

# U.S. NUCLEAR REGULATORY COMMISSION

## DRAFT REGULATORY GUIDE DG-1442

### *Proposed Revision 1 to Regulatory Guide 1.211*



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## QUALIFICATION OF SAFETY-RELATED CABLES AND FIELD SPLICES FOR PRODUCTION AND UTILIZATION FACILITIES

### A. INTRODUCTION

#### **Purpose**

This regulatory guide (RG) describes an approach that is acceptable to the staff of the U.S. Nuclear Regulatory Commission (NRC) to meet regulatory requirements for the environmental qualification (EQ) of safety-related cables and field splices in production and utilization facilities. It endorses, subject to the conditions described in Section C of this RG, Institute of Electrical and Electronic Engineers (IEEE) Standard (Std.) 383-2023, “IEEE Standard for Qualifying Electric Cables and Splices for Nuclear Facilities” (Ref. 1).

#### **Applicability**

This RG applies to licensees and applicants subject to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, “Domestic Licensing of Production and Utilization Facilities” (Ref. 2), and 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants” (Ref. 3). With respect to 10 CFR Part 50, this RG applies to licensees of, or applicants for, production and utilization facilities. Under 10 CFR Part 52, this RG applies to applicants and holders of combined licenses, standard design certifications, standard design approvals, and manufacturing licenses.

#### **Applicable Regulations**

- 10 CFR Part 50 provides regulations for licensing production and utilization facilities.
  - 10 CFR 50.49, “Environmental qualification of electric equipment important to safety for nuclear power plants,” requires that holders or applicants for an operating license issued under 10 CFR Part 50 shall establish a program for the EQ of electric equipment.

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This RG is being issued in draft form to involve the public in the development of regulatory guidance in this area. It has not received final staff review or approval and does not represent an NRC final staff position. Public comments are being solicited on this DG and its associated regulatory analysis. Comments should be accompanied by appropriate supporting data. Comments may be submitted through the Federal rulemaking website, <http://www.regulations.gov>, by searching for draft regulatory guide DG-1442. Alternatively, comments may be submitted to the Office of Administration, Mailstop: TWFN 7A-06M, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, ATTN: Program Management, Announcements and Editing Staff. Comments must be submitted by the date indicated in the *Federal Register* notice.

Electronic copies of this DG, previous versions of DGs, and other recently issued guides are available through the NRC’s public website under the Regulatory Guides document collection of the NRC Library at <https://nrc.gov/reading-rm/doc-collections/reg-guides/index.html>. The DG is also available through the NRC’s Agencywide Documents Access and Management System (ADAMS) at <https://www.nrc.gov/reading-rm/adams.html>, under Accession No. ML24358A029. The regulatory analysis may be found in ADAMS under Accession No. ML24358A030.

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- 10 CFR 50.55a(h) provides requirements for protection and safety systems and incorporates by reference IEEE Std. 603-1991, “Criteria for Safety Systems for Nuclear Power Generating Plants,” (Ref. 4) and IEEE Std. 279-1971, “Criteria for Protection Systems for Nuclear Power Generating Stations” (Ref. 5), contingent on the date of construction permit issuance. The applicability of each of these standards to a given nuclear power plant depends on the plant’s licensing date and other criteria.
- 10 CFR 50.69, “Risk-informed categorization and treatment of structures, systems and components for nuclear power reactors,” states in part that a holder of a license to operate a light-water reactor nuclear power plant under 10 CFR Part 50; a holder of a renewed light-water reactor license under 10 CFR Part 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants”; an applicant for a construction permit or operating license under 10 CFR Part 50; or an applicant for a design approval, combined license, or manufacturing license under 10 CFR Part 52 may voluntarily comply with the requirements in 10 CFR 50.69 as an alternative to compliance with 10 CFR 50.49 for risk-informed safety class (RISC)-3 and RISC-4 structures, systems, and components (SSCs).
- General Design Criterion (GDC) 1, “Quality Standards and Records,” in Appendix A, “General Design Criteria for Nuclear Power Plants,” to 10 CFR Part 50 requires, in part, that SSCs important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.
- GDC 2, “Design Bases for Protection Against Natural Phenomena,” states, in part, that SSCs important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their safety functions.
- GDC 4, “Environmental and Dynamic Effects Design Bases,” states, in part, that SSCs important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents.
- GDC 22, “Protection System Independence,” states, in part, that the protection system shall be designed to provide assurance that the effects of natural phenomena and of normal operating, maintenance, testing, and postulated accident conditions on redundant channels do not result in loss of the protection function or shall be demonstrated to be acceptable on some other defined basis.
- GDC 23, “Protection System Failure Modes,” states, in part, that the protection system shall be designed to fail into a safe state or into a state demonstrated to be acceptable on some other defined basis if conditions such as disconnection of the system, loss of energy (e.g., electric power, instrument air), or postulated adverse environments (e.g., extreme heat or cold, fire, pressure, steam, water, and radiation) are experienced.
- Criterion III, “Design Control”; of Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” to 10 CFR Part 50 requires design control measures to verify the adequacy of the design.
- Criterion XI, “Test Control”; and Criterion XVII, “Quality Assurance Records,” of Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” to 10 CFR Part 50 requires a test program to provide assurance that all testing required to

