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 SAR for posting on June 5, 2007.
2. The SAR was posted for comment from June 11, 2007–July 10, 2007.
3. The SC approves development of the standard on August 13, 2007.
4. First posting of revised standard on July 24, 2009.
5. Second posting of revised standard on June 11, 2010
6. Third posting of revised standard on ~~September 24~~November 17, 2010

Description of Current Draft:

This is the ~~third~~ fourth draft of the Standard. This standard merges previous standards PRC-005-1, 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 30-day comment and ballot.	~~November 17 December 17, 2010~~15~~-~~ April 125, 2011
2. Conduct successive ballot	~~December 7 December 17, 2010~~May 2 – May 12, 2011
3. Drafting Team Responds to Comments	~~January 5, 2011 January 25~~ May 16 – June 3, 2011

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.
- Restore — Return malfunctioning components to proper operation.

Protection System (NERC Board of Trustees ~~modification~~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.

Maintenance Correctable Issue – Failure of a component to operate within design parameters such that it cannot be restored to functional order by repair or calibration during performance of the initial on-site activity. Therefore this issue 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~~a segment. A 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 is any individual discrete piece of equipment included in a Protection System, ~~such as~~including but not limited to a protective relay or current sensing device. ~~For components such as control circuits, t~~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.

Countable Event – ~~Any failure of a~~A component which has failed ~~requires~~and requires repair or replacement, any condition discovered during the verification activities in Tables 1-1 through 1-5 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.

A. Introduction

1. Title: **Protection System Maintenance**

2. Number: PRC-005-2

3. Purpose: To ensure all transmission and generation Protection Systems affecting the reliability of the Bulk Electric System (BES) are maintained.

4. Applicability:

4.1. Functional Entities:

4.1.1 Transmission Owners

4.1.2 Generator Owners

4.1.3 Distribution Providers

4.2. Facilities:

4.2.1 Protection Systems ~~applied on, or~~ designed to provide protection for~~, the~~ BES Element(s).

~~4.2.1~~4.2.2 Protection Systems used for underfrequency load-shedding systems installed per ERO underfrequency load-shedding requirements.

~~4.2.2~~4.2.3 Protection Systems used for undervoltage load-shedding systems installed to prevent system voltage collapse or voltage instability for BES reliability.

~~4.2.3~~4.2.4 Protection Systems installed as a Special Protection System (SPS) for BES reliability.

~~4.2.4~~4.2.5 Protection Systems for generator Facilities that are part of the BES, including:

~~4.2.4.1~~4.2.5.1 Protection Systems that act to trip the generator either directly or via generator lockout or auxiliary tripping relays.

~~4.2.4.2~~4.2.5.2 Protection Systems for generator step-up transformers for generators that are part of the BES.

~~4.2.4.3~~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).

~~4.2.4.4~~4.2.5.4 Protection Systems for generator-connected station service transformers for generators that are part of the BES.

~~4.2.4.5 Protection Systems for system-connected station service transformers for generators that are part of the BES.~~

5. (Proposed) 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 ~~applied on, or~~ designed to provide protection for~~, the~~ BES Element(s). The PSMP shall: *[Violation Risk Factor: Medium] [Time Horizon: Long Term Planning]*

1.1. Address all Protection System component types.

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

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 and Table 2.

~~**1.4.**~~ Include all applicable monitoring attributes and related maintenance activities applied to each Protection System component type~~, to include those~~ consistent with the maintenance intervals specified in Tables 1-1 through 1-5 and Table 2.

~~**1.5.** Identify calibration tolerances or other equivalent parameters for each Protection System component type that establish acceptable parameters for the conclusion of maintenance activities.~~

1.4. ~~Each Transmission Owner, Generator Owner, and Distribution Provider that uses maintenance intervals for monitored Protection Systems described in Tables 1-1 through 1-5, shall verify those components possess the monitoring attributes identified in Tables 1-1 through 1-5 in its PSMP. *[Violation Risk Factor: Medium] [Time Horizon: Long Term Planning]*~~

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 identified maintenance correctable issues~~, including identification of the resolution of all maintenance correctable issues as follows:~~ . *[Violation Risk Factor: High] [Time Horizon: Operations Planning]*

~~**R4.** Perform the maintenance activities for all Protection System components according to the PSMP established in accordance with Requirement R1:~~

~~**R5.** For time-based maintenance programs, perform maintenance activities no less frequently than the maximum allowable intervals established in Tables 1-1 through 1-5.~~

