. ¶ 31,212 (2006).

9 As reclosing relays facilitate automatic restoration, they are often referred to as "automatic reclosing relays" or "autoreclosing relays". The term "reclosing relay", as used in this Petition, has the same meaning as the terms "automatic reclosing relay" and "autoreclosing relay" as they may appear in Exhibits to this Petition.

In response to Order No. 758, the NERC System Analysis and Modeling Subcommittee ("SAMS") and System Protection and Control Subcommittee ("SPCS") jointly performed a technical study to determine which reclosing relays should be addressed within PRC-005 and provide advice to the Protection System Maintenance and Testing Standard Drafting Team ("Standard Drafting Team") regarding appropriate maintenance intervals and activities for those relays ("SAMS/SPCS Report") (**Exhibit D**). The Standard Drafting Team developed revisions to Reliability Standard PRC-005-2 in line with the SAMS/SPCS Report recommendations. As a result, proposed Reliability Standard PRC-005-3 adds reclosing relays that can affect the reliable operation of the Bulk-Power System to the applicability of Reliability Standard PRC-005 to satisfy NERC's commitment to address the Order No. 758 directive and provide for the maintenance and testing of these relays.

II. NOTICES AND COMMUNICATIONS

Notices and communications with respect to this filing may be addressed to the following:[10]

[10] Persons to be included on the Commission's service list are identified by an asterisk. NERC respectfully requests a waiver of Rule 203 of the Commission's regulations, 18 C.F.R. § 385.203 (2013), to allow the inclusion of more than two persons on the service list in this proceeding.

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III. BACKGROUND

A. Regulatory Framework

By enacting the Energy Policy Act of 2005,[11] 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 duties of certifying an ERO that would be charged with developing and enforcing mandatory Reliability Standards, subject to Commission approval. Section 215(b)(1)[12] of the 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. Section 215(d)(5)[13] of the FPA authorizes the Commission to order the ERO to submit a new or modified Reliability Standard. Section 39.5(a)[14] of the Commission's regulations requires the ERO to file with the Commission for its approval each Reliability Standard that the ERO proposes should become

[11] 16 U.S.C. § 824o (2012).
[12] *Id.* § 824(b)(1).
[13] *Id.* § 824o(d)(5).
[14] 18 C.F.R. § 39.5(a).

mandatory and enforceable in the United States, and each modification to a Reliability Standard that the ERO proposes should be made effective.

The Commission has the regulatory responsibility to approve Reliability Standards that protect the reliability of the Bulk-Power System and to ensure that such Reliability Standards are just, reasonable, not unduly discriminatory or preferential, and in the public interest. Pursuant to Section 215(d)(2) of the FPA[15] and Section 39.5(c)[16] 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.

B. NERC Reliability Standards Development Procedure

The proposed Reliability Standards were developed in an open and fair manner and in accordance with the Commission-approved Reliability Standard development process.[17] NERC develops Reliability Standards in accordance with Section 300 (Reliability Standards Development) of its Rules of Procedure and the NERC Standard Processes Manual.[18] In its order certifying NERC as the Commission's Electric Reliability Organization, , 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[19]

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15 16 U.S.C. § 824o(d)(2).

16 18 C.F.R. § 39.5(c)(1).

17 *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.").

18 The NERC *Rules of Procedure* are available at http://www.nerc.com/AboutNERC/Pages/Rules-of-Procedure.aspx. The NERC *Standard Processes Manual* is available at http://www.nerc.com/comm/SC/Documents/Appendix_3A_StandardsProcessesManual.pdf.

19 116 FERC ¶ 61,062 at P 250.

and thus satisfies certain of the criteria for approving Reliability Standards.[20] 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.

C. History of Project 2007-17.2

In Order No. 693,[21] the Commission approved Reliability Standard PRC-005-1 and directed NERC to "develop a modification … through the Reliability Standards development process that includes a requirement that maintenance and testing of a protection system must be carried out within a maximum allowable interval that is appropriate to the type of the protection system and its impact on the reliability of the Bulk-Power System."[22] In 2007, NERC initiated Project 2007-17 Protection System Maintenance and Testing to address the Commission's directive.

While the Standard Drafting Team developed these revisions to PRC-005, the Commission approved two interpretations of PRC-005-1. On April 15, 2011, NERC filed a petition seeking Commission approval of an interpretation of Requirements R1 and R3 of Reliability Standard PRC-004-1 (Analysis and Mitigation of Transmission and Generation Protection System Misoperations) and Requirements R1 and R2 of Reliability Standard PRC-005-1 (Transmission and Generation Protection System Maintenance and Testing). The Commission approved NERC's interpretation, effective as of September 26, 2011.[23] On

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[20] Order No. 672 at PP 268, 270.

[21] *Mandatory Reliability Standards for the Bulk-Power System*, Order No. 693, FERC Stats. & Regs. ¶ 31,242 ("Order No. 693"), *order on reh'g*, Order No. 693-A, 120 FERC ¶ 61,053 (2007).

