Technical Justification

PRC-005-2 Protection System Maintenance

The purpose of the proposed PRC-005-2 Reliability Standard is 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. The proposed Reliability Standard further combines the legacy Reliability Standards PRC-005-1b, PRC-008-0, PRC-011-0, and PRC-017-0, as these legacy Reliability Standards have similar reliability goals and requirements. This purpose is consistent with NERC's goal to create and implement reliability standards that enable or support at least one of the eight, defined Reliability Principles. The requirements of the proposed PRC-005-1 Reliability Standard directly support the following Reliability Principles:

> Reliability Principle 1 – Interconnected bulk power systems shall be planned and operated in a coordinated manner to perform reliably under normal and abnormal conditions as defined in the NERC Standards.
>
> Reliability Principle 7 – The reliability of the interconnected bulk power systems shall be assessed, monitored, and maintained on a wide-area basis.

The existing PRC-005-1b, PRC-008-0, PRC-011-0, and PRC-017-0 Reliability Standards, as assessed by the NERC System Protection and Control Task Force (SPCTF) in its report of March 8, 2007, contain several fundamental flaws within the requirements. Within this assessment, the SPCTF asserts, for all four standards, that:

> *"The listed requirements do not provide clear and sufficient guidance concerning the maintenance and testing of the Protection Systems to achieve the commonly stated purpose which is "To ensure all transmission and generation Protection Systems affecting the reliability of the Bulk Electric System (BES) are maintained and tested.""*

And further recommends that:

- *"The standards should clearly state which power system elements are being addressed."*
- *"The requirements should reflect the inherent differences between different technologies of protection systems."*
- *"The terms maintenance programs and testing programs should be clearly defined in the glossary. The terms "maintenance" and "testing" are not interchangeable, and the requirements must be clear in their application. Additional terms may also have to be added to the glossary for clarity."*
- *"The requirements of the existing standards, as stated, support time-based maintenance and testing, and should be expanded to include condition-based and performance-based maintenance and testing. The R1.2 summary of maintenance and testing procedures needs to*

have some minimum defined sub-requirements to insure that the stated intent of the standards is met to support review by the compliance monitor," and

- *The SPCTF recommends that standards PRC-005-1b, PRC-008-0, PRC-011-0, and PRC-017-0 … be included in a new Standard Authorization Request for a single Protection System maintenance and testing standard.*

Relative to PRC-005-1, the Federal Energy Regulatory Commission (FERC), in Order 693 further directed in paragraph 1476:

"… the Commission directs the ERO to develop a modification to PRC–005–1 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. We further direct the ERO to consider FirstEnergy's and ISO–NE's suggestion to combine PRC–005–1, PRC–008–0, PRC–011–0, and PRC–017–0 into a single Reliability Standard through the Reliability Standards development process."

FERC offered, in paragraphs 1492, 1517, and 1547, similar directives regarding PRC-008-0, PRC-011-0, and PRC-017-0, respectively.

With the development of the proposed PRC-005-2 Reliability Standard, the Standard Drafting Team (SDT) for Project 2007-17 – Protection System Maintenance, has followed the observations and recommendation of the NERC SPCTF assessment of PRC-005-1, PRC-008-0, PRC-011-0, and PRC-017-0. The SDT also addressed FERC's directives from Order 693. The SDT accomplishes this by:

1. Merging the reliability objectives of the four legacy standards.
2. Establishing minimum acceptable maintenance activities and accompanying maximum allowable maintenance intervals, reflecting various technologies of the Components being addressed.
3. Providing entities the flexibility to implement condition-based maintenance by adjusting the minimum acceptable maintenance activities and maximum allowable maintenance intervals to reflect condition monitoring of the various Protection System Components, and
4. Providing requirements for effective implementation of a performance-based maintenance program.

The proposed PRC-005-2 Reliability Standard includes five requirements that:

1. Combine the reliability goals of developing detailed tables of minimum maintenance activities and maximum maintenance intervals for all five Component Types addressed within the NERC definition of Protection System. These tables include adjustments to those activities and intervals to reflect the benefits of any condition monitoring that may be present.

2. Require, within Requirement R1, that entities using a time-based maintenance program (which includes condition-based maintenance) shall establish a Protection System Maintenance Program (PSMP) that conforms to the tables described above.
3. Establish, within Requirement R2, the opportunity and requirements for establishment of a performance-based maintenance program for those entities that have (or wish to develop) sufficient performance observations for their Protection System Components such that they may determine maintenance intervals other than those specified within the tables while maintaining the level of reliability prescribed within the Standard.
4. Require, within Requirements R3 and R4, that entities fully implement their PSMP as determined pursuant to Requirement R1 for time-based maintenance programs and Requirement R2 for performance-based maintenance programs, respectively.
5. Further require, within Requirement R5, that entities demonstrate efforts to correct any deficiency identified during a maintenance interval that causes the Component to not meet the intended performance and requires follow-up corrective action in order to return it to good working order. The SDT elected to not require that entities complete the resolution of these issues, as the time required to effectively resolve the problems may vary widely depending on the scope of that resolution.

