Standard Development Roadmap

This section is maintained by the drafting team during the development of the standard and will be removed when the standard becomes effective.

Development Steps Completed:

1. Standards Committee ~~approves~~approved posting SAR and draft standard on August 11, 2011.

2. SAR and draft standard were posted for a 45-day concurrent posting and initial ballot from August 15, 2011 through September 29, 2011.

Description of Current Draft:

This is the ~~first~~second draft of the Standard. This standard merges previous standards ~~PRC-005-1,~~ PRC-005-1a, PRC-008-0, PRC-011-0, and PRC-017-0. It also addresses FERC comments from Order 693, and addresses observations from the NERC System Protection and Control Task Force, as presented in *NERC SPCTF Assessment of Standards: PRC-005-1 — Transmission and Generation Protection System Maintenance and Testing, PRC-008-0 — Underfrequency Load Shedding Equipment Maintenance Programs, PRC-011-0 — UVLS System Maintenance and Testing, PRC-017-0 — Special Protection System Maintenance and Testing.*

Future Development Plan:

Anticipated Actions	Anticipated Date
1. Post for combined ~~45~~30-day comment and successive ballot.	~~September – October, 2011~~March – April, 2012
2. ~~Conduct initial ballot~~Drafting Team Responds to Comments	~~October, 2011~~May – June, 2012
3. ~~Drafting Team Responds to Comments~~Conduct recirculation ballot	~~November – December, 2011~~June, 2012

Definitions of Terms Used in Standard

This section includes all newly defined or revised terms used in the proposed standard. Terms already defined in the Reliability Standards Glossary of Terms are not repeated here. New or revised definitions listed below become approved when the proposed standard is approved. When the standard becomes effective, these defined terms will be removed from the individual standard and added to the Glossary.

Protection System Maintenance Program (PSMP) — An ongoing program by which Protection System components are kept in working order and proper operation of malfunctioning components is restored. A maintenance program for a specific component includes one or more of the following activities:

- Verify — Determine that the component is functioning correctly.
- Monitor — Observe the routine in-service operation of the component.
- Test — Apply signals to a component to observe functional performance or output behavior, or to diagnose problems.
- Inspect — Detect visible signs of component failure, reduced performance and degradation.
- Calibrate — Adjust the operating threshold or measurement accuracy of a measuring element to meet the intended performance requirement.

Protection System (NERC Board of Trustees Approved Definition)

- Protective relays which respond to electrical quantities,
- Communications systems necessary for correct operation of protective functions,
- Voltage and current sensing devices providing inputs to protective relays,
- Station dc supply associated with protective functions (including station batteries, battery chargers, and non-battery-based dc supply), and
- Control circuitry associated with protective functions through the trip coil(s) of the circuit breakers or other interrupting devices.

The following terms are defined for use only within PRC-005-2, and should remain with the standard upon approval rather than being moved to the Glossary of Terms.

Unresolved Maintenance Issue – A deficiency ~~that cannot be corrected~~identified during ~~the performance of the~~ a maintenance activity that causes the component to not meet the intended performance and requires follow-up corrective action.

Segment – Protection Systems or components 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~~Segment. A ~~segment~~Segment must contain at least sixty (60) individual components.

Component Type - Any one of the five specific elements of the Protection System definition.

Component – A ~~component~~Component is any individual discrete piece of equipment included in a Protection System, including but not limited to a protective relay or current sensing device. The designation of what constitutes a control circuit ~~component~~Component is ~~very~~ 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~~Components. Another example of where the entity has some discretion on determining what constitutes a single ~~component~~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~~Component.

Countable Event – A ~~component~~Component which has failed and requires repair or replacement, any condition discovered during the maintenance activities in Tables 1-1 through 1-5 and Table 3 which requires corrective action~~,~~ or a 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~~Component configuration errors, or Protection System application errors are not included in Countable Events.

A. Introduction

1.   **Title:**   **Protection System Maintenance**

2.   **Number:**   PRC-005-2

3.   **Purpose:**   To document and implement programs for the maintenance of all Protection Systems affecting the reliability of the Bulk Electric System (BES) so that these Protection Systems are kept in working order.

4.   **Applicability:**

   4.1. Functional Entities:

   4.1.1   Transmission ~~Owners~~Owner

   4.1.2   Generator ~~Owners~~Owner

   4.1.3   Distribution ~~Providers~~Provider

   4.2. Facilities:

   4.2.1   Protection Systems that are installed for the purpose of detecting ~~faults~~Faults on BES Elements (lines, buses, transformers, etc.)

   4.2.2   Protection Systems used for underfrequency load-shedding systems installed per ERO underfrequency load-shedding requirements.