[22] *Id.* at P 1475.

[23] *N. Am. Elec. Reliability Corp.*, 136 FERC 61,208 (2011).

February 3, 2012, the Commission issued Order No. 758,[24] approving a second interpretation of PRC-005-1. In that Order, the Commission directed NERC to address concerns raised regarding reclosing relays in the revisions to Reliability Standard PRC-005-1. Specifically, the Commission directed NERC to include maintenance and testing of reclosing relays that can affect the reliable operation of the Bulk-Power System.[25]

In response to Order No. 758, the Standard Drafting Team drafted a Standard Authorization Request to modify PRC-005 to include the maintenance and testing of reclosing relays that can affect the Reliable Operation of the Bulk-Power System. On May 10, 2012, the NERC Standards Committee accepted the Standard Authorization Request and authorized that it be posted for information only along with the third draft of PRC-005-2.

On July 30, 2012, NERC submitted an informational filing[26] reporting to the Commission that proposed Reliability Standard PRC-005-2—containing the revisions to Reliability Standard PRC-005-1 outlined in Order No. 693—was in the final stages of development and that NERC would address the Commission's directive regarding reclosing relays in a separate petition. On January 17, 2013, the NERC Standards Committee approved a Standard Authorization Request to address the addition of reclosing relays through Project 2007-17.2 Protection System Maintenance and Testing - Phase 2 (Reclosing Relays).

IV. JUSTIFICATION FOR APPROVAL

As discussed in **Exhibit C** and below, proposed Reliability Standard PRC-005-3 satisfies the Commission's criteria in Order No. 672 and is just, reasonable, not unduly discriminatory or

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[24] *Interpretation of Protection System Reliability Standard*, Order No. 758, 138 FERC ¶ 61,094 ("Order No. 758"), *order on reh'g*, 139 FERC ¶ 61,227 (2012).

[25] *Id.* at P 22-27.

[26] *NERC Jul. 30, 2012 Informational Filing in Compliance with Order No. 758*, Docket No. RM10-5 (2012), available at: http://www.nerc.com/pa/Stand/Project%202007172%20Protection%20System%20Manintenance%20and/Final_Info_Filing_Order_758_07-30-12_complete.pdf.

preferential, and in the public interest. The improved proposed Reliability Standard promotes reliability by adding Automatic Reclosing to the Commission-approved Reliability Standard PRC-005-2. The purpose of proposed PRC-005-3 is to document and implement programs for the maintenance of all Protection Systems and Automatic Reclosing affecting the reliability of the Bulk Electric System so that they are kept in working order.

PRC-005-3 has five Requirements that address the inclusion of Automatic Reclosing. The revised Reliability Standard requires entities to develop an appropriate Protection System Maintenance Program, to implement their program, and to initiate the follow-up activities necessary to resolve maintenance issues in the event they are unable to restore Automatic Reclosing Components to proper working order while performing maintenance. Proposed PRC-005-3 adds detailed tables of minimum maintenance activities and maximum maintenance intervals for Automatic Reclosing to the existing PRC-005-2 Reliability Standard, extending the benefits of a strong maintenance program to these Components. The subset of Automatic Reclosing applications included in proposed PRC-005-3 is based on the findings of the SAMS/SPCS Report included as **Exhibit D.** To assist responsible entities in understanding the addition of Automatic Reclosing to PRC-005, the Standard Drafting Team revised the *Supplementary Reference and FAQ* document developed with PRC-005-2 and posted the document concurrently with the proposed Reliability Standard during each posting. This revised document will be posted with the proposed PRC-005-3 Reliability Standard following approval.

Proposed PRC-005-3 satisfies the Commission's directive in Order No. 758 by including the necessary reclosing relay applications with the potential to impact Reliable Operation of the Bulk-Power System in the scope of Reliability Standard PRC-005. Provided below is a summary of the recommendations from the SAMS/SPCS Report including discussion of

reclosing relays, an overview of the modifications to Reliability Standard PRC-005-2 necessary to meet the Commission's directive, and a discussion of the Implementation Plan.

A. Reclosing Relays

Reclosing relays are utilized on transmission systems to restore transmission elements to service following automatic circuit breaker tripping.[27] There are several types of reclosing relays, including electromechanical, solid state, and microprocessor-based, which may be applied in a variety of scenarios.[28] Most reclosing relays share three main functions: supervisory, timing, and output.[29] A relay failure is most likely to occur as part of one of these functions. Reclosing relays are typically installed to lessen the burden on Transmission Operators of manually restoring transmission lines.[30] Relays of this type also provide improved capability in restoration of overhead transmission lines. The degree to which such capability is improved depends on the nature of the fault—permanent or temporary—and on Transmission Operator practices regarding manual restoration.[31]

While more efficient restoration of transmission lines following temporary faults does provide an inherent reliability benefit, certain applications of reclosing relays can result in undesired relay operation or operation not consistent with relay design, leading to adverse reliability impacts. Because certain applications of reclosing relays can have the potential to impact the Bulk-Power System, it is beneficial to reliability that those relays be included under the applicability of proposed Reliability Standard PRC-005-3.