The proposed PRC-005-2 Reliability Standard provides a comprehensive set of requirements and associated information (within the tables) that define a strong PSMP. Entities that monitor the actual condition of their Protection System Components are further empowered to utilize the monitoring to improve the efficiency and effectiveness of their PSMP, and those entities that have extensive performance data regarding their Protection System Components can utilize that performance data to further improve the efficiency and effectiveness of their PSMP.

Requirement R1:

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: Operations Planning]*

The PSMP shall:

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. 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 and Table 3.*

1.2. *Include 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 where monitoring is used to extend the maintenance intervals beyond those specified for unmonitored Protection System components.*

Background and Rationale

Establishment of a Protection System Maintenance Program as directed by Requirement R1 is needed to detect and correct plausible age- and service-related degradation of Protection System components. To ensure reliability of the Bulk Electric System, it is important that a Protection System continue to function as designed over its service life.

Requirement R1 establishes that entities develop a comprehensive maintenance program for Protection System components addressing the elements specified in the Protection System Maintenance Program definition:

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 — Examine for 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.

Maintenance and testing programs often incorporate the following types of maintenance practices:

- TBM – time-based maintenance – externally prescribed maximum maintenance or testing intervals are applied for components or groups of components. The intervals may have been developed from prior experience or manufacturers' recommendations. The TBM verification interval is based on a variety of factors, including experience of the particular asset owner, collective experiences of several asset owners who are members of a country or regional council, etc. The maintenance intervals are fixed, and may range in number of months or in years.

  TBM can include review of recent power system events near the particular terminal. Operating records may verify that some portion of the Protection System has operated correctly since the last test occurred. If specific protection scheme components have demonstrated correct performance within specifications, the maintenance test time clock can be reset for those components.

- PBM – Performance-Based Maintenance - intervals are established based on analytical or historical results of TBM failure rates on a statistically significant population of similar components. Some level of TBM is generally followed. Statistical analyses accompanied by adjustments to maintenance intervals are used to justify continued use of PBM-developed extended intervals when test failures or in-service failures occur infrequently.

- CBM – condition-based maintenance – continuously or frequently reported results from non-disruptive self monitoring of components demonstrate operational status as those components remain in service. Whatever is verified by CBM does not require manual testing, but taking advantage of this requires precise technical focus on exactly what parts are included as part of the self diagnostics. While the term "Condition-Based-Maintenance" (CBM) is no longer used within the Standard itself, it is important to note that the concepts of CBM are a part of the Standard (in the form of extended time intervals through status-monitoring). These extended time intervals are only allowed (in the absence of PBM) if the condition of the device is monitored (CBM). As a consequence of the "monitored-basis-time-intervals" existing within the Standard the explanatory discussions within this Supplementary Reference concerned with CBM will remain in this reference and are discussed as CBM.

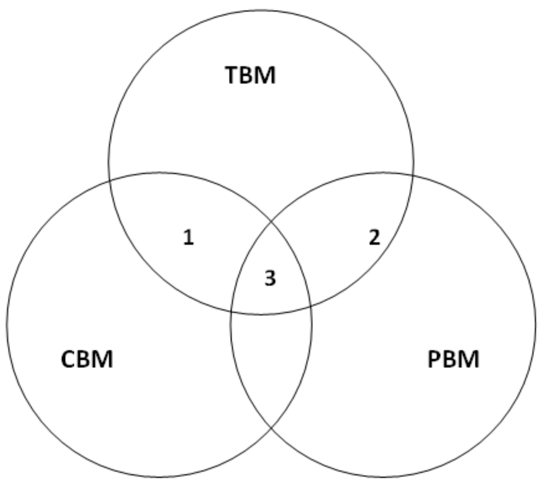
  A key feature of condition-based monitoring is that it effectively reduces the time delay between the moment of a protection failure and time the protection system owner knows about it, for the monitored segments of the protection system. In some cases, the verification is practically continuous - the time interval between verifications is minutes or seconds. Thus, technically sound, condition-based verification, meets the directives of FERC Order 693 even more effectively than the strictly time-based tests of the same system components.

