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OFFICE OF NUCLEAR REGULATORY RESEARCH

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Division 1

DRAFT REGULATORY GUIDE

Contact: S. Aggarwal
(301) 251-7627

DRAFT REGULATORY GUIDE DG-1150

(Proposed Revision 1 of Regulatory Guide 1.40, dated March 1973)

QUALIFICATION OF CONTINUOUS DUTY SAFETY-RELATED MOTORS FOR NUCLEAR POWER PLANTS

A. INTRODUCTION

The U.S. Nuclear Regulatory Commission's (NRC's) regulations in Title 10, of the *Code of Federal Regulations*, Part 50, "Domestic Licensing of Production and Utilization Facilities" (10 CFR Part 50) (Ref. 1), require that structures, systems, and components in a nuclear power plant that are important to safety be designed to accommodate the effects of environmental conditions (i.e., they must remain functional under postulated design-basis events (DBEs)). General Design Criteria (GDC) 1, "Quality Standards and Records," 2, "Design Bases for Protection against Natural Phenomena," 4, "Environmental and Dynamic Effects Design Bases," and 23, "Protection System Failure Modes," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, contain the general requirements for meeting those conditions. The specific requirements in 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants," for the qualification of certain electrical equipment important to safety augment the general requirements of GDC 1, 2, 4, and 23. In addition, Criterion III, "Design Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, requires that test programs, when used to verify the adequacy of a specific design feature, should include the suitable qualification testing of prototype units under the most adverse design conditions.

This guide describes a method that the NRC staff considers acceptable for complying with the Commission's regulations for the qualification of continuous duty safety-related motors for nuclear power plants.

This regulatory guide is being issued in draft form to involve the public in the early stages of the development of a regulatory position in this area. It has not received final staff review or approval and does not represent an official NRC final staff position.

Public comments are being solicited on this draft guide (including any implementation schedule) and its associated regulatory analysis or value/impact statement. Comments should be accompanied by appropriate supporting data. Written comments may be submitted to the Rulemaking, Directives, and Editing Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; e-mailed to nrcrep.resource@nrc.gov; submitted through the NRC's interactive rulemaking Web page at http://www.nrc.gov; or faxed to (301) 492-3446. Copies of comments received may be examined at the NRC's Public Document Room, 11555 Rockville Pike, Rockville, MD. Comments will be most helpful if received by October 30, 2009.

Electronic copies of this draft regulatory guide are available through the NRC's interactive rulemaking Web page (see above); the NRC's public Web site under Draft Regulatory Guides in the Regulatory Guides document collection of the NRC's Electronic Reading Room at http://www.nrc.gov/reading-rm/doc-collections/; and the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html, under Accession No. ML091200454.

The NRC issues regulatory guides to describe methods that the staff considers acceptable for use in implementing specific parts of the agency's regulations, to explain techniques that the staff uses in evaluating specific problems or postulated accidents, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations and compliance with them is not required.

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 Qualification of Motors (Subcommittee (SC 2.2) of the Nuclear Power Engineering Committee of the Institute of Electrical and Electronics Engineers, Inc. (IEEE) developed Standard 334-2006, "IEEE Standard for Qualifying Continuous Duty Class 1E Motors for Nuclear Power Generating Stations." The IEEE Standards Board approved this standard on September 15, 2006, and it was published on January 31, 2007 (Ref. 2). This standard establishes criteria for qualification of continuous duty Class 1E motors, located in mild and harsh environments in nuclear power plants to demonstrate their ability to perform their intended safety functions. The standard also provides guidance for qualification of refurbished motors and insulation systems for motor rewinds.

The purpose of qualification is to provide reasonable assurance that safety-related motors can perform their specified safety functions and that no failure mechanisms exist that can lead to a common-cause failure under the postulated service conditions. The standard provides the methods for qualifying safety-related motors.

Applicants and licensees should accomplish qualification by using these methods (type testing, operating experience, analysis as a supplement to type testing and operating experience, ongoing qualification, or any combination thereof). However, the preferred method of qualification is type testing.

Changes in IEEE Std 334-2006, IEEE Std 334-1994, and IEEE Std 334-1971:

The changes incorporated to IEEE 334-2006 were arrived through an intermediate version issued in 1994. The changes can be summarized as follows:

- Included and added significant definitions of terms (Sec. 3.0).
- Expanded use of IEEE 334 to include Insulation Systems throughout the document as well as complete motors.
- Significantly expanded guidance on "Type Test Models" (Sec. 5.3.2).
- Inclusion of thermal criteria for the application of load (Sec. 5.3.2).
- Significantly expanded detailed guidance on "Type Test Sequence" (Sec. 5.3.3) primarily through reference and inclusion of other applicable IEEE standards for testing and aging.
- Significantly expanded detailed guidance on loading and operational requirements for

DBE conditions (Sec. 5.3.6).

