

U.S. NUCLEAR REGULATORY COMMISSION

REGULATORY GUIDE 1.248, Revision 0



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GUIDE FOR ASSESSING, MONITORING, AND MITIGATING AGING EFFECTS ON ELECTRICAL EQUIPMENT USED IN 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 managing, monitoring, and mitigating the aging effects on electrical equipment. It endorses Institute of Electrical and Electronics Engineers (IEEE) Standard (Std.) 1205-2014, “IEEE Guide for Assessing, Monitoring, and Mitigating Aging Effects on Electrical Equipment Used in Nuclear Power Generating Stations and Other 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); 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants” (Ref. 3); 10 CFR Part 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants” (Ref. 4). With respect to 10 CFR Part 50, this RG applies to holders of or applicants for an operating license and / or holders of a renewed or subsequently renewed operating license. With respect to 10 CFR Part 52, this RG applies to holders of and applicants for combined licenses, standard design certifications, standard design approvals, and manufacturing licenses. With respect to 10 CFR Part 54, this RG applies to applicants for and holders of a renewed or subsequently renewed operating license. This RG does not apply to nuclear power plants that have submitted licensing termination certifications as required by 10 CFR 50.82(a)(1) and 10 CFR 52.110(a).

Applicable Regulations

- 10 CFR Part 50 requires, among other things, that structures, systems, and components (SSCs) that are important to safety must be designed to accommodate the effects of environmental conditions (i.e., remain functional under postulated design-basis events).

Written suggestions regarding this guide may be submitted through the NRC’s public Web site in the NRC Library at <https://nrc.gov/reading-rm/doc-collections/reg-guides/index.html>, under Document Collections, in Regulatory Guides, at <https://nrc.gov/reading-rm/doc-collections/reg-guides/contactus.html>, and will be considered in future updates and enhancements to the “Regulatory Guide” series. During the development process of new guides suggestions should be submitted within the comment period for immediate consideration. Suggestions received outside of the comment period will be considered if practical to do so or may be considered for future updates.

Electronic copies of this RG, previous versions of RGs, and other recently issued guides are also available through the NRC’s public web site in the NRC Library at <https://nrc.gov/reading-rm/doc-collections/reg-guides/>, under Document Collections, in Regulatory Guides. This RG is also available through the NRC’s Agencywide Documents Access and Management System (ADAMS) at <http://www.nrc.gov/reading-rm/adams.html>, under ADAMS Accession Number (No.) ML22221A220. The regulatory analysis may be found in ADAMS under Accession No. ML21288A112. The associated draft guide DG-1393 may be found in ADAMS under Accession No. ML21288A115, and the staff responses to the public comments on DG-1393 may be found under ADAMS Accession No. ML22221A222.

- 10 CFR 50.34(b)(6)(iv) requires each application for an operating license to include a final safety analysis report that contains plans for conducting normal operations, including maintenance, surveillance, and periodic testing of SSCs.
- 10 CFR 50.49(a), “Environmental qualification of electric equipment important to safety for nuclear power plants,” requires that holders of or applicants for an operating license issued under 10 CFR Part 50 or a combined license or a manufacturing license issued under 10 CFR Part 52 shall establish a program for the environmental qualification of electric equipment as defined in 10 CFR 50.49(b). For a manufacturing license (as defined in 10 CFR 52.157), only electric equipment defined in 10 CFR 50.49(b) that is within the scope of the manufactured reactor must be included in the program.
- 10 CFR 50.65, “Requirements for monitoring the effectiveness of maintenance at nuclear power plants,” requires that each holder of an operating license for a nuclear power plant under 10 CFR Part 50 and each holder of a combined license under 10 CFR Part 52 (after the Commission makes the finding under 10 CFR 52.103(g)) shall monitor the performance or condition of SSCs against licensee-established goals, in a manner sufficient to provide reasonable assurance that these SSCs are capable of fulfilling their intended functions. These goals shall be established commensurate with safety and, where practical, take into account industrywide operating experience. When the performance or condition of an SSC does not meet established goals, appropriate corrective action shall be taken. For a nuclear power plant for which the licensee has submitted the certifications specified in 10 CFR 50.82(a)(1) or 10 CFR 52.110(a)(1), as applicable, 10 CFR 50.65 shall only apply to the extent that the licensee shall monitor the performance or condition of all SSCs associated with the storage, control, and maintenance of spent fuel in a safe condition, in a manner sufficient to provide reasonable assurance that these SSCs are capable of fulfilling their intended functions.
- General Design Criterion 4, “Environmental and dynamic effects design bases,” of Appendix A, “General Design Criteria for Nuclear Power Plants,” to 10 CFR Part 50 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.
- 10 CFR Part 52 requires that SSCs important to safety in a nuclear power plant be designed to accommodate the effects of environmental conditions and that design control measures, such as testing, be used to check the adequacy of the design.
 - Under 10 CFR 52.79(a)(15), an application for a combined license shall contain a final safety analysis report that describes the program, and its implementation, for monitoring the effectiveness of maintenance necessary to meet the requirements of 10 CFR 50.65.
- 10 CFR Part 54 provides the requirements for the issuance of renewed (or subsequently renewed) operating licenses and renewed (or subsequently renewed) combined licenses for nuclear power plants licensed in accordance with Sections 103 or 104b of the Atomic Energy Act of 1954, as amended (Ref. 5), and Title II of the Energy Reorganization Act of 1974 (Ref. 6).
 - 10 CFR 54.4, “Scope,” provides that SSCs within the scope of 10 CFR Part 54 include SSCs that are relied upon to remain functional during and following design-basis events (as defined in 10 CFR 50.49 (b)(1)) to ensure the performance or accomplishment of certain specified functions, including, among other things, SSCs that are relied on in

safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission's regulations for environmental qualification (10 CFR 50.49).