  Microprocessor based Protection System components that perform continuous self-monitoring verify correct operation of most components within the device. Self-monitoring capabilities may include battery continuity, float voltages, unintentional grounds, the ac signal inputs to a relay, analog measuring circuits, processors and memory for measurement, protection, and data communications, trip circuit monitoring, and protection or data communications signals (and many, many more measurements). For those conditions, failure of a self-monitoring routine generates an alarm and may inhibit operation to avoid false trips. When internal components, such as critical output relay contacts, are not equipped with self-monitoring, they can be manually tested. The method of testing may be local or remote, or through inherent performance of the scheme during a system event.

TBM, PBM, and CBM can be combined for individual components, or within a complete Protection System. The following diagram illustrates the relationship between various types of maintenance practices described in this section. In the Venn diagram the overlapping regions show the relationship of TBM with PBM historical information and the inherent continuous monitoring offered through CBM.

This figure shows:

- Region 1: The TBM intervals that are increased based on known reported operational condition of individual components that are monitoring themselves.
- Region 2: The TBM intervals that are adjusted up or down based on results of analysis of maintenance history of statistically significant population of similar products that have been subject to TBM.
- Region 3: Optimal TBM intervals based on regions 1 and 2.



Relationship of time-based maintenance types

The PSMP shall:

R1, Part 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.

R1, Part 1.1 gives entities the flexibility to choose between the various methods listed above to maintain their Protection System equipment.

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 and Table 3.

Batteries are the only element of a Protection System that is a perishable item with a shelf life. As a perishable item batteries require not only a constant float charge to maintain their freshness (charge), but periodic inspection to determine if there are problems associated with their aging process and testing to see if they are maintaining a charge or can still deliver their rated output as required.

Besides being perishable, a second unique feature of a battery that is unlike any other Protection System element is that a battery uses chemicals, metal alloys, plastics, welds, and bonds that must interact with each other to produce the constant dc source required for Protection Systems, undisturbed by ac system disturbances.

No type of battery manufactured today for Protection System application is free from problems that can only be detected over time by inspection and test. These problems can arise from variances in the manufacturing process, chemicals and alloys used in the construction of the individual cells, quality of welds and bonds to connect the components, the plastics used to make batteries and the cell forming process for the individual battery cells.

Other problems that require periodic inspection and testing can result from transportation from the factory to the job site, length of time before a charge is put on the battery, the method of installation, the voltage level and duration of equalize charges, the float voltage level used, and the environment that the battery is installed in.

All of the above mentioned factors and several more not discussed here are beyond the control of the Functional Entities that want to use a performance-based Protection System Maintenance (PBM) program. These inherent variances in the aging process of a battery cell make establishment of a designated segment based on manufacturer and type of battery impossible.

R1, Part 1.2 Include the applicable monitored Component 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 where monitoring is used to extend the maintenance intervals beyond those specified for unmonitored Protection System Components.

It is necessary for entities to specify the monitoring attributes utilized in their PSMP to demonstrate the existence of the monitoring elements which permit using the extended maintenance intervals established in Tables 1-1 through 1-5, Table 2, and Table 3 of the standard.

All maintenance is fundamentally time-based. Default time-based intervals are commonly established to assure proper functioning of each component of the Protection System, when data on the reliability of the components is not available other than observations from time-based maintenance. Excessive maintenance can actually decrease the reliability of the component or system. It is not unusual to cause failure of a component by removing it from service and restoring it. The improper application of test signals may cause failure of a component. Making use of the extended intervals by employing component monitoring minimizes human performance errors. The following factors may influence the established default intervals:

- If continuous indication of the functional condition of a component is available (from relays or chargers or any self monitoring device), then the intervals may be extended or manual testing may be eliminated. This is referred to as condition-based maintenance or CBM. CBM is valid only for precisely the components subject to monitoring. In the case of microprocessor-based relays, self-monitoring may not include automated diagnostics of every component within a microprocessor.
- Previous maintenance history for a group of components of a common type may indicate that the maintenance intervals can be extended while still achieving the desired level of performance. This is referred to as Performance-Based Maintenance or PBM. It is also sometimes referred to as reliability-centered maintenance or RCM, but PBM is used in this document.
- Observed proper operation of a component may be regarded as a maintenance verification of the respective component or element in a microprocessor-based device. For such an observation, the maintenance interval may be reset only to the degree that can be verified by data available on the operation. For example, the trip of an electromechanical relay for a fault verifies the trip contact and trip path, but only through the relays in series that actually operated; one operation of this relay cannot verify correct calibration.