   4.2.3   Protection Systems used for undervoltage load-shedding systems installed to prevent system voltage collapse or voltage instability for BES reliability.

   4.2.4   Protection Systems installed as a Special Protection System (SPS) for BES reliability.

   4.2.5   Protection Systems for generator Facilities that are part of the BES, including:

      4.2.5.1 Protection Systems that act to trip the generator either directly or via ~~generator~~ lockout or auxiliary tripping relays.

      4.2.5.2 Protection Systems for generator step-up transformers for generators that are part of the BES.

      4.2.5.3 Protection Systems for transformers connecting aggregated generation, where the aggregated generation is part of the BES (e.g., transformers connecting facilities such as wind-farms to the BES).

      4.2.5.4 Protection Systems for generator-connected station service transformers ~~for~~used on generators ~~that~~which are part of the BES, that act to trip the generator either directly or via lockout or tripping auxiliary relays.

5.   **Effective Date:** See Implementation Plan

B. Requirements

R1.   Each Transmission Owner, Generator Owner, and Distribution Provider shall establish a Protection System Maintenance Program (PSMP) for its Protection Systems identified in Section 4.2. *[Violation Risk Factor: Medium] [Time Horizon: ~~Long Term~~Operations Planning]*

The PSMP shall:

    1.1. ~~Address all Protection System **component types.**~~

    ~~1.2.~~**1.1.** Identify which maintenance method (time-based, performance-based (per PRC-005 Attachment A), or a combination) is used to address each Protection System ~~component type.~~Component Type. All batteries associated with the station dc supply ~~component type~~Component Type of a Protection System shall be included in a time-based program as described in Table 1-4 and Table 3.

Component Type - Any one of the five specific elements of the Protection System definition.

    1.3. ~~Identify the associated maintenance intervals for time-based programs, to be no less frequent than the intervals established in Table 1-1 through 1-5, Table 2, and Table 3.~~

~~**Unresolved Maintenance Issue -** *A deficiency that cannot be corrected during the performance of the maintenance activity and requires follow-up corrective action.*~~

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.

    ~~1.4.~~**1.2.** Include ~~all~~the applicable ~~monitoring~~monitored Component attributes ~~and related maintenance activities~~ applied to each Protection System ~~component type~~Component Type consistent with the maintenance intervals specified in Tables 1-1 through 1-5, Table 2, and Table 3 where monitoring is used to extend the maintenance intervals beyond those specified for unmonitored Protection System Components.

R2. Each Transmission Owner, Generator Owner, and Distribution Provider that uses performance-based maintenance intervals in its PSMP shall follow the procedure established in PRC-005 Attachment A to establish and maintain its performance-based intervals. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning]*

R3. Each Transmission Owner, Generator Owner, and Distribution Provider ~~shall implement and follow its PSMP and initiate resolution of any **unresolved maintenance issues**.~~ that utilizes time-based maintenance program(s) shall maintain its Protection System Components that are included within the time-based maintenance program in accordance with the minimum maintenance activities and maximum maintenance intervals prescribed within Tables 1-1 through 1-5, Table 2, and Table 3. *[Violation Risk Factor: High] [Time Horizon: Operations Planning]*

Unresolved Maintenance Issue - A deficiency identified during a maintenance activity that causes the component to not meet the intended performance and requires follow-up corrective action.

R4. Each Transmission Owner, Generator Owner, and Distribution Provider that utilizes performance-based maintenance program(s) in accordance with Requirement R2 shall implement and follow its PSMP for its Protection System Components that are included within the performance-based program(s). *[Violation Risk Factor: High] [Time Horizon: Operations Planning]*

~~*Component Type - Any one of the five specific elements of the Protection System definition.*~~

R5. Each Transmission Owner, Generator Owner, and

Distribution Provider shall demonstrate efforts to correct identified Unresolved Maintenance Issues. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning]*

C. Measures

M1. Each Transmission Owner, Generator Owner and Distribution Provider shall have a ~~current~~ documented Protection System Maintenance Program ~~that addresses all component types of its Protection Systems, as required by~~in accordance with Requirement R1.

