



EAGLE EYE WHITE PAPER

Title	Differences between the IEEE Stationary Battery Maintenance Standards and NERC PRC-005 Requirements with Respect to Load Testing
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Revision History

Date	Revision	Change Description	Author(s)
8/5/20	0	Original document	AB

Overview

In 2011, the North American Electric Reliability Corporation (NERC) released the Protection System Maintenance Standard, PRC-005-2. NERC comes under the Federal Energy Regulatory Commission (FERC). The mission of NERC is to ensure the reliability of the bulk power system in the USA and Canada.

FERC is an independent government agency that is part of the Department of Energy. The purpose of the FERC is to protect the public and energy customers, ensuring that regulated energy companies are acting within the law.

The purpose of PRC-005 (now in the 6th revision, PRC-005-6), 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. Compliance is mandatory. NERC defines reliability as Ensuring that the Bulk Power System (BPS) or Bulk Electric System (BES) is able to meet the electricity needs of all end-user customers, even when unexpected equipment failures reduce the amount of available electricity.

Batteries that are used in conjunction with protection systems, fall under the requirements of PRC-005-6. The maintenance requirements for protection system dc supply using Vented Lead-Acid (VLA) and Valve-Regulated Lead-Acid (VRLA) batteries are detailed in Tables 1-4(a), 1-4(b) and 1-4(f) of the document.

There are considerable differences with respect to load testing between the requirement of PRC-005-6, IEEE 450-2010, the *IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications*. And IEEE 1188-2005, the *IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid Batteries for Stationary Applications*.

PRC-005-6

The contents of Table 1-4(a) state the following regarding load and performance testing of VLA batteries.

Maximum of every 18 months.

Verify that the station battery can perform as manufactured by evaluating cell/unit measurements indicative of battery performance (e.g. internal ohmic values or float current) against the station battery baseline.

Or:

Maximum of every 6 years.

Verify that the station battery can perform as manufactured by conducting a performance or modified performance capacity (load) test of the entire battery bank.

Table 1-4(f) lists the exclusions for Protection System dc Supply (having) Monitoring Systems and Devices.

The contents of Table 1-4(f) include the following statement:

- “Any Valve Regulated Lead-Acid (VRLA) or Vented Lead-Acid (VLA) station battery with internal ohmic value or float current monitoring and alarming and evaluating present values relative to baseline internal ohmic values for every cell/unit.
 - No periodic evaluation relative to baseline of battery cell/unit measurements indicative of battery performance is required to verify the station battery can perform as manufactured.”

Note. See author’s comment in the Summary section of this document.

What does IEEE 450-2010 recommend?

Section 6. Performance Testing.

- a) A performance test of the battery capacity should be made within the first two years of service. It is desirable for comparison purposes that the performance tests be similar in duration to the battery duty cycle.
- b) Batteries should undergo additional performance tests periodically. When establishing the interval between tests, factors such as design life and operating temperature should be considered. It is recommended that the performance test interval should not be greater than 25% of the expected service life.
- c) Annual performance tests of battery capacity should be made on any battery that shows signs of degradation or has reached 85% of the service life expected for the application.

In view of the above, it is noted that the requirements of PRC-005-2 are much less stringent than those of IEEE 450-2010. In particular:

IEEE 450-2010 recommends that performance (load) testing be carried out within the first two years and at periods of not greater than 25% of expected service life. PRC-005-2 only requires a performance test every six years and none if ohmic measurements are taken every 18 months and/or float current is monitored. There is also no requirement for a performance test if the battery has degraded to 85% of service life.

PRC-005-6

The contents of Table 1-4(b) state the following regarding load and performance testing of VRLA batteries.

Every 6 calendar months:

Verify that the station battery can perform as manufactured by evaluating cell/unit measurements indicative of battery performance (e.g. internal ohmic values or float current) against the station battery baseline.

Or:

Every 3 calendar years.

Verify that the station battery can perform as manufactured by conducting a performance or modified performance capacity (load) test of the entire battery bank.

What does IEEE 1188-2005 recommend?

In Section 6, Test description and schedule, under 6.3 Performance

“A performance test of the battery capacity should be made upon installation. It is desirable for

comparison purposes that the performance tests be similar in duration to the battery duty cycle.”

(Author’s note. A performance test is a load test. PRC-005-6 does not address any testing before a system is put into service.)

“Batteries should undergo additional performance tests periodically. When establishing the interval between tests, factors such as design life and operating temperature should be considered. It is recommended that the performance test interval should not be greater than 25% of the expected service life or two years, whichever is less. The expected service life may be significantly less than the warranty period. The recommended interval assumes that an on-site acceptance test was performed with acceptable results.

Acceptable results are defined as the capacity of each cell exceeding 90%, and the capacity of all cells are within 10% of the average cell performance. For batteries that were not acceptance tested on site or had unacceptable results, the first performance test should be given within one year of installation. Capacity testing may also be warranted within the recommended interval where internal ohmic values have changed significantly between readings and/or significant physical changes have occurred to the cells (e.g., leakage, bulging, etc.).”

Annual performance tests of battery capacity should be made on any battery that shows signs of degradation or has reached 85% of the service life expected for the application. Degradation is indicated when the battery capacity drops more than 10% from its capacity on the previous performance test or is below 90% of the manufacturer’s rating.”

Summary

In view of the above, the author recommends that in order to properly and adequately maintain a VLA or VRLA battery plant, the requirements of IEEE 450-2010 and IEEE 1188-2005 should be followed with respect to load testing. PRC-005-2, while a step in the right direction, in the opinion of this author, does not adequately provide for satisfactory battery maintenance. If a permanent monitor is installed, then this is a big improvement with respect to reliability as charger and battery degradation can be observed in a real-time basis. However, to do this, any alarms must be analyzed by experienced personnel who must routinely interpret the monitored data.

Although there is some correlation between ohmic measurement and battery state of health (SOH), there is absolutely no correlation between ohmic measurement and battery capacity. PRC 005 seems to indicate that there is, and with that and trending, it can be a substitute for performance load testing. The only way to determine battery performance is to conduct a load test.

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