~~**R6.** For performance-based maintenance programs, perform the maintenance activities no less frequently than the intervals established in Requirement R3.~~

~~**R7.**~~**R3.** ~~Either verify that the components are within the acceptable parameters established in accordance with Requirement R1, Part 1.5 at the conclusion of the maintenance activities, or initiate resolution of any identified maintenance correctable issues.~~

C. Measures

~~**M1.**~~ Each Transmission Owner, Generator Owner and Distribution Provider shall have a current or updated documented Protection System Maintenance Program that addresses all component types of its Protection Systems, as required by Requirement R1. For each Protection System component type, the documentation shall include the type of maintenance program applied (time-based, performance-based, or a combination of these maintenance methods), maintenance activities, ~~and~~ maintenance intervals, and, for component types that use

monitoring to extend the intervals, the appropriate monitoring attributes as specified in Requirement R1, Parts 1.1 through 1.~~5~~4.

M1. ~~Each Transmission Owner, Generator Owner, and Distribution Provider that uses maintenance intervals for monitored Protection Systems shall have evidence such as engineering drawings or manufacturer's information showing that the components possess the monitoring attributes identified in Tables 1-1 through 1-5, as required by Requirement R2.~~

M2. Each Transmission Owner, Generator Owner, and Distribution Provider that uses a performance-based maintenance program shall have evidence which may include but not limited to ~~such as~~ equipment lists, dated maintenance records, and dated analysis records and results that its current performance-based maintenance program is in accordance with Requirement ~~R3~~R2.

M3. Each Transmission Owner, Generator Owner, and Distribution Provider shall have evidence ~~such as~~which may include but not limited to dated maintenance records, dated maintenance summaries, dated check-off lists, dated inspection records, or dated work orders as evidence that it has implemented the Protection System Maintenance Program and initiated resolution of identified maintenance correctable issues in accordance with Requirement ~~R4~~R3.

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance Monitoring Responsibility

Regional Entity

1.2. Compliance Monitoring and Enforcement Processes:

Compliance Audits

Self-Certifications

Spot Checking

Compliance Violation Investigations

Self-Reporting

Complaints

1.3. Data Retention

The Transmission Owner, Generator Owner, and Distribution Provider shall each keep data or evidence to demonstrate 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.

For Requirement R1, the Transmission Owner, Generator Owner, and Distribution Provider shall each keep its current dated Protection System Maintenance Program including the documentation that specifies the type of maintenance program applied for each Protection System component type.

~~For R2, the Transmission Owner, Generator Owner, and Distribution Provider shall each keep the evidence that proves the Protection System components possess the identified monitoring attributes as long as they are used to justify the intervals and activities associated with a performance-based maintenance program as identified within Tables 1-1 through 1-5.~~

For Requirement ~~R3~~ R2 and Requirement ~~R4~~R3, 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,~~-~~ or all performances of each distinct maintenance activity for the Protection System component since ~~or to~~ the previous scheduled audit date, whichever is longer.

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

1.4. Additional Compliance Information

None.

2. Violation Severity Levels

Requirement Number	Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	Failed to specify whether one component type is being addressed by time-based or performance-based maintenance. (~~Clause~~Part 1.2)	Failed to specify whether two component types are being addressed by time-based or performance-based maintenance. (~~Clause~~Part 1.2)	Failed to include station batteries in a time-based program (~~Clause~~Part 1.2) OR Failed to include all maintenance activities or intervals relevant for the identified monitoring attributes specified in Tables 1-1 through 1-5. (~~Clause~~Part 1.4) ~~OR~~ ~~Failed to establish calibration tolerance or equivalent parameters to determine if components are within acceptable parameters.~~	Entity has not established a PSMP. OR The entity's PSMP failed to address three or more component types included in the definition of 'Protection System' (~~Clause~~Part 1.1) OR Failed to specify whether three or more component types are being addressed by time-based or performance-based maintenance.
~~R2~~	~~Entity has Protection System components in a condition-based PSMP, but documentation to support the monitoring attributes used to determine relevant intervals is incomplete on no more than 5% of the Protection System components maintained according to Tables 1-1 through 1-5.~~	~~Entity has Protection System elements in a condition-based PSMP, but documentation to support monitoring attributes used to determine relevant intervals is incomplete on more than 5%, but 10% or less, of the Protection System components maintained according to Tables 1-1 through 1-5.~~	~~Entity has Protection System elements in a condition-based PSMP, but documentation to support monitoring attributes used to determine relevant intervals is incomplete on more than 10%, but 15% or less, of the Protection System components maintained according to Tables 1-1 through 1-5.~~	~~Entity has Protection System elements in a condition-based PSMP, but documentation to support monitoring attributes used to determine relevant intervals is incomplete on more than 15% of the Protection System components maintained according to Tables 1-1 through 1-5.~~
~~R3~~R2	Entity has Protection System elements in a performance-based PSMP but has: 1) ~~1)~~ Failed to reduce countable events to less than 4% within three years OR	NA	Entity has Protection System elements in a performance-based PSMP but has failed to reduce countable events to less than 4% within four years.	Entity has Protection System components in a performance-based PSMP but has: 1) Failed to establish the entire technical justification described within R3 and Attachment A for the initial use of the performance-based