<u>Requirement R2:</u>

Overview

Requirement 2, stated below, deals with Performance Based Maintenance. The requirement refers to Attachment A. Rather than simply list Attachment A, the requirements of Attachment A are listed below with a technical justification discussion for each. The criteria within Attachment A are largely based on application of statistical analysis theory.

Requirement R2

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]*

Background and Rationale

Performance Based Maintenance (PBM) is included in PRC-005-2 to allow utilities to adjust maintenance intervals based on their individual experience with equipment types and manufacture. The utility must create a segment of components with similar manufacture and model characteristics of statistically significant size.

Based on equipment failure(s) and out-of-tolerance(s), called Countable Events, in any given year, the utility then sets its maintenance interval to keep the Countable Events below 4%. Performance Based Maintenance is discussed at length in Section 9.1 of the Supplemental Reference for PRC-005-2. Many of the technical justifications shown below come from of the Supplemental Reference. Each requirement of Attachment A will now be listed and individually discussed.

> **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 must contain at least sixty (60) individual components.*

> **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 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.*

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.

   A sample size requirement can be estimated using the bound on the Error of Distribution Formula when the expected result is of a "Pass/Fail" format and will be between 0 and 1.0.

The Error of Distribution Formula is:

$$B = z\sqrt{\frac{\pi(1-\pi)}{n}}$$

Where:

B = bound on the error of distribution (allowable error)

z = standard error

π = expected failure rate

n = sample size required

Solving for n provides:

$$n = \pi(1-\pi)\left(\frac{z}{B}\right)^2$$

One entity's population of components should be large enough to represent a sizeable sample of a vendor's overall population of manufactured devices. For this reason the following assumptions are made:
B = 5%
z = 1.96 (This equates to a 95% confidence level)
π = 4% (see number 5 below)
Using the equation above, n=59.0. The Standard Drafting Team chose to use the round number of 60 for the requirement.

2. Maintain the Components in each 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 are available for a minimum of 30 individual Components of the Segment.

   An assumption that needs to be made when choosing a sample size is "the sampling distribution of the sample mean can be approximated by a normal probability distribution." The Central Limit Theorem states: "In selecting simple random samples of size *n* from a population, the sampling distribution of the sample mean *x* can be approximated by a normal probability distribution as the sample size becomes large." (Essentials of Statistics for Business and Economics, Anderson, Sweeney, Williams, 2003)

   To use the Central Limit Theorem in statistics, the population size should be large. The references below are supplied to help define what is large.

"… whenever we are using a large simple random sample (rule of thumb: n>=30), the central limit theorem enables us to conclude that the sampling distribution of the sample mean can be approximated by a normal distribution." (Essentials of Statistics for Business and Economics, Anderson, Sweeney, Williams, 2003)

"If samples of size n, when n>=30, are drawn from any population with a mean *u* and a standard deviation σ, the sampling distribution of sample means approximates a normal distribution. The greater the sample size, the better the approximation." (Elementary Statistics - Picturing the World, Larson, Farber, 2003)

"The sample size is large (generally n>=30)… (Introduction to Statistics and Data Analysis - Second Edition, Peck, Olson, Devore, 2005)

"… the normal is often used as an approximation to the *t* distribution in a test of a null hypothesis about the mean of a normally distributed population when the population variance is estimated from a relatively large sample. A sample size exceeding 30 is often given as a minimal size in this connection." (Statistical Analysis for Business Decisions, Peters, Summers, 1968)

3. Document the maintenance program activities and results for each Segment, including maintenance dates and Countable Events for each included Component.

   This requirement needs little justification. To analyze system performance, the activities and results must be documented.
4. Analyze the maintenance program activities and results for each Segment to determine the overall performance of the Segment and develop maintenance intervals.

   This requirement states the obvious for a program that is based on the performance results of the Segment.

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.

   The Performance Based Maintenance (PBM) program ensures no more than a 4% failure rate for each segment of a Component Type. The 4% number was developed using the following:
   - General experience of the Standard Drafting Team (SDT) based on open discussions of past performance.

- Test results provided by Consumers Energy for the years 1998-2008 showing a yearly average of 7.5% out-of-tolerance relay test results and a yearly average of 1.5% defective rate.
- Two failure analysis reports from Tennessee Valley Authority (TVA) where TVA identified problematic equipment based on a noticeably higher failure of a certain relay type (failure rate of 2.5%) and voltage transformer type (failure rate of 3.6%).

In addition to the number "30" discussion from number 2 above, the Error of Distribution formula discussed in number 1 above allows the number of Components that should be included in a sample size for evaluation of the appropriate testing interval to be smaller because a lower confidence level is acceptable since the sample testing is repeated or updated annually. For this reason, the following assumptions are made:
B = 5%
z = 1.44 (85% confidence level)
π = 4%
Using the equation above, n=31.8. The Standard Drafting Team chose to use the round number of 30.

