U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REGULATORY RESEARCH

April 2013
Division 1

DRAFT REGULATORY GUIDE

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DRAFT REGULATORY GUIDE DG-1235

(Proposed Revision 1 of Regulatory Guide 1.73, dated January 1974)

QUALIFICATION TESTS FOR SAFETY-RELATED ACTUATORS IN NUCLEAR POWER PLANTS

A. INTRODUCTION

Purpose

This guide describes a method that the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable for complying with the Commission's regulations for the environmental qualification of safety-related power-operated valve actuators in nuclear power plants.

Applicable Rules and Regulations

The regulations established by the NRC in Title 10, Part 50, "Domestic Licensing of Production and Utilization Facilities," of the *Code of Federal Regulations* (10 CFR Part 50) (Ref. 1), require that structures, systems, and components (SSCs) important to safety in a nuclear power plant be designed to accommodate the effects of environmental conditions (i.e., they must remain functional under postulated design-basis events (DBE)).

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, contain general requirements to provide reasonable assurance that SSCs are designed to accommodate the effects of environmental conditions. Augmenting the above mentioned general requirements are specific requirements pertaining to qualification of certain electrical equipment important to safety as described 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 and Fuel Reprocessing Plants," to 10 CFR Part 50, requires that, when a test program is used to verify the adequacy of a specific design

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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 through the federal government-wide Web site WWW.Regulations.gov. Alternatively, written comments may be submitted to the Rules, Announcements, and Directives Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; submitted through the NRC's interactive rulemaking Web page at 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 June 28, 2013.

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 Library at WWW.nrc.gov/reading-rm/doc-collections/; and the NRC's Agencywide Documents Access and Management System (ADAMS) at WWW.nrc.gov/reading-rm/adams.html, under Accession No. ML12158A082. The regulatory analysis may be found in ADAMS under Accession No. ML12219A400.

feature, the test program must include suitable qualification testing of a prototype unit under the most adverse design conditions. Additionally, in accordance with 10 CFR 52.48, "Standards for Review of Applications," and 10 CFR 52.81, "Standards for Review of Applications," these GDC and quality assurance criteria also apply to nuclear power reactor licenses issued under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants" (Ref. 2).

Purpose of Regulatory Guides

The NRC issues regulatory guides (RGs) to describe methods 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.

Information Collection Requirements

This RG contains information collection requirements covered by 10 CFR Part 50 and Part 52 that the Office of Management and Budget (OMB) approved under OMB control number 3150-0011 and 3150-151 respectively. 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

Reason for Change

Regulatory Guide 1.73, "Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants," was originally issued in January 1974 to endorse the Institute of Electrical and Electronics Engineers (IEEE) Std. 382-1972, "IEEE Trial-Use Guide for Type Test of Class I Electric Valve Operators for Nuclear Power Generating Stations" (Ref. 3). The IEEE standard was revised in 1985, again in 1996, and, most recently, in 2006. However this regulatory guide has not been updated since its original issue. This revision updates the regulatory guide to endorse the current version of IEEE Std. 382-2006, "Standard for Qualification of Safety-Related Actuators for Nuclear Power Generating Stations," (Ref. 4) with certain exceptions and modifications.

Background

IEEE Std. 382-2006, was published on March 15, 2007. It was developed by the Subcommittee on Qualification of Actuators (SC 2.3) of the IEEE Nuclear Power Engineering Committee and approved by the IEEE Standards Association (IEEE-SA) Standards Board on December 6, 2006. This standard establishes criteria for the qualification of safety-related actuators and actuator components, in nuclear power generating stations. The primary objective is to demonstrate with reasonable assurance that safety-related actuators for which a qualified life or condition has been established can perform their safety function(s) without common-cause failures before, during, and after applicable DBE. Safety-related actuators and their interfaces must meet or exceed the equipment specification requirements. The standard specifies procedures for testing under conditions that simulate (1) the postulated DBE conditions including specified high-energy line break, loss of coolant accident, main steam line break, and safe shutdown seismic earthquake events, and (2) those occurring during normal operating conditions.