Requirement Number	Lower VSL	Moderate VSL	High VSL	Severe VSL
	2) ~~2)~~ Failed to annually document program activities, results, maintenance dates, or countable events for 5% or less of components in any individual segment OR 3) Maintained a segment with 54-59 components or containing different manufacturers.			PSMP OR ~~1)~~2) Failed to reduce countable events to less than 4% within five years OR ~~2~~3) Failed to annually document program activities, results, maintenance dates, or countable events for over 5% of components in any individual segment OR ~~3~~4) Maintained a segment with less than 54 components OR ~~4~~5) Failed to: • Annually update the list of components, • Perform maintenance on the greater of 5% of the segment population or 3 components, • Annually analyze the program activities and results for each segment.
~~R4~~R3	Entity has failed to complete scheduled program on 5% or less of total Protection System components. OR Entity has failed to initiate resolution on 5% or less of identified maintenance~~-~~ correctable issues.	Entity has failed to complete scheduled program on greater than 5%, but no more than 10% of total Protection System components OR Entity has failed to initiate resolution on greater than 5%, but less than or equal to~~no more than~~ 10% of identified maintenance~~-~~	Entity has failed to complete scheduled program on greater than 10%, but no more than 15% of total Protection System components OR Entity has failed to initiate resolution on greater than 10%, but less than or equal to~~no more than~~ 15% of	Entity has failed to complete scheduled program on greater than 15% of total Protection System components OR Entity has failed to initiate resolution on greater than 15% of identified maintenance~~-~~ correctable

Requirement Number	Lower VSL	Moderate VSL	High VSL	Severe VSL
		correctable issues.	identified.	issues.

E. Regional Variances

None

F. Supplemental Reference Documents

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 2009~~February 2011.

~~1. NERC Protection System Maintenance Standard PRC-005-2 FREQUENTLY ASKED QUESTIONS — Practical Compliance and Implementation DRAFT 1.0 — June 2009~~

Version History

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

Table 1-1 Component Type - Protective Relay **Note:** Table requirements apply to all components of Protection Systems, UVLS and UFLS Systems, and SPSs except as noted.		
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. • 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 ~~that are also performing self monitoring and alarming~~ (see Table 2). • 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.

Table 1-2 **Component Type - Communications Systems** **Note:** Table requirements apply to all components of Protection Systems, UVLS and UFLS Systems, and SPSs except as noted.		
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.	3 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 ~~such as~~ signal level, reflected power, or data error rate). Verify essential signals to and from other 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 ~~such as~~ signal level, reflected power, or data error rate). Verify essential signals to and from other 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~~e.g. ~~such as~~ 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 **Note:** Table requirements apply to all components of Protection Systems, UVLS and UFLS Systems, and SPSs except as noted.		
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 ~~acceptable measurements of the~~ current and voltage ~~signals~~ signal values are ~~received by~~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.	No periodic maintenance specified	None.

