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1.0 PURPOSE:

This maintenance standard establishes general practices for routine preventative maintenance of batteries and battery chargers utilized at the Company's electric generating plants.

2.0 APPLICABILITY:

2.1 This standard addresses all aspects of routine maintenance and recommended maintenance intervals.

2.2 Xcel Energy Generating Plants have a large variety of battery types and battery applications. This standard is primarily directed toward the maintenance of large strings of flooded cells of either the vented lead acid, lead calcium, lead antimony, or lead selenium type. As such, IEEE Standard 450 – “IEEE Recommended Practice for Maintenance, Testing and Replacement of Vented Lead Acid Batteries for Stationary Applications” provides, in general, the basis for both the content and the frequency of performance of the battery maintenance and testing procedures set forth in this Energy Supply Maintenance Standard. Any deviations between the requirements contained in this standard and the specific IEEE Standard 450 recommendations are within the allowable program considerations discussed in Section 1.2 of IEEE Standard 450. Maintenance activities specific to other types of batteries such as valve regulated lead acid batteries that are used in these applications in power plants have also been included in the program. Proper functioning of battery chargers is validated by observing that the battery charger maintains connected batteries in a fully charged condition by its ability to maintain a proper float voltage on the battery.

For batteries and battery chargers serving as part of a NERC PRC-005 related Protection System, the maintenance activities and maximum allowable intervals of this standard meet or are more restrictive than the NERC Standard PRC-005 for minimum maintenance activities and maximum maintenance intervals for batteries and battery chargers. NERC PRC-005 related batteries and chargers SHALL be maintained per this standard and are on a time-based maintenance program with intervals not to exceed the PRC-005 specified maintenance intervals for unmonitored components.

2.3 This standard applies to batteries and battery chargers used in the following applications:


2.3.1 24 V, 48 V, 125 V or 250 VDC Station Service Batteries

2.3.2 UPS batteries

2.4 Some provisions of this document may be applicable to other battery types and applications. Compliance with this standard for these additional battery types and

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applications is at the discretion of the power plant for non-NERC PRC-005 related batteries.

3.0 RESPONSIBILITIES:

- 3.1 Performance Optimization is responsible for assigning a Fleet Engineering staff member in each region to serve as the Battery Maintenance subject matter expert, (SME)
- 3.2 The facility director and Performance Optimization management should collaborate and designate an individual to serve as a Site Electrical Maintenance Coordinator, (Site EMC), for each site. The Site EMC responsibilities will, in part, include administration of the requirements identified in Section 4.0 below.

Most frequently the Site EMC will be the electrical Performance Optimization Reliability Engineer assigned to the site. Alternatively, if there is not an electrical Performance Optimization Reliability Engineer assigned to the site, a Maintenance Planner, Operations Support Manager, Station Electrician, or a Performance Optimization Fleet Engineer may be assigned to fulfill this role.


4.0 REQUIREMENTS:

The following maintenance and testing activities are identified for implementation of the battery maintenance program and shall be used by plant management, engineering, operations, and maintenance personnel to assure reliable operations of station DC systems:

- 4.1 Monthly Inspections:
 - 4.1.1 Plant electrical staff or other knowledgeable battery technician shall perform a monthly inspection of applicable batteries.
 - 4.1.2 The above work should be performed per Performance Optimization Maintenance Procedure, “Battery – Monthly Testing”. This procedure should be set up in the work and asset management program to be performed on each applicable station battery on a monthly basis. A copy of the procedure is available in [Energy Supply Policy/Procedure Toolbox](#).
- 4.2 Quarterly Inspections
 - 4.2.1 In addition to the monthly inspections, plant personnel or other knowledgeable battery technician shall also perform a quarterly inspection of applicable batteries.

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The above work should be performed per Performance Optimization Maintenance Procedure, “Battery – Quarterly Testing”. This procedure should be set up in the work and asset management program to be performed on each applicable station battery on a quarterly basis. A copy of the procedure is available in [Energy Supply Policy/Procedure Toolbox](#).

4.3 Annual Inspections:

4.3.1 In addition to the monthly and quarterly battery inspection requirements, plant electrical staff or other knowledgeable battery technicians shall perform a detailed annual inspection of applicable batteries.

4.3.2 The above work should be performed per Performance Optimization Maintenance Procedure, “Battery – Annual Testing”. This procedure should be set up in the work and asset management program to be performed on each applicable station battery on an annual basis. A copy of the procedure is available in [Energy Supply Policy/Procedure Toolbox](#).