The standard specifies procedures for accomplishing aging of components to simulate the effects of long-term operation under normal and abnormal operating conditions. These effects include exposure

to thermodynamic environment (temperature, pressure, relative humidity), fluid jet or spray environment, seismic and non-seismic vibration environment, radiation environment, input power source (electrical and mechanical), and electrical and mechanical characteristics, and provides guidance for how to incorporate manufacturer's recommended maintenance intervals into the qualification process.

Documents Endorsed in this Guide

This regulatory guide endorses IEEE Std. 382-2006, issued in March 2007, with some clarifications and exceptions.

Section 1.2 of IEEE Std. 382-2006 references IEEE Std. 323-2003, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations" (Ref. 5) which provides guidance on demonstrating the qualification of safety-related equipment including components of any interface whose failure could adversely affect the performance of safety-related systems and electric equipment. As of the date of this RG, the NRC staff does not endorse IEEE Std. 323-2003 or IEEE Std. 323-1983 as acceptable means of meeting regulatory requirements for qualifying equipment for operations in harsh environments. In revision 1 of RG 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants" (Ref. 6) the NRC staff endorses, in part, IEEE Std. 323-1974 which is generally used by the nuclear industry to qualify safety-related (Class 1E) electric equipment located in an environment resulting from a postulated DBE (termed as a harsh environment as defined in IEEE Std. 323-2003), non-safety related equipment whose failure under postulated environmental conditions could prevent satisfactory accomplishment of certain safety functions, and certain post-accident monitoring equipment needed to satisfy the requirements in 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants."

In RG 1.100, "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants," (Ref. 7) the NRC staff describes methods considered acceptable for the seismic qualification of electrical and active mechanical equipment and the functional qualification of active mechanical equipment for nuclear power plants. In RG 1.100, the NRC staff endorses the use of IEEE Std 344-2004, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," (Ref. 8) and the American Society of Mechanical Engineers (ASME) Standard QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plant," (Ref. 9) with specific conditions.

ASME Standard QME-1-2007 incorporates lessons learned from valve operating experience and research programs for the qualification of power-operated valves used in nuclear power plants. For example, ASME QME-1-2007 includes more stringent provisions for the functional qualification of power-operated valves regarding acceptable qualification methods, actuator grouping, actuator output capability testing, and extrapolation of actuator qualification than specified in IEEE Std 382-2006. ASME QME-1-2007 specifies the seismic qualification of valve assemblies in accordance with IEEE Std. 344-2004 as addressed in RG 1.100 or as described in that ASME standard.

ASME QME-1-2007 specifies, in part, that valve actuators should be environmentally qualified in accordance with IEEE Std. 323-1983, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," (Ref. 10) and IEEE Std. 382-1985, "Standard for Qualification of Actuators for Power-Operated Valve Assemblies with Safety-Related Functions for Nuclear Power Plants" (Ref. 11). The NRC staff however, accepts the use of IEEE Std. 382-2006 for the environmental qualification of power-operated valve actuators in nuclear power plants subject to the provisions of this regulatory guide. In this regulatory guide, environmental qualification includes such activities as aging (e.g., thermal, cycling, radiation, and vibration), pressurization cycle testing, radiation exposure testing,

and ambient condition testing (e.g., temperature, pressure, moisture, and spray environment). The users of IEEE Std. 382-2006 will need to address the other aspects of the qualification process (such as seismic and functional qualification) for power-operated valves through the guidance in RG 1.100.

Harmonization with International Standards

The International Atomic Energy Agency (IAEA) has established a series of safety guides and standards constituting a high level of safety for protecting people and the environment. IAEA safety guides are international standards to help users striving to achieve high levels of safety. Pertinent to this RG, IAEA Safety Reports Series No. 3, "Equipment Qualification in Operational Nuclear Power Plants: Upgrading, Preserving, and Reviewing" issued April 1998 (Ref. 12) addresses environmental qualification of equipment important to safety in nuclear power plants. This RG incorporates similar environmental qualification recommendations and is consistent with the basic safety principles provided in IAEA Safety Report Series No. 3.