Table 1-4 Component Type – Station dc Supply Note: Table requirements apply to all components of Protection Systems, UVLS and UFLS Systems, and SPSs except as noted.		
Component Attributes	**Maximum Maintenance Interval**	**Activities**
Any dc supply for a UFLS or UVLS system.	When control circuits are verified	Verify dc supply voltage
Any unmonitored station dc supply not having the monitoring attributes of a category below. (excluding UFLS and UVLS)	3 Calendar Months	Verify: • Station dc supply voltage Inspect: • Electrolyte level (excluding valve regulated lead acid batteries) • For unintentional grounds
	18 Calendar Months	Verify: • State of charge of the individual battery cells/units • Float voltage of battery charger • Battery continuity • Battery terminal connection resistance • Battery internal cell-to-cell or unit-to-unit connection resistance (where available to measure) 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 • Condition of non-battery-based dc supply
Any unmonitored Station dc supply in which a battery is not used and not having the monitoring attributes of a category below. (excluding UFLS and UVLS)	6 Calendar Years	Verify that the dc supply can perform as designed when ac power from the grid is not present.
Unmonitored Station dc supply with Valve Regulated Lead-Acid (VRLA) batteries that does not have the monitoring attributes of a category below. (excluding UFLS and UVLS)	3 Calendar Months	Verify that the station battery can perform as designed by evaluating the measured cell/unit internal ohmic values to station battery baseline.

Table 1-4 Component Type – Station dc Supply Note: Table requirements apply to all components of Protection Systems, UVLS and UFLS Systems, and SPSs except as noted.		
Component Attributes	**Maximum Maintenance Interval**	**Activities**
	or	
	3 Calendar Years	Verify that the station battery can perform as designed by conducting a performance or service capacity test of the entire battery bank.
Unmonitored Station dc supply with Vented Lead-Acid Batteries (VLA) that does not have the monitoring attributes of a category below. (excluding UFLS and UVLS)	18 Calendar Months	Verify that the station battery can perform as designed by evaluating the measured cell/unit internal ohmic values to station battery baseline.
	or	
	6 Calendar Years	Verify that the station battery can perform as designed by conducting a performance, service, or modified performance capacity test of the entire battery bank.
Unmonitored Station dc supply with Nickel-Cadmium (Ni-Cad) batteries that does not have the monitoring attributes of a category below. (excluding UFLS and UVLS)	6 Calendar Years	Verify that the station battery can perform as designed by conducting a performance service, or modified performance capacity test of the entire battery bank.
Monitored Station dc supply (excluding UFLS and UVLS) with: Monitor and alarm for variations from defined levels (See Table 2): • Station dc supply voltage (voltage of battery charger) • State of charge of the individual battery cell/units • Battery continuity of station battery • Cell-to-cell (if available) and battery terminal resistance	18 calendar months	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 • Condition of non-battery-based dc supply

Table 1-4 Component Type – Station dc Supply Note: Table requirements apply to all components of Protection Systems, UVLS and UFLS Systems, and SPSs except as noted.		
Component Attributes	**Maximum Maintenance Interval**	**Activities**
• Electrolyte level of all cells in a station battery • Unintentional dc grounds • Cell/unit internal ohmic values of station battery	6 calendar years	Verify that the monitoring devices are calibrated (where necessary)
Continuously monitored Station dc supply (excludes UFLS and UVLS) with preceding row attributes and the following: • The monitoring devices themselves are monitored.	18 calendar months	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 • Condition of non-battery-based dc supply

Table 1-4(a) Component Type - Station dc Supply Using Vented Lead-Acid (VLA) Batteries		
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Station dc supply with **Vented Lead-Acid (VLA) batteries** not having monitoring attributes of Table 1-4(f). Station dc supply for distribution breakers for UFLS or UVLS are excluded (see Table 1-4(e)).	3 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 - Station dc Supply Using Valve-Regulated Lead-Acid (VRLA) Batteries		
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Station dc supply **with Valve Regulated Lead-Acid (VRLA) batteries** not having monitoring attributes of Table 1-4(f). Station dc supply for distribution breakers for UFLS or UVLS are excluded (see Table 1-4(e)).	3 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(c) Component Type - Station dc Supply Using Nickel-Cadmium (NiCad) Batteries		
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Station dc supply **Nickel-Cadmium (NiCad) batteries** not having monitoring attributes of Table 1-4(f). Station dc supply for distribution breakers for UFLS or UVLS are excluded (see Table 1-4(e)).	3 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. • Physical condition of battery rack
	6 Calendar Years	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 - Station dc Supply Using Non Battery Based Energy Storage		
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Any station dc supply not using a battery and not having monitoring attributes of Table 1-4(f). Station dc supply for distribution breakers for UFLS or UVLS are excluded (see Table 1-4(e)).	3 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 - Station dc Supply for Distribution Breakers		
Component Attributes	**Maximum Maintenance Interval**	**Maintenance Activities**
Any dc supply for tripping only distribution breakers as part of a UFLS or UVLS system, or SPS and not having monitoring attributes of Table 1-4(f).	When control circuits are verified	Verify: • Station dc supply voltage~~Verify:~~ ~~dc supply voltage~~