• Provided detailed requirements for Margin (Sec. 5.5).

• Provided detailed guidance on documentation requirements (Sec. 7).

Proposed RG 1.40, Revision 1 and RG 1.40, dated March 1973:

In RG 1.40, the NRC staff took 2 significant exceptions to IEEE Std 334-1971. The staff has now concluded that IEEE Std 334-2006 adequately addresses these exceptions. The basis of this conclusion is as follows:

Exception 1: *To the extent practicable, auxiliary equipment that will be part of the installed motor assembly should also be qualified in accordance with IEEE Std 334-1971*. This statement was included in the RG 1.40 to assure that all equipment required for the motor to perform as intended was included in testing. The following improvements have been identified to address this exception:

Sec. 3.3, *Components*, IEEE Std 334-2006 added the definition of component which includes some items that are considered "auxiliary equipment" such as thermal overload relays, instrument sensors, seals, sight glasses, etc. The intent of providing a specific definition of "components" as related to motors was to include these types of auxiliary equipment.

Sec. 4, *Qualification Methods, Subsection 4.1, General,* states that seals, gaskets and other nonmetallic components that have significant aging mechanisms shall be evaluated. This section further states that wear and aging mechanisms exist for bearings and lubricants and should be addressed during qualification.

Sec. 5.3.2, *Type Test Model, Para 1*, states that the model should be composed of a full size motor or scale model that incorporates essential components used in production equipment such as bearings, seals, lead seals, lubricants and "other essential accessory devices and equipment". This paragraph goes on to state that if accessories of production motors are different than the test model, then the production motor accessories must also be qualified.

Sec. 5.3.4.1, *Insulation Thermal Conditioning*, states that motor components (e.g. rotor and stator) "and "other age sensitive components" shall be thermally aged to account for degradation…". The intent of this section is to ensure that other auxiliary equipment be included in the thermal aging program.

Sec. 5.3.4.2, *Lubricants, Bearings and Seal Components*, This section specifically addresses aging of subcomponents not as a part of the insulation system.

Sec. 5.8, *Motor Lead Cable*, Motor lead cable is not normally considered part of the motor or motor insulation system. Specific qualification guidance was provided in this section to address motor lead cables.

Sec. 5.9, *Bearings*, This section specifically addresses bearings and their relation to the motor qualification.

Sec. 5.10, *Lubricants*, This section specifically addresses lubricants and their relation to the motor qualification.

Sec. 5.11, *Seals and Gaskets*, This section specifically addresses seals and gaskets and their relation to the motor qualification.

Sec. 5.12, *Accessories*, This section specifically addresses items such as space heaters, temperature detectors, and vibration detectors and their relation to the motor qualification.

Sec. 5.13, *Equipment Boundary and Interfaces*, This section addresses defining boundaries for motor accessory and/or driven equipment for seismic qualification.

Exception 2: *Qualification tests should simulate as close as practicable all design basis events…*

Sec. 3.3, *Components*, IEEE 334-2006 added the definition of component which includes some items that are considered "auxiliary equipment" such as thermal overload relays, instrument sensors, seals, sight glasses, etc. The intent of providing a specific definition of "components" as related to motors was to include these types of auxiliary equipment. The configuration of the test specimen is the qualifiers responsibility. When the standard states "motor", the intent is that any given motor may include various components/ auxiliary equipments. Therefore, when the standard states "motor", the intent is that the motor specimen should include any applicable auxiliary equipment.

Sec. 5.1.3, *Motor Performance,* This section states that the qualification program shall demonstrate that the motor (inclusive of auxiliary equipment per Sec. 3.3) is able to start, accelerate to operating speed and operate under all specified combinations of driven equipment load and speed variations and environmental conditions.

Sec. 5.3.2, *Type Test Model, Para 1*, states that the model should be composed of a full size motor or scale model that incorporates essential components used in production equipment such as bearings, seals, lead seals, lubricants and "other essential accessory devices and equipment". This paragraph goes on to state that if accessories of production motors are different than the test model, then the production motor accessories must also be qualified. Paragraph 3 of this section specifically defines requirements for loading the "type test model" to various operational and environmental conditions.

Sec. 5.3.6, *Design Basis Event Conditions*, Paragraph 3 states, "The design-basis-event simulation shall also include testing the motor or insulation system model for a period of time equivalent to the duration following the design basis event for which the motor's safety function(s) are required. During this time, the motor or insulation system model shall be operated to simulate its specified requirements during the post-event period, including stopping, starting, or continuous operation. The duration of this test shall equal the post-event service period, including margin." This section goes on to provide specific worst case scenarios of stopping, starting, etc.

C. REGULATORY POSITION

The NRC staff considers conformance with IEEE Standard 334-2006 an acceptable method for use in satisfying the Commission's regulations with respect to qualification of continuous duty safety-related motors.