For each Protection System ~~component type~~Component Type, the documentation shall include the type of maintenance ~~program~~method applied (time-based, performance-based, or a combination of these maintenance methods), ~~maintenance activities, maintenance intervals, and, for component types~~and shall include all batteries associated with the station dc supply Component Types in a time-based program as described in Table 1-4 and Table 3. (Part 1.1)

~~**M1.**~~ For Component Types that use monitoring to extend the ~~intervals,~~maintenance intervals, the responsible entity(s) shall have evidence for each protection Component Type (such as manufacturer's specifications or engineering drawings) of the appropriate ~~monitoring~~monitored Component attributes as specified in ~~Requirement R1, Parts 1.~~Tables 1-1 through 1~~4.~~-5, Table 2, and Table 3. (Part 1.2)

M2. Each Transmission Owner, Generator Owner, and Distribution Provider that uses ~~a~~ performance-based maintenance ~~program~~intervals shall have evidence that its current performance-based maintenance program(s) is in accordance with Requirement R2, which may include but is not limited to ~~equipment~~Component lists, dated maintenance records, and dated analysis records and results.

M3. Each Transmission Owner, Generator Owner, and Distribution Provider that utilizes time-based maintenance program(s) shall have evidence that it has ~~implemented the~~maintained its Protection System ~~Maintenance Program and initiated resolution of unresolved maintenance issues~~Components included within its time-based program in accordance with Requirement R3~~, which~~. The evidence may include but is not limited to dated maintenance records, dated maintenance summaries, dated check-off lists, dated inspection records, or dated work orders.

M4. Each Transmission Owner, Generator Owner, and Distribution Provider that utilizes performance-based maintenance intervals in accordance with Requirement R2 shall have evidence that it has implemented the Protection System Maintenance Program for the Protection System Components included in its performance-based program in accordance with Requirement R4. The evidence may include but is not limited to dated maintenance records, dated maintenance summaries, dated check-off lists, dated inspection records, or dated work orders.

M5. Each Transmission Owner, Generator Owner, and Distribution Provider shall have evidence that it has undertaken efforts to correct identified Unresolved Maintenance Issues in accordance with Requirement R5. The evidence may include but is not limited to work orders, replacement Component orders, invoices, project schedules, return material authorizations (RMAs) or purchase orders.

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance ~~Monitoring Responsibility~~Enforcement Authority

Regional Entity

1.2. Compliance Monitoring and Enforcement Processes:

Compliance ~~Audits~~Audit

Self-~~Certifications~~Certification

Spot Checking

Compliance ~~Violation Investigations~~Investigation

Self-Reporting

Complaints

1.3. ~~Data~~Evidence **Retention**

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

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

~~**Component** — A component is any individual discrete piece of equipment included in a Protection System, including but not limited to a protective relay or current sensing device. The designation of what constitutes a control circuit component is very 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.~~

For Requirement R1, the Transmission Owner, Generator Owner, and Distribution Provider shall each keep its current dated Protection System Maintenance Program, as well as any superseded versions since the preceding compliance audit, including the documentation that specifies the type of maintenance program applied for each Protection System ~~component type~~Component Type.

For Requirement R2, Requirement R3, Requirement R4, and Requirement ~~R3~~R5, the Transmission Owner, Generator Owner, and Distribution Provider shall each keep documentation of the two most recent performances of each distinct maintenance activity for the Protection System ~~components~~Components, or all performances of each distinct maintenance activity for the Protection System ~~component~~Component since the previous scheduled audit date, whichever is longer.

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

1.4. Additional Compliance Information

None.

2.	**Violation Severity Levels**

Requirement Number	Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	The responsible entity's PSMP failed to specify whether one ~~component type~~Component Type is being addressed by time-based or performance-based maintenance, or a combination of both. (Part 1.~~2~~1) OR The responsible entity's PSMP failed to include applicable station batteries in a time-based program. (Part 1.1)	~~The responsible entity's PSMP failed to address one component type included in the definition of 'Protection System' (Part 1.1)~~ ~~OR~~ The responsible entity's PSMP failed to specify whether two ~~component types~~Component Types are being addressed by time-based or performance-based maintenance, or a combination of both. (Part 1.~~2~~1)	The responsible ~~entity's PSMP failed to address two component types included in the definition of 'Protection System' (Part 1.1)~~ ~~OR~~ ~~The responsible entity's~~entities' PSMP failed to include ~~station batteries in a time-based program (Part 1.2)~~ ~~OR~~ ~~The responsible entity failed to include all maintenance activities or intervals relevant for the identified~~the applicable monitoring attributes applied to each Protection System Component Type consistent with the maintenance intervals specified in Tables 1-1 through 1-5, Table 2, and Table 3~~. (Part 1.3 and 1.4)~~ where monitoring is used to extend the maintenance intervals beyond those specified for unmonitored Protection System Components. (Part 1.2).	The responsible entity ~~has not established~~failed to establish a PSMP. OR ~~The responsible entity's PSMP failed to address three or more component types included in the definition of 'Protection System' (Part 1.1)~~ ~~OR~~ The responsible entity failed to specify whether three or more ~~component types~~Component Types are being addressed by time-based or performance-based maintenance, or a combination of both. (Part 1.~~2~~1).
R2	The responsible entity uses performance-based maintenance intervals in its PSMP but ~~has:~~ ~~1)~~ ~~Failed~~failed to reduce ~~countable events~~Countable Events to less than 4% within three years. ~~OR~~	NA	The responsible entity uses performance-based maintenance intervals in its PSMP but ~~has~~ failed to reduce ~~countable events~~Countable Events to less than 4% within four years.	The responsible entity uses performance-based maintenance intervals in its PSMP but ~~has:~~ 1) Failed to establish the ~~entire~~ technical justification described within Requirement R2 for the initial use of the performance-based PSMP