4.4 Battery Capacity Tests

4.4.1 Plant electrical staff or knowledgeable battery technicians shall perform a battery capacity test at no longer than a 6-calendar year interval for Vented Lead Acid batteries or a 3-calendar year interval for Valve Regulated Lead Acid batteries.


4.4.2 The above work should be performed per Performance Optimization Maintenance Procedure, “Battery – Capacity Testing.” This procedure should be set up in the work and asset management program to be performed on each applicable station battery on an interval not to exceed that identified in Section 4.4.1 for that type of battery. A copy of the procedure is available in [Energy Supply Policy/Procedure Toolbox](#). As battery capacity tests frequently require a plant outage, plants should consider their typical maintenance outage interval when establishing the interval for the performance of battery capacity tests associated with a given unit.

4.5 For newly acquired plants, the following grace period is established to bring the facility's battery maintenance program into alignment with this Standard:

4.5.1 The newly acquired plant's NERC related battery system(s) SHALL have a Monthly and Quarterly Inspection performed per the procedures referenced in Sections 4.1 and 4.2 above within three months of assuming ownership of the facility.

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4.5.2 The newly acquired plant's NERC related battery systems SHALL have an Annual Inspection performed per the procedure referenced in Section 4.3 above within the first year of assuming ownership of the facility.

4.5.3 The newly acquired plant's NERC related battery system(s) SHALL have a Capacity Test performed per the procedure referenced in Section 4.4 above no later than the sooner of the end of first scheduled maintenance outage or within two years of assuming ownership of the facility unless test records are available from the previous owner's testing program to justify a later test date.

4.6 For batteries and battery chargers serving as part of a NERC PRC-005 related Protection System, the work and asset management shall call for the use of the Monthly, Quarterly, Annual, and Capacity Procedures or approved equivalent forms.

4.7 Plants shall maintain a listing of NERC PRC-005 related batteries and associated battery acceptance criteria. This Battery Acceptance Criteria document shall be kept current.

4.8 Identify any subsequent Work and Asset Management Work Orders issued to address and track any Unresolved Maintenance Issues.

5.0 REQUIRED RECORDS


5.1 The plant shall maintain copies of monthly and quarterly inspection data sheets in the plant maintenance files for at least 3 years. For NERC PRC-005 related batteries, the plant shall maintain copies of monthly and quarterly inspection data sheets for the longer of three years or since the last NERC Compliance audit.

5.2 The plant shall maintain copies of annual inspection completed procedure and data sheets in the plant maintenance files for at least 5 years. For NERC PRC-005 related batteries, the plant shall maintain completed copies of the annual inspection procedure and data sheets for the longer of five years or since the last NERC Compliance audit.

5.3 The plant shall maintain copies of battery capacity procedure and test data sheets in the plant maintenance files for the life of the battery or three years, whichever is longer. For NERC PRC-005 related batteries, the plant shall maintain completed copies of the completed capacity test procedure and data sheets for the longer of the life of the battery or since the last NERC Compliance audit.

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6.0 DEFINITIONS & REFERENCES

6.1 Definitions

6.1.1 Battery Monthly Inspection – A documented routine inspection of a battery and its charger that should be performed once each month of the year. If scheduling or resource issues prevent completion of a monthly inspection in each calendar month, the reason for the failure to complete the inspection on the normal monthly basis SHALL be documented on the associated Work Order or maintenance procedure and the monthly inspection SHALL be completed within the next calendar month. Technical Rationale for Monthly Inspection Time Allowance: IEEE Standard 450, Section 1.2 allows for some minor program deviations. Furthermore, the Monthly inspection delineated in the associated procedure contains all measurements required on a 4-calendar month interval by the current draft of PRC-005. As such, the one-month time allowance discussed in this paragraph still results in inspections on an interval roughly half of that allowed in the NERC PRC-005 standard. Furthermore, a NERC violation only occurs if a Battery Monthly Inspection is missed for 4 consecutive months


6.1.2 Battery Quarterly Inspection– A documented routine inspection of a battery and its charger that should be performed once each quarter of the year. If scheduling or resource issues prevent completion of a quarterly inspection, the reason for the failure to complete the inspection SHALL be documented on the associated Work Order or maintenance procedure and the quarterly inspection SHALL be completed in conjunction with the next monthly inspection.