IEEE Standard 334-2006 references several industry codes and standards. If the NRC's regulations separately incorporate a referenced standard, 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.

D. IMPLEMENTATION

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

The NRC has issued this draft guide to encourage public participation in its development. The NRC will consider all public comments received in development of the final guidance document. In some cases, applicants or licensees may propose an alternative 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.

REGULATORY ANALYSIS

Statement of the Problem

The nuclear industry has used IEEE Standard 334-1971, "Trial Use Guide for Type Tests of Continuous Duty Class 1 Motors Installed inside the Containment of Nuclear Power Generating Stations,' (Ref. 4), for qualification of safety-related motors since issuance of the standard in 1971. IEEE revised this standard and issued it 1974 & 1994 as, "IEEE Standard For Type Tests Of Continuous Duty Class 1E Motors For Nuclear Power Generating Stations." The NRC staff has previously endorsed the trial guide (IEEE Std 334-1971) in March 1973, as Regulatory Guide 1.40. However, over the ensuing years, the staff has been working with IEEE to revise this standard, and the revised version, IEEE Standard 334-2006, is generally consistent with the NRC's regulatory requirements.

Since the issuance in 1971 of IEEE Standard 334-1971, nuclear power plant licensees have used either the 1971 standard or IEEE Standard 334-1994 for qualification of safety-related motors for nuclear power plants, subject to NRC staff review on a case-by-case basis. The case by case approach is time consuming. The use of a single, updated standard would enhance the review process.

Objective

The objective of this action is to provide clear, updated guidance on qualification of safety-related motors. Issuing a regulatory guide is consistent with the NRC policy of evaluating the latest versions of consensus safety standards in terms of their suitability for endorsement by regulatory guides. This approach would also comply with the NRC's directive to use standards developed by consensus bodies in accordance with Public Law 104-113, "National Technology Transfer and Advancement Act of 1995."

Alternative Approaches

The NRC staff considered the following alternative approaches:

- Do not revise the regulatory guide endorsing IEEE standard 334-2006.
- Revise the regulatory guide endorsing IEEE standard 334-2006.

Alternative 1: Do Not Issue a Regulatory Guide Endorsing IEEE Standard 334-2006

Under this alternative, the NRC would not issue additional guidance, and the current ad hoc guidance for qualifying safety related motors would be retained. If NRC does not take action, there would not be any changes in costs or benefit to the public, licensees or NRC. However, the "no-action" alternative would not address identified concerns with the current lack of guidance. This alternative provides a baseline condition from which any other alternatives will be assessed.

Alternative 2: Issue a Regulatory Guide Endorsing IEEE Standard 334-2006

Preparing and issuing the revised regulatory guide will provide the industry with clearer guidance and understanding of the methodology the NRC staff will use to establish the basic principles, and methods of qualifying safety-related motors for applications in both harsh and mild environments in nuclear power plants. IEEE Standard 334-2006 is an acceptable standard which reflects the current state of technology. The technical approach discussed in the revised standard is consistent with the NRC's regulatory requirements.

The impact to the NRC would be the costs associated with preparing and issuing the regulatory guide. The impact to the public would be the voluntary costs associated with reviewing and providing comments to NRC during the public comment period. The value to NRC staff and its applicants would be the benefits associated with enhanced efficiency and effectiveness in using a common guidance document as the technical basis for license applications and other interactions between the NRC and its regulated entities.

Conclusion

The NRC should revise this regulatory guide to enhance the licensing process. The staff has concluded that the proposed action will reduce unnecessary burden on both the NRC and its licensees and will result in an improved and more uniform process for qualifying safety-related motor control centers. Moreover, the staff sees no adverse effects associated with issuing this regulatory guide.

REFERENCES[1]

1. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," U.S. Nuclear Regulatory Commission, Washington, DC.

2. IEEE Std. 334-2006, "IEEE Standard for Qualifying Continuous Duty Class 1E Motors for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, Inc., Piscataway, NJ, January 31, 2007. [2]

3. IEEE Std. 334-1971, "Trial Use Guide for Type Tests of Continuous Duty Class 1 Motors Installed inside the Containment of Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, Inc., Piscataway, NJ.

4. IEEE Std. 334-1974, "IEEE Standard For Type Tests Of Continuous Duty Class 1E Motors For Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, Inc., Piscataway, NJ.

5. IEEE Std. 334-1994, "IEEE Standard For Type Tests of Continuous Duty Class 1E Motors for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, Inc., Piscataway, NJ.

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1 Publicly available NRC published documents such as Regulations, Regulatory Guides, NUREGs, and Generic Letters 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/. 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 e-mail PDR.Resource@nrc.gov.

2 Copies of the non-NRC documents included in these references may be obtained directly from the publishing organization.