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IEEE Standard for Qualification of Class 1E Vented Lead Acid Storage Batteries for Nuclear Power Generating Stations

IEEE Power and Energy Society

Sponsored by the
Stationary Batteries Committee

IEEE
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USA

IEEE Std 535™-2013
(Revision of
IEEE Std 535-2006)

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Abstract: Qualification methods for Class 1E vented lead acid batteries and racks to be used in nuclear power generating stations outside primary containment are described in this standard. Qualifications required by IEEE Std 308™ can be demonstrated by using the procedures in this standard in accordance with IEEE Std 323™. The application of batteries in nuclear power generating stations can be divided into two sections: duty cycles equal to or less than 8 h and duty cycles greater than 8 h. A process to demonstrate qualifications for both applications is provided in this standard.

Keywords: acceptance test, battery capacity, battery maintenance, battery replacement criteria, electrolyte level, equalize charge, float voltage, IEEE 450™, IEEE 535™, performance test, specific gravity, test-discharge rate, vented lead-acid battery

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Introduction

This introduction is not part of IEEE Std 535™-2013, IEEE Standard for Qualification of Class 1E Vented Lead Acid Storage Batteries for Nuclear Power Generating Stations.

IEEE Std 323™, IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations, was developed to provide guidance for demonstrating and documenting the adequacy of electrical equipment used in all Class 1E and interface systems. This standard, IEEE Std 535, was developed to provide specific methods and type-test procedures for lead storage batteries in adherence to IEEE Std 323. IEEE Std 344™ methodology for seismic qualification is included for testing cells with and without battery racks.

In general, IEEE Std 323 describes the qualification of equipment as requiring aging and irradiation exposure, followed by seismic testing. The qualification effort required in IEEE Std 323 may be reduced if the equipment is in a mild environment. However, since vented lead acid battery cells have a significant aging mechanism in mild environments, aging is required prior to seismic testing. IEEE Std 535 was developed to provide a specific common process for qualification of vented lead acid cells that could be used by battery manufacturers.

IEEE Std 535-1979 was the initial issue of the standard. IEEE Std 535-1986 revised the standard to limit the plate designs to lead calcium-pasted (Fauré) and lead antimony-pasted (Faure).

IEEE Std 535-2006 was a general revision of IEEE Std 535-1986. This revision updates the standard to address the changes in nuclear plant design and the corresponding impact on battery cells. When IEEE Std 535 was first published, the typical duty cycle was 8 h or less. There was significant utility and telecommunications industry experience to back up the 8-h duty cycle.

This revision of IEEE Std 535 addresses fundamental changes in the duty cycle for the dc system in some of the new plant designs. The new passive design nuclear power plants have duty cycles up to 72 h. Industry experience at this time does not support 72-h duty cycles using the methods outlined in IEEE Std 535-2006. Therefore, this revision provides a methodology that can be used to qualify vented lead acid cells for duty cycles greater than 8 h.

Adherence to this standard may not suffice for assuring public health and safety because it is the integrated performance of electrical systems of the station that limits the consequences of accidents. Each plant has the responsibility to provide assurance that this document, if used, is pertinent to their application and that integrated performance of the station is adequate.

Contents

IEEE Standard for Qualification of Class 1E Vented Lead Acid Storage Batteries for Nuclear Power Generating Stations

1. Scope

This standard describes qualification methods for Class 1E vented lead acid batteries and racks to be used in nuclear power generating stations outside primary containment. Qualifications required by IEEE Std 308™[1] can be demonstrated by using the procedures in this standard in accordance with IEEE Std 323™. Application of batteries in nuclear power generating stations can be divided into two sections: duty cycles equal to or less than 8 h and duty cycles greater than 8 h. This standard provides a process to demonstrate qualification for both applications.

This standard is based on the user demonstrating that the predominant failure mechanism is positive plate grid corrosion. The following technologies have been demonstrated to meet this criterion for full float service:

a) Lead-calcium

b) Lead-antimony

c) Lead-selenium low antimony

[1] Information on references can be found in Clause 2.

To apply this standard to vented lead-acid technologies other than those listed above, the user is required to demonstrate the following for full float service:

a) The predominant failure mechanism is positive plate grid corrosion

b) The accelerated aging factors shall be determined in 8.3.2 e)

Battery sizing, maintenance, capacity testing, installation, charging equipment, and consideration of other type batteries are beyond the scope of this standard.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

ANSI/AISC N690™, Specification for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities—Supplement 1: April 2002.[2]

IEEE Std 308™, IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations.[3, 4]

IEEE Std 323™, IEEE Standard for Qualifying Class lE Equipment for Nuclear Power Generating Stations.

IEEE Std 344™, IEEE Recommended Practice for Seismic Qualification of Class lE Equipment for Nuclear Power Generating Stations.

IEEE Std 450™, IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.

IEEE Std 484™, IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications.

IEEE Std 485™, IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications.

3. Definitions, acronyms, and abbreviations

3.1 Definitions

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