Requirement Number	Lower VSL	Moderate VSL	High VSL	Severe VSL
	2) ~~Failed to annually document program activities, results, maintenance dates, or countable events for 5% or less of components in any individual segment.~~			OR 2) Failed to reduce ~~countable events~~Countable Events to less than 4% within five years OR 3) ~~Failed to annually document program activities, results, maintenance dates, or countable events for over 5% of components in any individual segment~~ ~~OR~~ 4) ~~Maintained a~~ ~~segment~~Segment with less than 60 ~~components~~Components OR ~~5~~4) Failed to: • Annually update the list of ~~components~~Components, OR • ~~Perform~~Annually perform maintenance on the greater of 5% of the segment population or 3 ~~components~~Components, OR • Annually analyze the program activities and results for each ~~segment~~Segment.
R3	~~The responsible entity has failed to implement and follow scheduled program on 5% or less of total Protection System components.~~ ~~OR~~	~~The responsible entity has failed to implement and follow scheduled program on greater than 5%, but no more than 10% of total Protection System components.~~	~~The responsible entity has failed to implement and follow scheduled program on greater than 10%, but no more than 15% of total Protection System components.~~	~~The responsible entity has failed to implement and follow scheduled program on greater than 15% of total Protection System components.~~

Requirement Number	Lower VSL	Moderate VSL	High VSL	Severe VSL
	~~The responsible entity has failed to initiate resolution on 5% or less of unresolved maintenance issues.~~For Protection System Components included within a time-based maintenance program, the responsible entity failed to maintain 5% or less of the total Components included within a specific Protection System Component Type, in accordance with the minimum maintenance activities and maximum maintenance intervals prescribed within Tables 1-1 through 1-5, Table 2, and Table 3.	~~OR~~ ~~The responsible entity has failed to initiate resolution on greater than 5%, but less than or equal to 10% of unresolved maintenance issues.~~For Protection System Components included within a time-based maintenance program, the responsible entity failed to maintain more than 5% but 10% or less of the total Components included within a specific Protection System Component Type, in accordance with the minimum maintenance activities and maximum maintenance intervals prescribed within Tables 1-1 through 1-5, Table 2, and Table 3.	~~OR~~ ~~The responsible entity has failed to initiate resolution on greater than 10%, but less than or equal to 15% of unresolved maintenance issues.~~For Protection System Components included within a time-based maintenance program, the responsible entity failed to maintain more than 10% but 15% or less of the total Components included within a specific Protection System Component Type, in accordance with the minimum maintenance activities and maximum maintenance intervals prescribed within Tables 1-1 through 1-5, Table 2, and Table 3.	~~OR~~ ~~The responsible entity has failed to initiate resolution on greater than 15% of unresolved maintenance issues.~~For Protection System Components included within a time-based maintenance program, the responsible entity failed to maintain more than 15% of the total Components included within a specific Protection System Component Type, in accordance with the minimum maintenance activities and maximum maintenance intervals prescribed within Tables 1-1 through 1-5, Table 2, and Table 3.
R4	For Protection System Components included within a performance-based maintenance program, the responsible entity failed to maintain 5% or less of the annual scheduled maintenance for a specific Protection System Component Type in accordance with their performance-based PSMP.	For Protection System Components included within a performance-based maintenance program, the responsible entity failed to maintain more than 5% but 10% or less of the annual scheduled maintenance for a specific Protection System Component Type in accordance with their performance-based PSMP.	For Protection System Components included within a performance-based maintenance program, the responsible entity failed to maintain more than 10% but 15% or less of the annual scheduled maintenance for a specific Protection System Component Type in accordance with their performance-based PSMP.	For Protection System Components included within a performance-based maintenance program, the responsible entity failed to maintain more than 15% of the annual scheduled maintenance for a specific Protection System Component Type in accordance with their performance-based PSMP.
R5	The responsible entity failed to undertake efforts to correct 5 or less Unresolved Maintenance Issues.	The responsible entity failed to undertake efforts to correct greater than 5, but less than or equal to 10 Unresolved Maintenance Issues.	The responsible entity failed to undertake efforts to correct greater than 10, but less than or equal to 15 Unresolved Maintenance Issues.	The responsible entity failed to undertake efforts to correct greater than 15 Unresolved Maintenance Issues.