B. SAMS/SPCS Report

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27 *See* SAMS/SPCS Report, Ex. D at 2.
28 *Id.* at 3.
29 *Id.* at 3-4.
30 *Id.*at 3.
31 *Id.*

The SAMS/SPCS Report recommended that the Standard Drafting Team modify Reliability Standard PRC-005-2 to: 1) explicitly address maintenance and testing of reclosing relays applied as an integral part of a Special Protection System; and 2) include maintenance and testing of reclosing relays at or in proximity to generating plants at which the total installed capacity is greater than the capacity of the largest generating unit within the Balancing Authority Area.[32] For this second category, the SAMS/SPCS Report suggested to define "proximity" as substations one bus away if the substation is within 10 miles of the plant. The SAMS/SPCS Report also suggested including a provision to exclude reclosing relays "if the equipment owner can demonstrate to the Transmission Planner that a close-in three-phase fault for twice the normal clearing time (capturing a minimum trip-close-trip time delay) does not result in a total loss of generation in the interconnection exceeding the largest unit within the Balancing Authority Area where the autoreclosing is applied."[33] Finally, the SAMS/SPCS Report included recommendations for minimum maintenance activities and maximum intervals based on comparable activities and intervals included in Reliability Standard PRC-005-2.[34]

To reach these recommendations, SAMS and SPCS considered the Commission's concerns in Order No. 758 and summarized in the SAMS/SPCS Report that the Commission's concerns could be grouped into two categories: (1) situations in which reclosing relays fail to operate when required to maintain Bulk-Power System reliability; and (2) situations in which reclosing relays operate in a manner not consistent with design, adversely affecting reliability of the Bulk-Power System. The SAMS/SPCS Report addresses these two categories of concern by

32 *Id.* at 10.
33 *Id.*
34 *Id.*

studying reclosing applications to improve Bulk-Power System performance and to aid in restoration.

In assessing the first category, SAMS and SPCS noted that while successful operation of reclosing relays will enhance reliability of the Bulk-Power System, reclosing into a permanent power system fault may adversely impact reliability. Because the potential for permanent power system faults exists for any application, it is not possible to depend on successful reclosing relay operation as a sole means to guarantee reliability or satisfy the Requirements contained in Reliability Standards. The same issues exist for single-pole reclosing with regard to the potential for reclosing into a permanent fault after all three poles are tripped. The exception is when reclosing relays are included as an integral part of a Special Protection System ("SPS"). In these applications, other functions of the SPS will operate to preserve reliability in the event that reclosing is unsuccessful; thus, failure of any part of the SPS may adversely impact reliability of the Bulk-Power System.

In assessing the second category, SAMS and SPCS note that reclosing relays are typically installed to alleviate the burden on operators of manually restoring transmission lines. Reclosing relays also provide improved availability of overhead transmission lines. The degree to which availability is improved depends on the nature of the fault (permanent or temporary) and on Transmission Operator practices for manually restoring lines. While faster restoration of transmission lines following temporary faults does provide an inherent reliability benefit, it is possible for undesired operation of the reclosing scheme, not consistent with its design, to adversely impact Bulk-Power System reliability. Certain credible failure modes, including those related to supervision, timing, and output, may lead to undesired reclosing relay operation which could pose a reliability risk.

C. Modifications in proposed Reliability Standard PRC-005-3

As discussed below, certain parts of Reliability Standard PRC-005-2 have been modified in order to add the necessary reclosing relays to the PRC-005 Reliability Standard.

1. Definitions

NERC developed one new and five revised definitions to accompany proposed PRC-005-3.[35] NERC proposes the following new definition to define the scope of what is included when Automatic Reclosing is referenced within the proposed PRC-005-3 Reliability Standard:

> **Automatic Reclosing** – Includes the following Components:
> - Reclosing relay
> - Control circuitry associated with the reclosing relay.

This definition is intended only for use within the proposed Reliability Standard and will not, at this time, be listed in the NERC Glossary of Terms.[36] The term will be included within the posted Reliability Standard itself.[37] This definition establishes that "Automatic Reclosing" includes reclosing relays and the associated dc control circuitry and reflects the SAMS/SPCS Report recommendation that PRC-005-3 should apply to both the reclosing relay and associated control circuitry. The recommendation includes both Component Types since a failure in the reclosing relay or the control circuitry may result in the same adverse reliability impact.

In addition, the previously-approved defined terms "Protection System Maintenance Program", "Component Type", "Component", and "Countable Event" were revised to add the

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[35] The definitions were posted in the draft PRC-005-3 Reliability Standard during the standards development process and will be implemented concurrently with the proposed Reliability Standard.