demonstrate that SSCs will perform satisfactorily in service is performed in accordance with written procedures.

- Criterion XVII, “Quality Assurance Records,” of Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” to 10 CFR Part 50 requires the maintenance of sufficient records as evidence of quality assurance activities.
- 10 CFR Part 52 governs the issuance of early site permits, standard design certifications, combined licenses, standard design approvals, and manufacturing licenses for nuclear power facilities.

### **Related Guidance**

- NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” Section 3.11, “Environmental Qualification of Mechanical and Electrical Equipment” (Ref. 6), identifies staff guidance for determining that all items of equipment that are important to safety (mechanical, electrical, and instrumentation and control (I&C) equipment) can perform their design safety functions under all normal environmental conditions, anticipated operational occurrences, and accident and post-accident environmental conditions. It includes all environmental conditions that may result from any normal mode of plant operation, anticipated operational occurrences, design-basis events (as defined in 10 CFR 50.49(b)(1)(ii)), post-design-basis events, and containment tests.
- NUREG/CR-6384, Volume 1, Parts 1 and 2, “Literature Review of Environmental Qualification of Safety-Related Electric Cables,” issued April 1996 (Ref. 7), summarize the findings from a review of published documents regarding research on the EQ of safety-related electric cables used in nuclear power plants.
- RG 1.89, “Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants” (Ref. 8), describes an approach to meet regulatory requirements for environmental qualification (EQ) of certain electric equipment important to safety for nuclear power plants.
- RG 1.97, “Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants” (Ref. 9), describes a method to meet regulatory requirements with respect to satisfying criteria for accident monitoring instrumentation in nuclear power plants.
- RG 1.100, “Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants,” issued May 2020 (Ref. 10), discusses, in part, the seismic qualification of electrical equipment.
- RG 1.153, “Criteria for Safety Systems” (Ref. 11), describes a method to meet regulatory requirements for the design, reliability, qualification, and testability of the power, instrumentation, and control portions of safety systems of production and utilization facilities.

RG 1.189, “Fire Protection for Nuclear Power Plants” (Ref. 12), provides comprehensive fire protection guidance to applicants and licensees that identifies the scope and depth of fire protection that the staff would consider acceptable for nuclear power plants to meet fire protection regulations.

- RG 1.215, “Guidance for ITAAC Closure Under 10 CFR Part 52” (Ref. 13), describes a method for documenting the completion of inspections, tests, analyses, and acceptance criteria.

### **Purpose of Regulatory Guides**

The NRC issues RGs to describe methods that are acceptable to the staff for implementing specific parts of the agency’s regulations, to explain techniques that the staff uses in evaluating specific issues or postulated events, and to describe information that the staff needs in its review of applications for permits and licenses. Regulatory guides are not NRC regulations and compliance with them is not required. Methods and solutions that differ from those set forth in RGs are acceptable if the applicant provides sufficient basis and information for the NRC staff to verify that the alternative methods comply with the applicable NRC regulations.

### **Paperwork Reduction Act**

This RG provides voluntary guidance for implementing the mandatory information collections in 10 CFR Parts 50, 50.55a, and 52 that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et. seq.). These information collections were approved by the Office of Management and Budget (OMB), under control numbers 3150-0011, 3150-0264, and 3150-0151, respectively. Send comments regarding this information collection to the FOIA, Library, and Information Collections Branch, Office of the Chief Information Officer, Mail Stop: T6-A10M, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001 or by e-mail to [Infocollects.Resource@nrc.gov](mailto:Infocollects.Resource@nrc.gov), and to the OMB reviewer at: OMB Office of Information and Regulatory Affairs (3150-0011, 3150-0264, and 3150-0151), Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street, NW, Washington, DC, 20503.