E. Regional Variances

None

F. Supplemental Reference Document

The following documents present a detailed discussion about determination of maintenance intervals and other useful information regarding establishment of a maintenance program…

1. PRC-005-2 Protection System Maintenance Supplementary Reference and FAQ — July 2011.

Version History

Version	Date	Action	Change Tracking
2	TBD	Complete revision, absorbing maintenance requirements from PRC-005-1, PRC-005-1a, PRC-008-0, PRC-011-0, PRC-017	Complete revision

Table 1-1 Component Type - Protective Relay Excluding distributed UFLS and distributed UVLS (see Table 3)		
Component Attributes	**Maximum Maintenance Interval**[1]	**Maintenance Activities**
Any unmonitored protective relay not having all the monitoring attributes of a category below.	6 calendar years	For all unmonitored relays: • Verify that settings are as specified For non-microprocessor relays: • Test and, if necessary calibrate For microprocessor relays: • Verify operation of the relay inputs and outputs that are essential to proper functioning of the Protection System. • Verify acceptable measurement of power system input values.
Monitored microprocessor protective relay with the following: • Internal self diagnosis and alarming (see Table 2). • Voltage and/or current waveform sampling three or more times per power cycle, and conversion of samples to numeric values for measurement calculations by microprocessor electronics. • Alarming for power supply failure (see Table 2).	12 calendar years	Verify: • Settings are as specified. • Operation of the relay inputs and outputs that are essential to proper functioning of the Protection System. • Acceptable measurement of power system input values.

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[1] For the tables in this standard, a calendar year starts on the first day of a new year (January 1) after a maintenance activity has been completed.
For the tables in this standard, a calendar month starts on the first day of the first month after a maintenance activity has been completed.

Monitored microprocessor protective relay with preceding row attributes and the following: • Ac measurements are continuously verified by comparison to an independent ac measurement source, with alarming for excessive error~~.~~ (See Table 2~~)~~). • Some or all binary or status inputs and control outputs are monitored by a process that continuously demonstrates ability to perform as designed, with alarming for failure~~.~~ (See Table 2~~)~~). • Alarming for change of settings~~.~~ (See Table 2~~)~~).	12 calendar years	Verify only the unmonitored relay inputs and outputs that are essential to proper functioning of the Protection System.

Table 1-2 Component Type - Communications Systems Excluding distributed UFLS and distributed UVLS (see Table 3)		
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Any unmonitored communications system necessary for correct operation of protective functions, and not having all the monitoring attributes of a category below.	4 calendar months	Verify that the communications system is functional.
	6 calendar years	Verify that the channel meets performance criteria pertinent to the communications technology applied (e.g. signal level, reflected power, or data error rate). Verify operation of communication system inputs and outputs that are essential ~~signals~~ to ~~and from other~~proper functioning of the Protection System ~~components~~.

Any communications system with continuous monitoring or periodic automated testing for the presence of the channel function, and alarming for loss of function. (See Table 2~~)~~).	12 calendar years	Verify that the channel meets performance criteria pertinent to the communications technology applied (e.g. signal level, reflected power, or data error rate). Verify operation of communication system inputs and outputs that are essential ~~signals~~ to ~~and from other~~proper functioning of the Protection System ~~components~~.
Any communications system with continuous monitoring or periodic automated testing for the performance of the channel using criteria pertinent to the communications technology applied (e.g. signal level, reflected power, or data error rate, and alarming for excessive performance degradation). (See Table 2)	No periodic maintenance specified	None.

Table 1-3 Component Type - Voltage and Current Sensing Devices Providing Inputs to Protective Relays Excluding distributed UFLS and distributed UVLS (see Table 3)		
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Any voltage and current sensing devices not having monitoring attributes of the category below.	12 calendar years	Verify that current and voltage signal values are provided to the protective relays.

Voltage and Current Sensing devices connected to microprocessor relays with AC measurements are continuously verified by comparison of sensing input value, as measured by the microprocessor relay, to an independent ac measurement source, with alarming for unacceptable error or failure (see Table 2).	No periodic maintenance specified	None.