[36] NERC acknowledges the Commission's statement in Order No. 793 that "NERC should not adopt inconsistent definitions for the same term." Order No. 793 at P 70. Although this term will be posted along with the proposed Reliability Standard, NERC will not develop additional definitions of the same term approved for use in a particular Reliability Standard. If a future standards development project seeks to broaden the applicability of a standard-specific defined term, the defined term and where the term is posted (in the Reliability Standard or in the NERC *Glossary of Terms*) would need to be revisited through the standards development process.

[37] For clarity, NERC relocated the definitions specific to the PRC-005 Reliability Standard in part 6 of Section A (Introduction) in the posted version of the proposed Reliability Standard.

necessary reference to "Automatic Reclosing" or the associated Table within the proposed Reliability Standard to facilitate coverage of Automatic Reclosing Components within the coverage of the PRC-005 Requirements. The revised definitions are as follows (changes have been italicized for convenience):

> **Protection System Maintenance Program (PSMP)** — An ongoing program by which Protection System *and Automatic Reclosing Components* are kept in working order and proper operation of malfunctioning *C*omponents is restored. A maintenance program for a specific *C*omponent includes one or more of the following activities:
>
> - Verify — Determine that the *C*omponent is functioning correctly.
> - Monitor — Observe the routine in-service operation of the *C*omponent.
> - Test — Apply signals to a *C*omponent to observe functional performance or output behavior, or to diagnose problems.
> - Inspect — Examine for signs of *C*omponent failure, reduced performance or degradation.
> - Calibrate — Adjust the operating threshold or measurement accuracy of a measuring element to meet the intended performance requirement.
>
> **Component Type** – *Either a*ny one of the five specific elements of the Protection System definition *or any one of the two specific elements of the Automatic Reclosing definition*.
>
> **Component** – A Component is any individual discrete piece of equipment included in a Protection System *or in Automatic Reclosing*, including but not limited to a protective relay, reclosing relay, or current sensing device. The designation of what constitutes a control circuit Component is dependent upon how an entity performs and tracks the testing of the control circuitry. Some entities test their control circuits on a breaker basis whereas others test their circuitry on a local zone of protection basis. Thus, entities are allowed the latitude to designate their own definitions of control circuit Components. Another example of where the entity has some discretion on determining what constitutes a single Component is the voltage and current sensing devices, where the

entity may choose either to designate a full three-phase set of such devices or a single device as a single Component.

Countable Event – A failure of a Component requiring repair or replacement, any condition discovered during the maintenance activities in Tables 1-1 through 1-5, Table 3, *and Tables 4-1 through 4-2* which requires corrective action or a *Protection System* Misoperation attributed to hardware failure or calibration failure. Misoperations due to product design errors, software errors, relay settings different from specified settings, Protection System Component *or Automatic Reclosing* configuration or application errors are not included in Countable Events.

Lastly, two definitions contain capitalization changes to the previously-approved definitions to correctly reference the defined term "Component." The revised definitions read as follows:

Unresolved Maintenance Issue – A deficiency identified during a maintenance activity that causes the *C*omponent to not meet the intended performance, cannot be corrected during the maintenance interval, and requires follow-up corrective action.

Segment – *C*omponents of a consistent design standard, or a particular model or type from a single manufacturer that typically share other common elements. Consistent performance is expected across the entire population of a Segment. A Segment must contain at least sixty (60) individual *C*omponents.

2. Applicability

Automatic Reclosing is addressed in PRC-005-3 by explicitly addressing it outside the definition of Protection System. The specific locations for applicable Automatic Reclosing are addressed in a new subsection 4.2.6 under the listing of covered "Facilities." The PRC-005-3 *Supplementary Reference and FAQ* document includes examples to depict which Automatic Reclosing applications are included in the scope of the proposed PRC-005-3 Reliability Standard. The Applicability, as detailed below, was recommended by the NERC SAMS and

SPCS after a lengthy review of the use of reclosing within the Bulk Electric System. SAMS and SPCS concluded that reclosing is largely implemented throughout the Bulk Electric System as an operating convenience, and that reclosing mal-performance affects Bulk Electric System reliability only when the reclosing is part of a Special Protection System, or when premature reclosing has the potential to cause generating unit or plant instability.[38]

a) Section 4.2.6.1

> 4.2.6.1 Automatic Reclosing applied on the terminals of Elements connected to the BES bus located at generating plant substations where the total installed gross generating plant capacity is greater than the gross capacity of the largest BES generating unit within the Balancing Authority Area.