### **Public Protection Notification**

The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

## **B. DISCUSSION**

### **Reason for Revision**

This revision of the guide (Revision 1) endorses, subject to the conditions described in Section C of this RG, IEEE Std. 383-2023 and applies to production and utilization facilities licensed under 10 CFR Part 50 and 10 CFR Part 52 within the scope of this RG. The previous version of this RG endorsed, with certain clarifications, IEEE Std. 383-2003. In 2023, the IEEE revised IEEE Std. 383 to provide greater guidance for cable and splice qualification and to clarify the existing principles of qualification provided by International Electrotechnical Commission (IEC)/IEEE Std. 60780-323-2016, “Nuclear facilities—Electrical equipment important to safety—Qualification,” Edition 1 (Ref. 14).

### **Background**

This RG provides guidance to applicants and licensees to meet regulatory requirements for the EQ of safety-related cables and field splices in production and utilization facilities.

IEEE Std. 383-2023 is an updated consensus standard that adds new recommendations and guidance for EQ of cables and splices. The standard was developed by the IEEE Power Engineering Society Nuclear Power Engineering Committee and approved by the IEEE Standards Association Standards Board on September 21, 2023.

IEEE Std. 383-2023 discusses EQ and how various electric cable designs and splices, including conductor types and their jackets and insulation, affect that qualification (type testing, operating experience, or analysis); qualified life extension; the role of condition monitoring; age conditioning and how it is performed; normal and mild environments; flame test qualification; and how changes in materials, design of cables and splices, or postulated environments affect qualification.

### **Consideration of International Standards**

The International Atomic Energy Agency (IAEA) works with member states and other partners to promote the safe, secure, and peaceful use of nuclear technologies. The IAEA develops Safety Requirements and Safety Guides for protecting people and the environment from harmful effects of ionizing radiation. This system of safety fundamentals, safety requirements, safety guides, and other relevant reports, reflects an international perspective on what constitutes a high level of safety. To inform its development of this RG, the NRC considered IAEA Safety Requirements and Safety Guides pursuant to the Commission’s International Policy Statement and Management Directive and Handbook 6.6, “Regulatory Guides.”

The following IAEA Safety Requirements and Guides were considered in the update of the Regulatory Guide:

- Specific Safety Guide No. SSG-48, “Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants,” issued 2018 (Ref. 15)
- Safety Report Series No. 3, “Equipment Qualification in Operational Nuclear Power Plants: Upgrading, Preserving and Reviewing,” issued April 1998 (Ref. 16)

## **Documents Discussed in Staff Regulatory Guidance**

This RG endorses, in part, the use of one or more codes or standards developed by external organizations, and other third-party guidance documents. These codes, standards and third-party guidance documents may contain references to other codes, standards or third-party guidance documents (“secondary references”). If a secondary reference has itself been incorporated by reference into NRC regulations as a requirement, then licensees and applicants must comply with that standard as set forth in the regulation. If the secondary reference has been endorsed in an RG as an acceptable approach for meeting an NRC requirement, then the standard constitutes a method acceptable to the NRC staff for meeting that regulatory requirement as described in the specific RG. If the secondary reference has neither been incorporated by reference into NRC regulations nor endorsed in an RG, then the secondary reference is neither a legally binding requirement nor a “generic” NRC approved acceptable approach for meeting an NRC requirement. However, licensees and applicants may consider and use the information in the secondary reference, if appropriately justified, consistent with current regulatory practice, and consistent with applicable NRC requirements.

## **C. STAFF REGULATORY GUIDANCE**

The staff finds that IEEE Std. 383-2023 provides methods acceptable to the NRC for meeting the regulatory requirements for the EQ of electric cables and splices in production and utilization facilities subject to the following:

1. This RG does not endorse Section 2, “Normative References,” of IEEE Std. 383-2023. RG 1.89, which endorses IEC/IEEE Std. 60780-323-2016, with clarifications, contains additional information on EQ of certain electric equipment important to safety for nuclear power plants, and RG 1.189, which endorses IEEE Std. 1202, “IEEE Standard for Flame-Propagation Testing of Wire and Cable,” with clarifications, contains additional information on electrical cable system fire protection design.