Table 1-4(a) Component Type – Protection System Station dc Supply Using Vented Lead-Acid (VLA) Batteries Excluding distributed UFLS and **distributed** UVLS (see Table 3) Protection System Station dc supply used only for non-BES interrupting devices for SPS, non-distributed UFLS systems, or non-distributed UVLS systems is excluded (see Table 1-4(e)).		
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Protection System Station dc supply using **Vented Lead-Acid (VLA) batteries** not having monitoring attributes of Table 1-4(f). Protection System Station dc supply for non-BES interrupting devices for SPS or non-distributed UVLS systems are excluded (see Table 1-4(e)).	4 Calendar Months	Verify: • Station dc supply voltage Inspect: • Electrolyte level • For unintentional grounds
	18 Calendar Months	Verify: • Float voltage of battery charger • Battery continuity • Battery terminal connection resistance • Battery intercell or unit-to-unit connection resistance Inspect: • Cell condition of all individual battery cells where cells are visible – or measure battery cell/unit internal ohmic values where the cells are not visible • Physical condition of battery rack
	18 Calendar Months -or- 6 Calendar Years	Verify that the station battery can perform as designed by evaluating the measured cell/unit internal ohmic values to station battery baseline. -or- Verify that the station battery can perform as designed by conducting a performance, service, or modified performance capacity test of the entire battery bank.

Table 1-4(b)			
Component Type – Protection System Station dc Supply Using Valve-Regulated Lead-Acid (VRLA) Batteries **Excluding distributed UFLS and ~~distributed~~ UVLS (see Table 3)** ~~Protection System Station dc supply used only for non-BES interrupting devices for SPS, non-distributed UFLS systems, or non-distributed UVLS systems is excluded (see Table 1-4(e)).~~			
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Protection System Station dc supply **with Valve Regulated Lead-Acid (VRLA) batteries** not having monitoring attributes of Table 1-4(f). ~~Station dc supply for non-BES interrupting devices for SPS or non-distributed UFLS and UVLS systems are excluded (see Table 1-4(e)).~~	4 Calendar Months	Verify: • Station dc supply voltage Inspect: • For unintentional grounds
	6 Calendar Months	Inspect: • Condition of all individual units by measuring battery cell/unit internal ohmic values.
	18 Calendar Months	Verify: • Float voltage of battery charger • Battery continuity • Battery terminal connection resistance • Battery intercell or unit-to-unit connection resistance Inspect: • Physical condition of battery rack
	6 Calendar Months -or- 3 Calendar Years	Verify that the station battery can perform as designed by evaluating the measured cell/unit internal ohmic values to station battery baseline. -or- Verify that the station battery can perform as designed by conducting a performance, service, or modified performance capacity test of the entire battery bank.

Table 1-4(d)		
Component Type – Protection System Station dc Supply Using Non Battery Based Energy Storage		
Excluding distributed UFLS and distributed UVLS (see Table 3)		
Station dc supply used only for non-BES interrupting devices for SPS, non-distributed UFLS system, or non-distributed UVLS systems is excluded (see Table 1-4(e)).		
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Any Protection System station dc supply not using a battery and not having monitoring attributes of Table 1-4(f). Protection System Station dc supply for non-BES interrupting devices for SPS or non-distributed UFLS and UVLS systems are excluded (see Table 1-4(e)).	4 Calendar Months	Verify: • Station dc supply voltage Inspect: • For unintentional grounds
	18 Calendar Months	Inspect: Condition of non-battery based dc supply
	6 Calendar Years	Verify that the dc supply can perform as designed when ac power is not present.

Table 1-4(e)		
Component Type – Protection System Station dc Supply for non-BES Interrupting ~~Device~~Devices for SPS, non-distributed UFLS, and non-distributed UVLS ~~and UFLS~~ systems		
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Any Protection System dc supply used only for tripping only non-BES interrupting devices as part of a SPS, non-distributed UFLS, or non-distributed UVLS ~~and UFLS~~ system and not having monitoring attributes of Table 1-4(f).	When control circuits are verified (See Table 1-5)	Verify Station dc supply voltage.