The SAMS/SPCS Report assessed Automatic Reclosing failure modes for potential effects to Reliable Operation of the Bulk-Power System. The report identified that premature reclosing has the potential to cause generating unit or plant instability, and noted the impact on Reliable Operation when the loss of generating resources exceeds the largest unit[39] within the Balancing Authority Area in which the Automatic Reclosing is applied. In this context, the NERC Reliability Standards require consideration of loss of the largest generating unit within a Balancing Authority Area; therefore, generation loss would not impact reliability unless the combined capacity loss exceeds the largest unit within the Balancing Authority Area. Including maintenance and testing of reclosing relays in PRC-005 is, therefore, appropriate for applications of Automatic Reclosing at generating plants with capacity exceeding the largest unit within the Balancing Authority Area.

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[38] *See Supplementary Reference and FAQ*, Ex.E at 7 (citing SAMS/SPCS Report).

[39] *See Supplementary Reference and FAQ*, Ex. E at 7. In this context the capacity of the largest unit is the value reported to the Balance Authority for generating plant capacity for planning and modeling purposes. This can be nameplate or other values based on generating plant limitations such as boiler or turbine ratings.

The applicability includes a reference the Bulk Electric System (referred to in the applicability section as "BES") in order to define the generating plant bus at which Automatic Reclosing is subject to PRC-005-3. In this context, "BES" is used to describe the high-voltage switchyard bus on the transmission system side of the generator step-up transformer. Similarly, "BES" is used to modify the largest generating unit with the Balancing Authority Area. Revisions to the "Bulk Electric System" definition are unlikely to affect present classification of generating units and buses in the context of the largest generating unit in a Balancing Authority Area or stations with capacity that exceed the largest unit within the Balancing Authority Area. However, PRC-005-3 will be workable regardless of how the Bulk Electric System is defined. If an element is a Bulk Electric System Element and is located at a generating plant substation, it is included per Section 4.2.6.1, and the Requirements for Automatic Reclosing apply.[40]

b) Section 4.2.6.2

> *4.2.6.2 Automatic Reclosing applied on the terminals of all BES Elements at substations one bus away from generating plants specified in Section 4.2.6.1 when the substation is less than 10 circuit-miles from the generating plant substation.*

Reclosing at transmission substations may affect the stability of generating units and generating plants when applied in proximity to a generating plant. Therefore, the Standard Drafting Team included applicability for Automatic Reclosing at buses in proximity to generating plants, in addition to Bulk Electric System buses at generating plants. The criteria that define proximity, i.e., "one bus away from generating plants specified in Section 4.2.6.1 when the substation is less than 10 circuit-miles from the generating plant substation," originated from the SAMS/SPCS Report. The criteria are based on the collective experience of the

[40] *See* Section 2.4.1 in the *Supplementary Reference and FAQ* document, Ex. E, for additional discussion.

subcommittee members performing transient stability studies. Their experience reveals that for cases in which generating units exhibit an unstable response to a bus fault at the high-side of the generator step-up transformer, the units exhibit a stable response if the fault location is on the order of one mile from the bus. The difference in response is based on two factors. The first is the additional impedance between the generators and the fault. The second is that when there are additional sources of fault current in addition to the generator, the in-feed from the other sources makes the apparent impedance[41] to the fault greater, further reducing the acceleration of the generating units during the fault. The SAMS and SPCS members applied a safety factor in recommending the 10-mile threshold.

c) Section 4.2.6.3

> *4.2.6.3 Automatic Reclosing applied as an integral part of an SPS specified in Section 4.2.4.*

As noted in the SAMS/SPCS Report, Special Protection Systems may be applied to meet system performance requirements in the NERC Reliability Standards or to increase the transfer limit associated with an Interconnection Reliability Operating Limit. When reclosing is included as an integral part of such a SPS, a failure of the reclosing function may adversely impact Bulk-Power System reliability.[42] In such applications, it typically is essential to successfully restore the power system to its pre-contingency state after a fault or disturbance (e.g., reclosing a transmission line connected at a generating station after it is tripped to clear a fault). Since it is possible that the fault or disturbance will be sustained and prevent restoration to the pre-contingency state, the SPS must take remedial action (e.g., initiating control system action or

[41] Apparent impedance is a term that refers to the effective impedance when more than one source contributes current through an element, resulting in an effective impedance greater than the actual impedance of the element.

[42] *See SAMS/SPCS Report*, Ex. E at 3.

tripping resources to reduce power transfers) if it determines the reclosing was unsuccessful. Unsuccessful reclosing may result from failure of the Automatic Reclosing or because of a subsequent trip when the fault or disturbance is sustained. In these applications Reliable Operation of the Bulk-Power System is dependent on proper operation of the SPS. This dependence on proper operation of the SPS dictates that maintenance and testing requirements apply to all parts of the SPS.

d) Footnote 1 Exclusion

> *FN1 Automatic Reclosing addressed in Section 4.2.6.1 and 4.2.6.2 may be excluded if the equipment owner can demonstrate that a close-in three-phase fault present for twice the normal clearing time (capturing a minimum trip-close-trip time delay) does not result in a total loss of gross generation in the Interconnection exceeding the gross capacity of the largest BES generating unit within the Balancing Authority Area where the Automatic Reclosing is applied.*