Technical Rationale for Quarterly Inspection Time Allowance for Vented Lead Acid Batteries: IEEE Standard 450, Section 1.2 allows for some minor program deviations. Furthermore, the Quarterly inspection delineated in the associated procedure contains measurements required for Vented Lead Acid batteries on an 18-calendar month interval by the current revision of PRC-005. As such, the additional one-month time allowance discussed in the above paragraph still results in inspections on a not to exceed 4-month interval which is over 4 times as frequent at the 18-calendar month interval allowed in NERC PRC-005 standard. As such, a NERC violation only occurs if a Battery Quarterly Inspection is missed for 6 consecutive quarters for a Vented Lead Acid Battery and then only if the Annual Inspection for the associated battery was also missed.

Technical Rationale for Quarterly Inspection Time Allowance for Valve Regulated Lead Acid Batteries: The Quarterly inspection delineated in the associated procedure contains measurements required for Valve Regulated Lead Acid

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batteries on a 6-calendar month interval by the current version of PRC-005. As such, the additional one-month time allowance discussed in the above paragraph still results in inspections on a not to exceed 4-month interval which is still more frequent than the 6-calendar month allowed in the NERC PRC-005 standard. As such, a NERC violation only occurs if a Battery Quarterly Inspection is missed for 2 consecutive quarters for a Valve Regulated Lead Acid Battery.

6.1.3 Battery Annual Inspection – A documented and detailed inspection of a battery and its charger that should be performed on a one-year interval. If scheduling or resource issues prevent completion of the annual inspection within 12 calendar months of its last completion, the reason for the failure to complete the inspection within the normal annual basis SHALL be documented on the associated Work Order or maintenance procedure and the annual inspection SHALL be completed within the next six calendar months. Technical Rationale for Annual Inspection Time Allowance: IEEE Standard 450, Section 1.2 allows for some minor program deviations. Furthermore, the Annual inspection delineated in the associated procedure contains measurements required on an 18-calendar month interval by the current version of PRC-005. As such, the additional six-month time allowance discussed in this paragraph results in inspections on an interval equivalent to the 18-calendar month allowed in the NERC PRC-005 standard.

6.1.4 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.

6.1.5 Additional Definitions – see IEEE Standard 450 for definitions and further descriptions of battery terms used in this standard or associated maintenance procedures.

6.2 References


6.2.1 IEEE Standard 450 – “IEEE Recommended Practice for Maintenance, Testing and Replacement of Vented Lead Acid Batteries for Stationary Applications. “

6.2.2 NERC Standard PRC-005

6.2.3 [Energy Supply Policy/Procedure Toolbox](#).

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REVISION HISTORY

Date	Revision	Change
8/1/05	0	Original Issue
3/12/07	0	Guideline rewritten into a standard
3/26/07	1.1	Clarified requirements for reading cell voltages only on a quarterly basis during performance of monthly inspections. See paragraph 4.1.1.
3/13/08	1.2	Expanded on definitions of monthly and annual inspections to allow for flexibility in scheduling.
4/7/08	1.3	Removed quarterly testing requirements from description of monthly inspection and added a stand-alone quarterly inspection requirement.
11/6/08	1.4	Removed inspection detailed guidelines from paragraphs 4.1.1, 4.2.1, 4.3.1 and 4.4.1 of the standards as this information is provided in the respective inspection and test procedures.
9/24/09	1.5	Revised paragraph 2.0 to clarify that IEEE Standard 450 serves as the primary basis of the Energy Supply Battery Maintenance program. Clarified maximum allowable interval for performance of battery capacity tests in paragraph in paragraph 4.4, and in Paragraph 6.0, eliminated definitions and instead referred to IEEE Standard 450 definitions and added IEEE Standard 450 as a reference.
1/26/2010	1.6	Reinstated definitions of monthly, quarterly, and annual inspections at section 6.0 to allow flexibility in scheduling.
05/24/2012	1.7	Updated hyperlinks.
08/26/2012	1.8	Updated hyperlinks, changed department names to reflect current organization.
11/21/2012	2.0	Major Revision to establish and document program alignment with pending PRC-005-2 requirements and to address change in NERC definition to include battery chargers as part of the DC Supply element of a Protection System.
03/02/2015	2.1	Reformatted to comply with XES 1.100P01 'Configuration Management for ES Policies and Procedures'. Minor grammatical revisions and clarification that monitoring attributes are not utilized to extend maintenance intervals.

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Date	Revision	Change
02/09/2016	2.2	Changed references from revision-specific to non-revision specific NERC standard PRC-005.
03/13/2017	2.3	Changed Maximo to generic “work and asset management”
09/14/2018	2.4	Updated hyperlinks. Changed “Maximo” to “Work and Asset Management” in section 4.8.
01/24/2022	3.0	Triennial review - Minor change to reflect current department names for the existing responsibilities
5/3/2023	3.1	Updated Links to the Electrical Maintenance Index

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