Table 1-4(f)		
Exclusions for Protection System Station dc Supply Monitoring Devices and Systems		
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Any station dc supply with high and low voltage monitoring and alarming of the battery charger voltage to detect charger overvoltage and charger failure. (See Table 2)).	No periodic maintenance specified	No periodic verification of station dc supply voltage is required.
Any battery based station dc supply with electrolyte level monitoring and alarming in every cell (See Table 2)).		No periodic inspection of the electrolyte level for each cell is required.
Any station dc supply with unintentional dc ground monitoring and alarming (See Table 2)).		No periodic inspection of unintentional dc grounds is required.
Any station dc supply with charger float voltage monitoring and alarming to ensure correct float voltage is being applied on the station dc supply (See Table 2)).		No periodic verification of float voltage of battery charger is required.
Any battery based station dc supply with monitoring and alarming of battery string continuity (See Table 2)).		No periodic verification of the battery continuity is required.
Any battery based station dc supply with monitoring and alarming of the intercell and/or terminal connection detail resistance of the entire battery (See Table 2)).		No periodic verification of the intercell and terminal connection resistance is required.
Any ~~lead acid battery based~~ Valve Regulated Lead-Acid (VRLA) or Vented Lead-Acid (VLA) station ~~dc supply~~ battery with internal ohmic value monitoring and alarming, and evaluating present values relative to baseline internal ohmic values for every cell/unit (See Table 2)).		No periodic measurement and evaluation relative to baseline of battery cell/unit internal ohmic values is required to verify the station battery can perform as designed ..
Any Valve Regulated Lead-Acid (VRLA) or Vented Lead-Acid (VLA) station battery with monitoring and alarming of each cell/unit internal ~~Ohmic~~ ohmic value. (See Table 2)).		No periodic inspection of the condition of all individual units by measuring battery cell/unit internal ohmic values of a station VRLA or Vented Lead-Acid (VLA) battery is required.

Table 1-5 Component Type - Control Circuitry Associated With Protective Functions Excluding distributed UFLS and distributed UVLS (see Table 3) **Note:** Table requirements apply to all Control Circuitry componentsComponents of Protection Systems, and SPSs except as noted.		
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Trip coils or actuators of circuit breakers, interrupting devices, or mitigating devices (regardless of any monitoring of the control circuitry).	6 calendar years	Verify that each trip coil is able to operate the circuit breaker, interrupting device, or mitigating device.
Unmonitored control circuitry associated with SPSElectromechanical lockout devices which are directly in a trip path from the protective relay to the interrupting device trip coil (regardless of any monitoring of the control circuitry).	126 calendar years	Verify all paths of the control circuits essential for properelectrical operation of the SPSelectromechanical lockout devices.
Electromechanical lockout and/or tripping auxiliary devices which are directly in a trip path from the protective relay to the interrupting device trip coil.Unmonitored control circuitry associated with SPS.	612 calendar years	Verify electricalall paths of the control circuits essential for proper operation of electromechanical trip and auxiliary devicesthe SPS.
Unmonitored control circuitry associated with protective functions inclusive of all auxiliary relays.	12 calendar years	Verify all paths of the trip circuits inclusive of all auxiliary relays through the trip coil(s) of the circuit breakers or other interrupting devices.
Control circuitry whose continuityassociated with protective functions and energization /or ability to operate areSPS whose integrity is monitored and alarmed (See Table 2).	No periodic maintenance specified	None.

Table 2 – Alarming Paths and Monitoring		
In Tables 1-1 through 1-5 and Table 3, alarm attributes used to justify extended maximum maintenance intervals and/or reduced maintenance activities are subject to the following maintenance requirements		
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Any alarm path through which alarms in Tables 1-1 through 1-5 and Table 3 are conveyed from the alarm origin to the location where corrective action can be initiated, and not having all the attributes of the "Alarm Path with monitoring" category below. Alarms are reported within 24 hours of DETECTIONdetection to a location where corrective action can be initiated.	12 Calendar Years	Verify that the alarm path conveys alarm signals to a location where corrective action can be initiated.
Alarm Path with monitoring: The location where corrective action is taken receives an alarm within 24 hours for failure of any portion of the alarming path from the alarm origin to the location where corrective action can be initiated.	No periodic maintenance specified	None.

Table 3 Maintenance Activities and Intervals for distributed UFLS and distributed UVLS Systems		
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Any unmonitored protective relay not having all the monitoring attributes of a category below.	6 calendar years	Verify that settings are as specified For non-microprocessor relays: • Test and, if necessary calibrate For microprocessor relays: • Verify operation of the relay inputs and outputs that are essential to proper functioning of the Protection System. • Verify acceptable measurement of power system input values.
Monitored microprocessor protective relay with the following: • Internal self diagnosis and alarming (See Table 2). • Voltage and/or current waveform sampling three or more times per power cycle, and conversion of samples to numeric values for measurement calculations by microprocessor electronics. Alarming for power supply failure (See Table 2).	12 calendar years	Verify: • Settings are as specified. • Operation of the relay inputs and outputs that are essential to proper functioning of the Protection System. • Acceptable measurement of power system input values. •