The applicability for Automatic Reclosing in PRC-005-3 is based on the SAMS and SPCS assessment of failure modes of reclosing relays that could impact Reliable Operation of the Bulk-Power System. During the SAMS/SPCS study, the SPCS identified the worst case reclosing relay failure modes and SAMS assessed the reliability risk to the Bulk-Power System. The worst case failure mode identified by SPCS is a failure that would lead to reclosing with no time delay. SAMS identified that this failure mode presents a risk to Reliable Operation of the Bulk-Power System when reclosing relays are used at or in proximity to generating stations, because it could lead to generating unit instability. SAMS and SPCS concluded that maintenance and testing of Automatic Reclosing should be required when the potential loss of generating resources may exceed the gross capacity of the largest Bulk Electric System unit within the Balancing Authority Area where the Automatic Reclosing is applied. Thus, the applicability establishes a bright line to allow entities to assess which Automatic Reclosing is

subject to requirements in PRC-005-3. Further, SAMS and SPCS recognized that failure of Automatic Reclosing may not affect reliability of the Bulk-Power System at all locations identified in the applicability of PRC-005-3. Determining which, if any, locations identified in the applicability do not pose a reliability risk would require case-by-case studies of the worst-case failure mode on which the applicability is based. Rather than including a requirement in PRC-005-3 for entities to perform such analysis, the Standard Drafting Team included Footnote 1 to allow entities the option to instead rule out certain locations at which this risk is not present.

Footnote 1 to Applicability Section 4.2.6 establishes that Automatic Reclosing addressed in 4.2.6.1 and 4.2.6.2 may be excluded if the equipment owner can demonstrate that a close-in three-phase fault present for twice the normal clearing time (capturing a minimum trip-close-trip time delay) does not result in a total loss of gross generation in the Interconnection exceeding the gross capacity of the largest Bulk Electric System unit within the Balancing Authority Area where the Automatic Reclosing is applied. This benchmark reflects the worst-case failure mode identified by SAMS and SPCS and, therefore, serves as a valid, technically-supported test for ruling out certain facilities from the applicability of PRC-005-3. The test simulates a fault for twice the normal clearing time because this is approximately the same as clearing the fault in normal clearing time, reclosing into the fault with no time delay, and clearing the fault again in normal clearing time.

e) NERC Evaluation of 10-Mile Threshold

As noted above, proposed Reliability Standard PRC-005-3 requires maintenance and testing of reclosing relays at generating stations, and at substations one bus away from a generating station if the substation is within 10 miles of the generating station. Further, the

criteria are based on the collective experience of the SAMS and SPCS members and include a safety factor in establishing the ten-mile threshold.

NERC staff has conducted an analysis to verify that the 10-mile threshold provides adequate margin to ensure maintenance and testing of all reclosing relays where failure could result in generating station instability. Testing was performed at the high-voltage switchyard for 50 generating stations. A sample of generating stations was used with high-side voltage ranging from 115 kV to 765 kV. The sample included a wide range of generating unit types, transmission line lengths, and switchyard configurations, and is therefore representative of generating stations across North America. Three-phase faults were simulated on each line[43] exiting each generating station. Faults were simulated for a duration that conservatively represents two times the normal clearing time for a three-phase fault. This test is based on a recommendation in the SAMS-SPCS Report to apply a close-in three-phase fault for twice the normal clearing time (capturing a minimum trip-close-trip time delay). This test approximates the response if a transmission line circuit breaker is reclosed into a fault without any time delay due to a reclosing relay failure. The fault durations used in the study are 8 cycles at voltage greater than 300 kV, 10 cycles for clearing times for voltage between 200 kV and 300 kV, and 12 cycles for voltage below 200 kV. Close-in faults were applied on each line on the line side of the circuit breaker(s). In cases where the generating unit response was unstable, the fault was reapplied at one-mile increments away from the bus until the generating unit response was stable. Testing was performed on a total of 145 transmission lines at 50 generating stations. The generating unit response was stable for 110 of the close-in faults. For the remaining 35 lines, the

[43] When two or more parallel lines exit a generating station and terminate at the same remote station, a fault was applied on only one line since the response would be essentially the same faults on each line.

generating response was stable for faults one mile from the generating station in 22 cases and was stable for faults greater than five miles from the generating station in 10 cases.

The three remaining cases involve two generating stations. At one station, the two transmission lines exiting the station are approximately 120 miles long. On one line, the generating units were stable for a fault 11 miles from the generating station and on the other line the generating units were unstable for faults anywhere on the line. At this generating station the predominant factor in the generating unit instability is the post-fault system impedance with the generating units remaining connected to one 120-mile line. The analysis was repeated at each remote bus at the remote terminal of the two 120-mile lines. The generating units were stable for close-in three phase faults on each line terminating at these remote buses. Since these remote buses are more than 10 miles from the generating station, PRC-005-3 would not be applicable to the reclosing relays and the analysis confirms there is not a reliability need to include these relays.