6. At least annually, update the list of Protection System Components and Segments and/or description if any changes occur within the Segment.

   Annually was chosen as a reasonable time frame to update Component Segments due to Component installation, replacement, and retirement.

7. 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.

   Note: this 5% threshold sets a practical limitation on total length of time between intervals at 20 years.

   This requirement ensures that a utility keeps a flow of recent data to use in its annual analysis. The Standard Drafting Team felt that 20 years was the maximum time that should be allowed before a Component should be checked or maintained. The minimum number of three allows for the same 20 years interval based on the minimum Segment population of 60 (60/3=20).
8. For the prior year, analyze the maintenance program activities and results for each segment to determine the overall performance of the segment.

   Annually was chosen as a reasonable time frame to allow for collection of new data to update the program's performance analysis.
9. 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.

Refer to number 5 above.

10. 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.

    The 4% number is discussed in number 5 above. Three years was chosen by the Standard Drafting Team because it allows time to modify the program and for the effects of a modified program to be observed.

Requirement R3:

R3. Each Transmission Owner, Generator Owner, and Distribution Provider that utilizes time-based maintenance programs 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]*

Background and Rationale

NERC Reliability Principle 1 establishes that "Interconnected bulk power systems shall be planned and operated in a coordinated manner to perform reliably under normal and abnormal conditions as defined in the NERC Standards."

NERC Reliability Principle 7 establishes that "The reliability of the interconnected bulk power systems shall be assessed, monitored, and maintained on a wide-area basis."

The proper performance of Protection Systems is fundamental to the reliability of the Bulk Electric System (BES) as embodied in Reliability Principles 1 and 7, and proper performance of Protection Systems cannot be assured without periodic maintenance of those systems.

Therefore, Requirement R3 requires the implementation of the minimum maintenance activities and maximum allowable maintenance intervals as elucidated in Requirement R1 and the tables within the standard.

Requirement R4:

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

Background and Rationale

NERC Reliability Principle 1 establishes that “Interconnected bulk power systems shall be planned and operated in a coordinated manner to perform reliably under normal and abnormal conditions as defined in the NERC Standards.”

NERC Reliability Principle 7 establishes that “The reliability of the interconnected bulk power systems shall be assessed, monitored, and maintained on a wide-area basis.”

The proper performance of Protection Systems is fundamental to the reliability of the Bulk Electric System (BES) as embodied in Reliability Principles 1 and 7, and proper performance of Protection Systems cannot be assured without periodic maintenance of those systems.

Therefore, Requirement R4 requires the implementation of an entity’s Protection System Maintenance Program established pursuant to Requirement R2.

Requirement R5:

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]*

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

Background and Rationale

The reliability objective of this requirement is to assure that Protection System Components are returned to working order following the discovery of failures or malfunctions during scheduled maintenance. The maintenance activities specified in the Tables 1-1 through 1-5, Table 2, and Table 3 do not present any requirements related to restoration; therefore Requirement R5 of the Standard was developed to require the entity to “demonstrate efforts to correct identified Unresolved Maintenance Issues”.

The SDT does not believe entities should be found in violation of a maintenance program requirement because of the inability to complete a remediation program within the original maintenance interval. The SDT does believe corrective actions should be timely but concludes it would be impossible to postulate all possible remediation projects and therefore, impossible to specify bounding time frames for resolution of all possible unresolved maintenance issues or what documentation might be sufficient to provide proof that effective corrective action has been initiated. Therefore Requirement R5 requires only the entity demonstrate efforts to correct the Unresolved Maintenance Issues.

Management of completion of the identified unresolved maintenance issue is a complex topic that falls outside of the scope of this standard. There can be any number of supply, process and management problems that make setting repair deadlines impossible. The SDT specifically chose to require the entity to "demonstrate efforts to correct …" because of the concern that many more complex unresolved maintenance issues might require greater than the remaining maintenance interval to resolve. For example, a problem might be identified on a VRLA battery during a 6 month check. In instances such as one that requiring battery replacement as part of the long term resolution, it is highly unlikely that the battery could be replaced in time to meet the 6 calendar month requirement for this maintenance activity.

During the period of time that the Protection System is operating in a degraded mode, NERC Standard PRC-001-1 requires that operating entities be informed of any Protection System failures that reduce reliability, and several NERC IRO-series and TOP-series standards require that operating entities operate the system in a manner that assures reliability while recognizing any system degradation.