Monitored microprocessor protective relay with preceding row attributes and the following: • Ac measurements are continuously verified by comparison to an independent ac measurement source, with alarming for excessive error. (See Table 2~~)~~). • Some or all binary or status inputs and control outputs are monitored by a process that continuously demonstrates ability to perform as designed, with alarming for failure. (See Table 2~~)~~). Alarming for change of settings. (See Table 2~~)~~).	12 calendar years	Verify only the unmonitored relay inputs and outputs that are essential to proper functioning of the Protection System.
Voltage and/or current sensing devices associated with UFLS or UVLS systems.	12 calendar years	Verify that current and/or voltage signal values are provided to the protective relays.
Protection System dc supply for tripping ~~only~~ non-BES interrupting devices ~~as part of~~used only for a UFLS or UVLS system.	12 calendar years	Verify Protection System dc supply voltage.
Control circuitry between the UFLS or UVLS relays and electromechanical lockout and/or tripping auxiliary devices. (excludes non-BES interrupting device trip coils).	12 calendar years	Verify the path from the relay to the lockout and/or tripping auxiliary relay (including essential supervisory logic).
Electromechanical lockout and/or tripping auxiliary devices associated only with UFLS or UVLS systems. (excludes non-BES interrupting device trip coils).	12 calendar years	Verify electrical operation of electromechanical lockout and/or tripping auxiliary devices.
Control circuitry between the electromechanical lockout and/or tripping auxiliary devices and the non-BES interrupting devices in UFLS or UVLS systems, or between UFLS or UVLS relays (with no interposing electromechanical lockout or auxiliary device) and the non-BES interrupting devices. (excludes non-BES interrupting device trip coils).	No periodic maintenance specified	None.
Trip coils of non-BES interrupting devices in UFLS or UVLS systems.	No periodic maintenance specified	None.

PRC-005 — Attachment A

Criteria for a Performance-Based Protection System Maintenance Program

Purpose: To establish a technical basis for initial and continued use of a performance-based Protection System Maintenance Program (PSMP).

To establish the technical justification for the initial use of a performance-based PSMP:

1. Develop a list with a description of ~~components~~Components included in each designated ~~segment~~Segment of the Protection System ~~component~~Component population, with a minimum **~~segment~~Segment** population of 60 ~~components~~Components.

2. Maintain the ~~components~~Components in each ~~segment~~Segment according to the time-based maximum allowable intervals established in Tables 1-1 through 1-5 and Table 3 until results of maintenance activities for the ~~segment~~Segment are available for a minimum of 30 individual ~~components~~Components of the ~~segment~~Segment.

3. Document the maintenance program activities and results for each ~~segment~~Segment, including maintenance dates and ~~countable events~~Countable Events for each included ~~component~~Component.

4. Analyze the maintenance program activities and results for each ~~segment~~Segment to determine the overall performance of the ~~segment~~Segment and develop maintenance intervals.

> **Segment** – *Protection Systems or components 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~~Segment. A ~~segment~~Segment must contain at least sixty (60) individual components.*

> **Countable Event** – *A component which has failed and requires repair or replacement, any condition discovered during the maintenance activities in Tables 1-1 through 1-5 and Table 3 which requires corrective action, or a 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 configuration errors, or Protection System application errors are not included in Countable Events.*

5. Determine the maximum allowable maintenance interval for each ~~segment~~Segment such that the ~~segment~~Segment experiences **~~countable events~~Countable Events** on no more than 4% of the ~~components~~Components within the ~~segment~~Segment, for the greater of either the last 30 ~~components~~Components maintained or all ~~components~~Components maintained in the previous year.

To maintain the technical justification for the ongoing use of a performance-based PSMP:

1. At least annually, update the list of Protection System ~~components~~Components and ~~segments~~Segments and/or description if any changes occur within the ~~segment~~Segment.

2. Perform maintenance on the greater of 5% of the ~~components~~Components (addressed in the performance based PSMP) in each ~~segment~~Segment or 3 individual ~~components~~Components within the ~~segment~~Segment in each year.

3. For the prior year, analyze the maintenance program activities and results for each ~~segment~~Segment to determine the overall performance of the ~~segment~~Segment.

4. Using the prior year's data, determine the maximum allowable maintenance interval for each ~~segment~~Segment such that the ~~segment~~Segment experiences ~~countable events~~Countable Events on no more than 4% of the ~~components~~Components within the ~~segment~~Segment, for the greater of either the last 30 ~~components~~Components maintained or all ~~components~~Components maintained in the previous year.

5. If the ~~components~~Components in a Protection System ~~segment~~Segment maintained through a performance-based PSMP experience 4% or more ~~countable events~~Countable Events, develop, document, and implement an action plan to reduce the ~~countable events~~Countable Events to less than 4% of the ~~segment~~Segment population within 3 years.