At the second generating station, one of the lines exiting the station is approximately two miles in length. The generating units were unstable for faults anywhere on this line. Proposed Reliability Standard PRC-005-3 would be applicable to reclosing relays at the remote bus because it is less than 10 miles from the generating station. In this case the generating units remain stable for close-in faults on each of the lines terminating at the remote bus, confirming that the criterion is conservative.

3. Changes to Requirements in Reliability Standard PRC-005-2

The proposed Reliability Standard consists of five Requirements. The Requirements and the associated Measures have been modified, as necessary, to add in the coverage of Automatic Reclosing to the Requirement language.

Requirement R1 now requires that Transmission Owners, Generator Owners, and Distribution Providers establish a Protection System Maintenance Program both for Protection Systems and for Automatic Reclosing relays as defined in the proposed Reliability Standard, and, as in Reliability Standard PRC-005-2, includes guidelines for the development of such a program.

Requirement R3 now requires Transmission Owners, Generator Owners, and Distribution Providers that utilize time-based maintenance programs to maintain Protection Systems and certain automatic reclosing relays as defined within the proposed Reliability Standard.

Requirement R4 now requires Transmission Owners, Generator Owners, and Distribution Providers that utilize performance-based maintenance programs to implement and follow a PSMP for Protection Systems and for Automatic Reclosing relays as defined within the proposed Reliability Standard.

Revisions to Requirements R2 and R5 were not necessary as each will apply in the same fashion in proposed Reliability Standard PRC-005-3 as approved by the Commission in Reliability Standard PRC-005-2.

D. Implementation Plan

The Implementation Plan for proposed Reliability Standard PRC-005-3 addresses both Protection Systems and Automatic Reclosing. PRC-005-2 has recently been approved by the Commission and has a twelve-year phased-in implementation period. The compliance dates for the various Requirements with respect to maintenance of Protection System Components in PRC-005-2 key off of the date of approval by the applicable regulatory authority. To account for this timing, and in order not to lose time on maintenance activities completed prior to the approval of PRC-005-3, the Standard Drafting Team has carried forward the language in the

implementation plan for PRC-005-2 and modified it to add compliance dates for the Requirements with respect to Automatic Reclosing Components. The Standard Drafting Team also modified the language for the compliance dates for Requirements with respect to Protection System Components to explicitly reference that the compliance timing for these Components counts forward from the applicable regulatory authority approval date for PRC-005-2. As a result, the Implementation Plan for PRC-005-3 captures the necessary implementation information for PRC-005-2. Under the Implementation Plan for PRC-005-3, entities will now, as an initial matter, indicate whether their Component is being maintained under one of the legacy Reliability Standards (PRC-005-1b, PRC-008-0, PRC-011-0, and PRC-017-0) or whether the Component is being maintained pursuant to PRC-005-3. Because PRC-005-3 has carried the Requirements from PRC-005-2 forward, including language regarding implementation timing, there is no need for an entity to cite to the version 2 Reliability Standard during the phased-in implementation period once the proposed Reliability Standard is approved.[44] Additional aspects of the Implementation Plan are addressed below.

1. Retirement of Legacy Reliability Standards

The Implementation Plan continues to reflect that the retirement of the legacy Reliability Standards will continue to key off of the applicable regulatory approval date of PRC-005-2. Because Automatic Reclosing is a new Component covered by the PRC-005 Reliability Standard, the retirement of the legacy Reliability Standards does not need to correspond with the enforcement date of proposed PRC-005-3. Proposed PRC-005-3 will retire Reliability Standard PRC-005-2 in the United States "at midnight of the day immediately prior to the first day of the

[44] The same approach will be used with respect to the addition of sudden pressure relays. This will allow for the full retirement of PRC-005-3 and its implementation plan leaving only one version of a new PRC-005 standard as the enforceable Reliability Standard rather than needing to reference versions 2 through 4 for the next twelve years.

first calendar quarter, twelve (12) calendar months following applicable regulatory approval of PRC-005-3."

2. Compliance Timeframes for Each Requirement

The Implementation Plan includes identical timeframes for entities to become compliant with the Requirements in PRC-005-3 as exist in the implementation plan for PRC-005-2. The only difference is the date from which entities will count forward to determine the date the entity must be compliant for a particular Component Type. Entities will continue to calculate compliance dates for Requirements in connection with any Protection System Components by counting forward from the applicable regulatory approval date of PRC-005-2. Entities will continue to calculate compliance dates for Requirements in connection with any Automatic Reclosing Components by counting forward from the applicable regulatory approval date of PRC-005-3.