Standards Endorsed in This Regulatory Guide

This RG endorses, in part, the use of one or more voluntary consensus codes or standards developed by external organizations. These codes or standards may contain references to other codes or standards (secondary references). These secondary references should be considered individually. If a secondary reference is incorporated separately into NRC regulations, licensees and applicants must comply with that code or standard as set forth in the regulation. If the secondary reference is endorsed in this or another guidance document, then it constitutes a method acceptable to the NRC staff for meeting a regulatory requirement as described in the specific guidance document. If a secondary reference is neither incorporated into NRC regulations nor endorsed in another guidance document, licensees and applicants may consider and use the information in the secondary reference, if appropriately justified and consistent with current regulatory practice.

C. STAFF REGULATORY GUIDANCE

The guidance in IEEE Std. 382-2006 provides an acceptable approach to the NRC for meeting the agency's regulatory requirements for environmental qualification of safety-related power-operated valve actuators in nuclear power plants with the exceptions and additions listed in this section. The guidance also provides an adequate basis for complying with the qualification testing requirements of Criterion III, "Design Control" of Appendix B to 10 CFR Part 50 to verify adequacy of design for service under DBE conditions subject to the following modifications.

1. To the extent practical, auxiliary equipment (e.g., limit switches) that are not integral with the actuator mechanism but will be part of the installed actuator assembly should be tested in accordance with guidance in IEEE 382-2006.

2. The applicants and licensees should perform environmental qualification of safety-related actuators using the guidance in RG 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants" (Ref. 13). This testing includes type testing, operating experience, and analysis as a supplement to type testing and operating experience, ongoing qualification, or any combination thereof. Type testing is the preferred method of equipment qualification because other methods may be based on older or dissimilar equipment that may not be comparable to the equipment being qualified.

3. The radiological source term for qualification tests in a nuclear radiation environment should be based on the same source term used in RG 1.89. The containment size should be taken into account in each case. For exposed organic materials, calculations should take into account both beta and gamma radiation.

4. Section 2, "Normative References," of IEEE Std. 382-2006, lists additional applicable IEEE standards. The specific applicability or acceptability of these referenced standards is discussed in the paragraph titled “Standards Endorsed in this Regulatory Guide” in Section B of this RG.

5. The environmental qualification criteria described in Section 6, "Qualification Testing of Selected Actuators in Generic Actuator Group," and Section 7, "Qualification of Actuator for Specific Application," of IEEE Std. 382-2006 should be used to qualify actuators in generic and specific applications, respectively, unless the anticipated actual service operating sequence for the actuator is expected to create a more severe operating condition than described in Section 6.3.2, "Test Sequence and Requirements." In such case, the actual service sequence should be used in the test.

6. The documentation requirements to determine the level of qualification of actuators intended for generic or specific applications should conform to Section 8, "Documentation," of IEEE Std. 382-2006.

7. Section 12.3, "Test Conduct," of IEEE Std. 382-2006 for Cycle Aging Tests, provides a representative number of cycles for the valve application. The applicant or licensee will be responsible for qualifying the actuator for its qualified life including its design cycles as specified in the design requirements for new nuclear power plants or plants receiving license renewal for extension, such as 60 years.

8. Section 14, "Vibration Aging Test," of IEEE Std. 382-2006 states that the vibration aging test is intended to provide a vibratory environment that is representative of normal plant induced vibration including system operating transients and other dynamic vibratory environments. The environmental qualification for power-operated valves should also address flow-induced vibration caused by acoustic resonance and hydraulic loading in the reactor, steam, and feed-water systems.