Table 1-4(f) Exclusions for 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 ~~6 calendar years~~ ~~6 calendar years~~ ~~6 calendar years~~ ~~6 calendar years~~ ~~6 calendar years~~ ~~6 calendar years~~	No periodic verification of station ~~battery charger~~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 ~~verification~~ 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 ~~verification~~ 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.~~Any battery based station dc supply with monitoring and alarming of the state of charge of the battery system (See Table 2)~~		No periodic verification of float voltage of battery charger is required~~No periodic verification of the battery state of charge 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 ~~string~~ continuity is required.
Any battery based station dc supply with monitoring and alarming of the ~~Cell to~~ intercell and/or terminal connection detail resistance of the entire battery (See Table 2)		No periodic verification of the ~~cell to~~ intercell and terminal connection resistance is required.
Any lead acid battery based station dc supply with monitoring and alarming of internal Ohmic values of every cell (if available for measurement) or each unit and alarming when any cell/unit deviates by an unacceptable value from the -baseline internal ohmic value. (See Table 2)		No periodic measurement and comparison to baseline of battery cell/unit internal ohmic values for VRLA batteries and VLA batteries where the cells are not visible are required. ~~verification of each cell or unit's Ohmic resistance is required~~.

Table 1-5 Component Type - Control Circuitry **Note:** Table requirements apply to all components of Protection Systems, UVLS and UFLS 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 (excluding UFLS or UVLS systems).	6 calendar years	Verify that each trip coil is able to operate the circuit breaker, interrupting device, or mitigating device.
Trip coils of circuit breakers and interrupting devices in UFLS or UVLS systems.	No periodic maintenance specified	None.
Electromechanical ~~trip or~~ lockout and/or tripping auxiliary devices which are directly in a trip path from the protective relay to the interrupting device trip coil.	6 calendar years	Verify electrical operation of electromechanical trip and auxiliary devices.
Unmonitored ~~Control~~ control circuitry associated with protective functions.	12 calendar years	Verify all paths of the control and trip circuits.
Control circuitry whose continuity and energization or ability to operate are monitored and alarmed (See Table 2).	No periodic maintenance specified	None.

Table 2 – Alarming Paths and Monitoring In Tables 1-1 through 1-5, 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 are conveyed from the alarm origin to the location ~~of~~ where corrective action can be initiated, and not having all the attributes of the ~~category~~ "Alarm Path with monitoring" category below. Alarms are ~~automatically~~ reported within 24 hours of DETECTION to a location where corrective action can be ~~taken~~initiated.	~~When alarm producing device or system is verified~~12 Calendar Years	Verify that the alarm path conveys alarm signals ~~are conveyed~~ to a location where corrective action can be ~~taken~~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 ~~taken~~initiated.	No periodic maintenance specified	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 included in each designated segment of the Protection System component population, with a minimum segment population of 60 components.
2. Maintain the components in each segment according to the time-based maximum allowable intervals established in Tables 1-1through 1-5 until results of maintenance activities for the segment are available for a minimum of 30 individual components of the segment.
3. Document the maintenance program activities and results for each segment, including maintenance dates and countable events[1] for each included component.
4. Analyze the maintenance program activities and results for each segment to determine the overall performance of the segment and develop maintenance intervals.
5. Determine the maximum allowable maintenance interval for each segment such that the segment experiences countable events on no more than 4% of the components within the segment, for the greater of either the last 30 components maintained or all 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 and segments and/or description if any changes occur within the segment.
2. Perform maintenance on the greater of 5% of the components (addressed in the performance based PSMP) in each segment or 3 individual components within the segment in each year.
3. For the prior year, analyze the maintenance program activities and results for each segment to determine the overall performance of the segment.
4. If the components in a Protection System segment maintained through a performance-based PSMP experience 4% or more countable events, develop, document, and implement an action plan to reduce the countable events to less than 4% of the segment population within 3 years.
5. Using the prior year's data, determine the maximum allowable maintenance interval for each segment such that the segment experiences countable events on no more than 4% of the components within the segment, for the greater of either the last 30 components maintained or all components maintained in the previous year.

~~[1] Countable events include any failure of a component requiring repair or replacement, any condition discovered during the verification activities in Table 1a through Table 1c which requires corrective action, or a Misoperation attributed to hardware failure or calibration failure.~~