



REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

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QUALIFICATION OF SAFETY-RELATED BATTERY CHARGERS AND INVERTERS FOR NUCLEAR POWER PLANTS

A. INTRODUCTION

This guide describes a method that the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable in complying with regulations for the qualification of safety-related battery chargers and inverters for nuclear power plants.

Title 10, Part 50, “Domestic Licensing of Production and Utilization Facilities,” of the *Code of Federal Regulations* (10 CFR Part 50)¹ requires that structures, systems, and components that are important to safety in a nuclear power plant must be designed to accommodate the effects of environmental conditions (i.e., remain functional under postulated design-basis events). Toward that end, the general requirements appear in General Design Criterion (GDC) 1, “Quality Standards and Records,” GDC 2, “Design Bases for Protection Against Natural Phenomena,” GDC 4, “Environmental and Dynamic Effects Design Bases,” and GDC 23, “Protection System Failure Modes,” of Appendix A, “General Design Criteria for Nuclear Power Plants,” to 10 CFR Part 50. Augmenting those general requirements, the specific

¹ All NRC regulations listed herein are available electronically through the Electronic Reading Room on the NRC’s public Web site, at <http://www.nrc.gov/reading-rm/doc-collections/cfr>. Copies are also available for inspection or copying for a fee from the NRC’s Public Document Room (PDR) at 11555 Rockville Pike, Rockville, MD; the mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; and email PDR@nrc.gov.

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This guide was issued after consideration of comments received from the public.

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requirements pertaining to the qualification of certain electrical equipment important to safety appear in 10 CFR 50.49, “Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants.” In addition, Criterion III, “Design Control,” of Appendix B, “Quality Assurance Criteria for Nuclear Power Plants,” to 10 CFR Part 50 requires that where a test program is used to verify the adequacy of a specific design feature, it should include suitable qualification testing of a prototype unit under the most severe design-basis event.

This regulatory guide contains information collection requirements covered by 10 CFR Part 50 that the Office of Management and Budget (OMB) approved under OMB control number 3150-0011. The NRC may neither conduct nor sponsor, and a person is not required to respond to, an information collection request or requirement unless the requesting document displays a currently valid OMB control number.

B. DISCUSSION

The Working Group on Battery Chargers and Inverters (SC 2.13), part of the Nuclear Power Engineering Committee of the Institute of Electrical and Electronics Engineers (IEEE), developed IEEE Std 650-2006, “IEEE Standard for Qualification of Class 1E Static Battery Chargers and Inverters for Nuclear Power Generating Stations,” published on August 31, 2006.² The IEEE Standards Board approved IEEE Std 650-2006 on June 8, 2006. That standard provides general requirements, direction, and methods for qualifying safety-related static battery chargers and inverters for service in nuclear power plants. The demonstration that an installed battery charger or inverter will meet its design specification requires many steps in a program of design, fabrication, quality assurance, qualification, transportation, storage, installation, maintenance, periodic testing, and surveillance. However, the scope of IEEE Std 650-2006 is limited to qualification.

Verifying the adequacy of a specific design, such that the battery chargers and inverters remain functional under postulated events, should be accomplished using qualification methods (i.e., type testing, operating experience, analysis as a supplement to type testing and operating experience, ongoing qualification, or any combination thereof).

Clause 5.3.1.7 of IEEE Std 650-2006 references IEEE Std 344-2004, “Recommended Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations,” and provides additional guidance for seismic testing. Recent studies related to the early site permit applications at certain east coast, hard-rock-based plants indicated that the site-specific spectra may exceed the certified design spectra of new proposed nuclear power plants in the very-high-frequency range (from 20 hertz (Hz) up to 100 Hz). Plants located in the central and eastern United States on hard rock should evaluate whether the high-frequency earthquake ground motion could affect battery chargers.

C. REGULATORY POSITION

The NRC staff considers conformance with the requirements of IEEE Std 650-2006 to be a method that is acceptable for use in satisfying the regulations with respect to the qualification of safety-related battery chargers and inverters, subject to the following conditions:

1. Clause 5.2.2.4 of IEEE Std 650-2006 should be supplemented to specify the following criterion for ignoring cycling as an aging factor:

² IEEE publications may be purchased from the IEEE Service Center, which is located at 445 Hoes Lane, Piscataway, NJ 08855, <http://www.ieee.org>, telephone (800) 678-4333.

Connector mechanical cycling can be ignored as an aging factor if the expected number of cycles during the qualified life or service life of the battery chargers and inverters is infrequent (i.e., less than 10 percent of the cycle design in the published connector specification). If the design capability has not been published, then “infrequent” means less than 10 times during the life of battery chargers and inverters.

Alternatively, the connectors can be inspected, replaced, or verified as acceptable using methodology such as thermography or connection resistance trending during the qualified life or service life.

2. Because of the complexity of static battery chargers and inverters, Clauses 1.2 and 5 of IEEE Std 650-2006 should be supplemented to specify that qualification by testing is the only method acceptable to the NRC staff for the environmental stress test (Clause 5.3.1.6) and the seismic test (Clause 5.3.1.7). However, the analysis can be used to justify minor design modification to equipment previously tested.
3. Clause 5.3.1.6 of IEEE Std 650-2006 should be supplemented to specify that functional performance data should be monitored continuously or at prespecified intervals during the qualification testing. Data loggers or other automated processes can be used to monitor and record the performance characteristics at prespecified intervals.

IEEE Std 650-2006 references several industry codes and standards. If the NRC has separately incorporated a referenced standard into the agency’s regulations, licensees and applicants must comply with the standard as set forth in the regulations. By contrast, if the NRC staff has endorsed a referenced standard in a regulatory guide, that standard constitutes an acceptable method of meeting a regulatory requirement as described in the regulatory guide, and is not a requirement.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC’s plans for using this regulatory guide. The NRC does not intend or approve any imposition or backfit in connection with its issuance.

In some cases, applicants or licensees may propose or use a previously established acceptable alternative method for complying with specified portions of the NRC’s regulations. Otherwise, the methods described in this guide will be used in evaluating compliance with the applicable regulations for license applications, license amendment applications, and amendment requests.