3. Newly Identified Automatic Reclosing Components

The Implementation Plan also includes implementation timeframes for newly identified Automatic Reclosing Components due to generation changes in the Balancing Authority Area. Additional applicable Automatic Reclosing Components may be identified because of the addition or retirement of generating units; or increases of gross generation capacity of individual generating units or plants within the Balancing Authority Area. The Implementation Plan provides that " [i]n such cases, the responsible entities must complete the maintenance activities, described in Table 4, for the newly identified Automatic Reclosing Components prior to the end of the third calendar year following the identification of those Components unless documented prior maintenance fulfilling the requirements of Table 4 is available."

E. Evidence Retention Periods

In order to establish effective maintenance procedures to ensure Reliable Operation of the Bulk-Power System, the Standard Drafting Team established certain evidence retention periods, which were approved by the Commission with Reliability Standard PRC-005-2. Those same evidence retention periods are maintained in proposed Reliability Standard PRC-005-3. These periods will now apply to evidence retained for compliance with the Requirements in connection with Automatic Reclosing. Proposed PRC-005-3 continues to require entities to maintain documentation for the longer of: (1) the two most recent performances of each distinct maintenance activity for the Protection System or Automatic Reclosing Component; (2) all performances of each distinct maintenance activity for the Protection System or Automatic Reclosing Component since the previous scheduled audit date. The Standard Drafting Team explains that this requirement assures that documentation is available to show that the time between maintenance cycles correctly meets the maintenance interval limits.[45] Maintaining elements according to these intervals is a critical aspect of properly maintaining a covered Component. Because some maintenance intervals in proposed PRC-005-3 (and the predecessor Reliability Standard PRC-005-2) are up to twelve years, it is possible that an entity may need to retain records for up to twenty-four years.

The evidence retention periods in proposed Reliability Standard PRC-005-3[46] continue to be reasonable for this type of activity. The type of evidence entities will retain to demonstrate that maintenance was last completed within a given interval are the usual and customary documents maintained by these entities today to document maintenance internally of various

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[45] *See Supplementary and FAQ*, Ex. E at 39.

[46] The evidence retention periods are outlined in the Compliance section of proposed Reliability Standard PRC-005-3, attached hereto as **Exhibit A.** The written description of the evidence retention periods corresponds to the Maintenance Interval and Maintenance Activities section of Table 1, also found in **Exhibit A.**

components. While the time intervals may seem longer than an entity may reasonably retain such records, the lengthy periods are necessary to establish maintenance has occurred according to the mandated intervals. Retaining records for the two most recent performances of each distinct maintenance activity, where the interval is twelve years, is how the twenty-four year retention period arises. Shortening the time period for retention would require that the maintenance intervals be reduced as well, which would significantly increase capital maintenance costs since entities would need to maintain Components under tighter time constraints.

The Measures in the proposed Reliability Standard provide examples of acceptable types of evidence for each Requirement, but the Measures do not mandate specific records be kept. Therefore, entities will have the flexibility to determine the level of documentation needed to verify this limited element of the proposed Reliability Standard. Generally, entities will likely only maintain summaries of their maintenance activities pertaining to the prior period in order to establish that the proper intervals were met. Therefore, the burden will be minimal compared to the increased capital costs that would result from shortening the intervals to create a shorter maximum retention time.

Recognizing that the period is long, NERC has requested that the Standard Drafting Team consider possible alternatives or refinements to the evidence retention periods in the PRC-005 Reliability Standard for all covered Component Types as part of NERC Project 2007-17.3 – Protection System Maintenance and Testing (Sudden Pressure Relays).

F. Enforceability of proposed Reliability Standard PRC-005-3

The proposed Reliability Standard includes Violation Risk Factors ("VRFs") and Violation Severity Levels ("VSLs"). The VRFs and VSLs for the proposed Reliability Standard

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 G**.

Because the Requirements contained in proposed Reliability Standard PRC-005-3 track with those contained in the already approved Reliability Standard PRC-005-2, the Standard Drafting Team determined that no revisions were necessary to the VRFs for the proposed Reliability Standard. NERC, therefore, requests that the Commission approve the VRFs as applied to the Automatic Reclosing Components now included in the proposed Reliability Standard.

The VSLs in PRC-005-2 have been revised accordingly to add the additional Component into the levels of severity. The changes are consistent with the approach taken for the VSLs in Reliability Standard PRC-005-2. The VSLs provide guidance on the way that NERC will enforce the Requirements of the proposed Reliability Standard for each of the Component Types.

The proposed Reliability Standard also include Measures that support each Requirement to help ensure that the Requirements will be enforced in a clear, consistent, and non-preferential manner and without prejudice to any party.

V. CONCLUSION

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

- approve the proposed Reliability Standard and other associated elements included in **Exhibit A**;
- the new and revised definitions, as noted herein;
- the VRFs and VSLs (as explained in **Exhibit E**);
- approve the Implementation Plan included in **Exhibit B**; and
- approve the retirement of Reliability Standard PRC-005-2, as proposed in the Implementation Plan.

Respectfully submitted,

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