9. The NRC staff considers the guidance in IEEE Std. 382-2006 section 15 as an acceptable method for the environmental qualification of valve actuators as part of the qualification process for power-operated valves described in RG 1.100 subject to the following provisions:

    9.1 Section 15.3(b) of IEEE Std. 382-2006 states, “Each sweep shall be from 2 Hz to 35 Hz to 2 Hz, or other enveloping frequency range specified by the user." The NRC staff recommends replacing this requirement with the following… “Each sweep shall be from 2Hz to 64Hz to 2Hz or if the Required Response Spectra (RRS) has a frequency range exceeding 64Hz then the frequency sweep should be consistent with the RRS of the specific plant equipment.”

    9.2 Section 15.3(c), of IEEE Std. 382-2006 states, for HRHF site plants, “...at one-third octave interval test frequencies indicated on Figure 1.” The NRC staff recommends replacing this with the following: “…the frequency interval should be one-sixth octave to adequately identify resonance frequencies.” The users of IEEE Std. 382-2006 need to address the other aspects of the qualification process (such as seismic and functional qualification) for power-operated valves as described in RG 1.100.

10. To assure that the actuator is tested under an environment of sufficient severity, the magnitude of the environmental conditions (e.g., temperature, pressure, radiation, humidity) that simulate the conditions to which the actuator is expected to be exposed during and following a DBE (Section 17, "DBE environment test" of IEEE Std. 382-2006) should be based on conservative calculations. The equipment needs to be qualified for the duration of its operational performance requirement for each applicable DBE condition, including any required post DBE operability period.

D. IMPLEMENTATION

The purpose of this section is to provide information on how applicants and licensees[1] may use this guide and information about the NRC's plans for using this RG. In addition, it describes how the staff complies with 10 CFR 50.109, "Backfitting" and any applicable finality provisions in 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

Use by Applicants and Licensees

Applicants and licensees may voluntarily[2] use the guidance in this document to demonstrate compliance with the underlying NRC regulations. Methods or solutions that differ from those described in this RG may be deemed acceptable if they provide sufficient basis and information for the staff to verify that the proposed alternative demonstrates compliance with the appropriate NRC regulations. Current licensees may continue to use guidance the NRC found acceptable in the past to comply with the identified regulations, as long as their current licensing basis remains unchanged**.**

Licensees may use the information in this RG for actions that do not require NRC review and approval, such as changes to a facility design under 10 CFR 50.59, "Changes, Tests, and Experiments." Licensees may use the information in this RG or applicable parts to resolve regulatory or inspection issues.

This RG is not being imposed upon current licensees and may be voluntarily used by existing licensees.

If a licensee believes that the NRC either is using this RG or requesting or requiring the licensee to implement the methods or processes in this RG in a manner inconsistent with the discussion in this implementation section, then the licensee may file a backfit appeal with the NRC in accordance with the guidance in NUREG-1409, "Backfitting Guidelines," (Ref. 14) and the NRC Management Directive 8.4, "Management of Facility-Specific Backfitting and Information Collection" (Ref. 15).

Use by NRC Staff

During regulatory discussions on plant-specific operational issues, the staff may discuss with licensees various actions consistent with staff positions in this RG, as one acceptable means of meeting the underlying NRC regulatory requirement. Such discussions would not ordinarily be considered

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1 In this section, "licensees" refers to licensees of nuclear power plants under 10 CFR Parts 50 and 52; and the term "applicants" refers to applicants for licenses and permits for (or relating to) nuclear power plants under 10 CFR Parts 50 and 52, and applicants for standard design approvals and standard design certifications under 10 CFR Part 52.

2 In this section, "voluntary" and "voluntarily" mean that the licensee is seeking the action of its own accord, without the force of a legally binding requirement or an NRC representation of further licensing or enforcement action.

backfitting, even if prior versions of this RG are part of the licensing basis of the facility. However, without more, the staff may not represent to the licensee that the licensee's failure to comply with the positions in this RG constitutes a violation.

If an existing licensee voluntarily seeks a license amendment or change and (1) the staff's consideration of the request involves a regulatory issue directly relevant to this new or revised RG, and (2) the specific subject matter of this RG is an essential consideration in the staff's determination of the acceptability of the licensee's request, then the staff may request that the licensee either follow the guidance in this RG or provide an equivalent alternative process that demonstrates compliance with the underlying NRC regulatory requirements. This action is not considered backfitting as defined in §50.109(a)(1) or a violation of any of the issue finality provisions in 10 CFR Part 52.