## **D. IMPLEMENTATION**

Licensees generally are not required to comply with the guidance in this regulatory guide. If the NRC proposes to use this regulatory guide in an action that would constitute backfitting, as that term is defined in 10 CFR 50.109, “Backfitting,” and as described in NRC Management Directive 8.4, “Management of Backfitting, Forward Fitting, Issue Finality, and Information Requests” (Ref. 17); affect the issue finality of an approval issued under 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants”; or constitute forward fitting, as that term is defined in Management Directive 8.4, then the NRC staff will apply the applicable policy in Management Directive 8.4 to justify the action. If a licensee believes that the NRC is using this regulatory guide in a manner inconsistent with the discussion in this Implementation section, then the licensee may inform the NRC staff in accordance with Management Directive 8.4.

## REFERENCES<sup>1</sup>

These references indicate the versions of the documents available at the time of issuance of this regulatory guide (RG). Licensees or applicants using this RG should check all referenced documents to verify that no change has occurred since the issuance of the RG.

1. Institute of Electrical and Electronic Engineers (IEEE) Standard (Std.) 383-2023, “IEEE Standard for Qualifying Electric Cables and Splices for Nuclear Facilities,” Piscataway, New Jersey, 2023.
2. *U.S. Code of Federal Regulations* (CFR), “Domestic Licensing of Production and Utilization Facilities,” Part 50, Chapter I, Title 10, “Energy.”
3. CFR, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” Part 52, Chapter I, Title 10, “Energy.”
4. IEEE Std. 603-1991, “Criteria for Safety Systems for Nuclear Power Generating Plants” Piscataway, New Jersey, 1991
5. IEEE Std. 279-1971, “Criteria for Protection Systems for Nuclear Power Generating Stations”, Piscataway, New Jersey, 1971
6. U.S. Nuclear Regulatory Commission (NRC), NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” Section 3.11, “Environmental Qualification of Mechanical and Electrical Equipment,” Washington, DC.
7. NRC, NUREG/CR-6384, Volume 1, Parts 1 and 2, “Literature Review of Environmental Qualification of Safety-Related Electric Cables,” Washington, DC, April 1996.
8. NRC, Regulatory Guide (RG) 1.89, “Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants,” Washington, DC.
9. NRC, RG 1.97, “Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants,” Washington, DC.
10. NRC, RG 1.100, “Seismic Qualification of Electrical and Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants,” Washington, DC, May 2020.
11. NRC, RG 1.153, “Criteria for Safety Systems,” Washington, DC.
12. NRC, RG 1.189, “Fire Protection for Nuclear Power Plants,” Washington, DC.
13. NRC, RG 1.215, “Guidance for ITAAC Closure Under 10 CFR Part 52,” Washington, DC.

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<sup>1</sup> Publicly available NRC published documents are available electronically through the NRC Library on the NRC’s public website at <http://www.nrc.gov/reading-rm/doc-collections/> and through the NRC’s ADAMS at <http://www.nrc.gov/reading-rm/adams.html>. The documents can also be viewed online or printed for a fee in the NRC’s Public Document Room (PDR) at 11555 Rockville Pike, Rockville, MD. For problems with ADAMS, contact the PDR staff at 301-415-4737 or (800) 397-4209; fax (301) 415-3548; or email [pdr.resource@nrc.gov](mailto:pdr.resource@nrc.gov).

14. International Electrotechnical Commission (IEC)/IEEE Std. 60780-323-2016, “Nuclear facilities —Electrical equipment important to safety—Qualification,” Edition 1, Piscataway, New Jersey, 2016.
15. International Atomic Energy Agency (IAEA) Specific Safety Guide No. SSG-48, “Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants,” Vienna, Austria, 2018.<sup>2</sup>
16. IAEA Safety Report Series No. 3, “Equipment Qualification in Operational Nuclear Power Plants: Upgrading, Preserving and Reviewing,” Vienna, Austria, 1998.
17. NRC, Management Directive 8.4, “Management of Backfitting, Forward Fitting, Issue Finality, and Information Requests,” Washington, DC.

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<sup>2</sup> Copies of IAEA documents may be obtained through their website: [WWW.IAEA.ORG/](http://WWW.IAEA.ORG/) or by writing the International Atomic Energy Agency, P.O. Box 100 Wagramer Strasse 5, A-1400 Vienna, Austria.