The staff does not intend or approve any imposition or backfitting of the guidance in this RG. The staff does not expect any existing licensee to use or commit to using the guidance in this RG, unless the licensee makes a change to its licensing basis. The staff does not expect or plan to request licensees to voluntarily adopt this RG to resolve a generic regulatory issue. The staff does not expect or plan to initiate NRC regulatory action that would require the use of this RG. Examples of such unplanned NRC regulatory actions include issuance of an order requiring the use of the RG, requests for information under 10 CFR 50.54(f) as to whether a licensee intends to commit to use of this RG, generic communication, or promulgation of a rule requiring the use of this RG without further backfit consideration.

Additionally, an existing applicant may be required to adhere to new rules, orders, or guidance if §50.109(a)(3) applies.

REFERENCES[3]

1. Code of Federal Regulations (CFR), *Title 10, Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities"

2. CFR, *Title 10, Energy*, Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants"

3. Institute of Electrical and Electronics Engineers (IEEE) Standard (Std.) 382-1974, "IEEE Trial-Use Guide for Type Test of Class I Electric Valve Operators for Nuclear Power Generating Stations" IEEE, Piscataway, NJ, 1974.[4] (ADAMS Accession No. ML032200206)

4. IEEE Std. 382-2006, "Standard for Qualification of Safety-Related Actuators for Nuclear Power Generating Stations," IEEE, Piscataway, NJ, 2007.

5. IEEE Std. 323-2003, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations" IEEE, Piscataway, NJ, 2004.

6. U. S. Nuclear Regulatory Commission (NRC), Regulatory Guide (RG) 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants," NRC, Washington, DC.

7. NRC, RG 1.100, "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants," NRC, Washington, DC.

8. IEEE Std. 344-2004, "Recommended Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," IEEE, Piscataway, NJ, 2004.

9. American Society of Mechanical Engineers (ASME) Standard QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plant," New York, NY.[5]

10. IEEE Std. 323-1983, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," IEEE, Piscataway, NJ. 1983.

11. IEEE Std. 382-1985, "Standard for Qualification of Actuators for Power-Operated Valve Assemblies with Safety-Related Functions for Nuclear Power Plants," IEEE, Piscataway, NJ. 1985.

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3 Publicly available NRC published documents can be accessed electronically through the NRC Library on the NRC's public Web site at: http://www.nrc.gov/reading-rm/doc-collections/. The documents also can be viewed online or printed for a fee in 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.

4 Copies of Institute of Electrical and Electronics Engineers (IEEE) documents may be purchased from the IEEE Service Center, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855 or through IEEE's public Web site at http://www.ieee.org/publications_standards/index.html.

5 Copies of American Society of Mechanical Engineers (ASME) standards may be purchased from ASME, Three Park Avenue, New York, New York 10016-5990; Telephone 800-843-2763. Purchase information is available through the ASME Web site store at http://www.asme.org/Codes/Publications/.

12. International Atomic Energy Agency (IAEA) Safety Reports Series No. 3, "Equipment Qualification in Operational Nuclear Power Plants: Upgrading, Preserving, and Reviewing," April 1998, Vienna, Austria. [6]

13. NRC, RG 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants," NRC, Washington, DC.

14. NRC, NUREG-1409, "Backfitting Guidelines," NRC, Washington, DC. (ADAMS Accession No. ML032230247)

15. NRC, Management Directive 8.4, "Management of Facility-Specific Backfitting and Information Collection," NRC, Washington DC.

6 Copies of International Atomic Energy Agency (IAEA) documents may be obtained through their Web site: WWW.IAEA.Org/ or by writing the International Atomic Energy Agency P.O. Box 100 Wagramer Strasse 5, A-1400 Vienna, Austria. Telephone (+431) 2600-0, Fax (+431) 2600-7, or E-Mail at Official.Mail@IAEA.Org