- 10 CFR 54.21, “Contents of application—technical information,” provides the requirements for the technical information in a license renewal application or a subsequent license renewal application.
- 10 CFR 54.21(a)(3) states, “For each structure and component identified in paragraph (a)(1) of this section, demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB [current licensing basis] for the period of extended operation.”

Related Guidance

- RG 1.89, “Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants” (Ref 7), describes a method acceptable to the NRC staff for complying with 10 CFR 50.49.
- RG 1.160, “Monitoring the Effectiveness of Maintenance at Nuclear Power Plants” (Ref. 8), provides general guidelines for complying with 10 CFR 50.65(a)(1).
- RG 1.218, “Condition Monitoring Techniques for Electric Cables Used in Nuclear Power Plants” (Ref. 9), describes a programmatic approach to condition monitoring of electric cable systems and their operating environments, as well as acceptable condition monitoring techniques.
- NUREG-1537, Parts 1 and 2, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors,” issued February 1996 (Ref. 10), contains format and content guidance for non-power reactor applicants and licensees, as well as a standard review plan and acceptance criteria for NRC staff.
- “Final Interim Staff Guidance Augmenting NUREG-1537, ‘Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Parts 1 and 2’, for Licensing Radioisotope Production Facilities and Aqueous Homogeneous Reactors,” issued October 2012 (Ref. 11), contains format and content guidance for non-power aqueous homogeneous reactor and radioisotope production facility applicants and licensees, as well as a standard review plan and acceptance criteria for the NRC staff.
- “Endorsement of Appendix A to Oak Ridge National Laboratory Report, ‘Proposed Guidance For Preparing and Reviewing A Molten Salt Non-Power Reactor Application,’ as Guidance for Preparing Applications for the Licensing of Non-Power Liquid Fueled Molten Salt Reactors,” dated November 18, 2020, (Ref. 12) which endorses with clarifications, “Proposed Guidance for Preparing and Reviewing a Molten Salt Non-Power Reactor Application” (ORNL/TM-2020/1478) to support the review of non-power molten salt reactors (Ref. 13).
- NUREG-1800, “Standard Review Plan for Review of License Renewal Applications for Nuclear power Plants,” Revision 2, issued December 2010 (Ref. 14), provides the criteria used by the NRC staff for reviewing aging management programs for in-scope SSCs for nuclear power plants for the initial renewal of an operating license.

- NUREG-1801, “Generic Aging Lessons Learned (GALL) Report,” Revision 2, issued December 2010 (Ref. 15), provides recommendations for managing the effects of aging of in-scope SSCs for the initial renewal of an operating license.
- NUREG-2191, Volumes 1 and 2, “Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report,” issued July 2017 (Ref. 16), provides recommendations for managing, monitoring and aging management of in-scope SSCs for the subsequent renewal of renewed operating licenses.
- NUREG-2192, “Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants—Final Report,” issued July 2017 (Ref. 17), provides guidance to the NRC staff for the review of aging management programs for in-scope SSCs for subsequent license renewal applications that request operation for 60 to 80 years.

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 supported by a basis for the issuance or continuance of a permit or license by the Commission.

Paperwork Reduction Act

This RG provides voluntary guidance for implementing the mandatory information collections in 10 CFR Parts 50, 52 and 54 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), approval numbers 3150-0011, 3150-0151 and 3150-0155. Send comments regarding this information collection to the FOIA, Library, and Information Collections Branch (T6-A10M), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollects.Resource@nrc.gov, and to the OMB reviewer at: OMB Office of Information and Regulatory Affairs (3150-0011, 3150-0151 and 3150-0155), Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street, NW Washington, DC 20503; e-mail: oira_submission@omb.eop.gov.

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 Issuance

The NRC is issuing this guide to endorse IEEE Std. 1205-2014 which provides an approach acceptable to the NRC staff for meeting regulatory requirements for managing, monitoring, and mitigating aging effects on electrical equipment. Providing this regulatory guide to endorse IEEE Std. 1205-2014 is consistent with the NRC policy of reviewing the latest versions of national consensus standards to determine their suitability for endorsement by regulatory guides. This guide provides information relevant to facilities operating during the initial license period (e.g., initial 40 years) as well as extended operations under license renewal and subsequent license renewal periods of operation (60 to 80 years).

Background

Production and utilization facilities licensed under 10 CFR Part 50 and 10 CFR Part 52 are required, under 10 CFR 50.65, to monitor the performance or condition of SSCs against licensee-established goals, in a manner sufficient to provide reasonable assurance that these SSCs are capable of fulfilling their intended functions. These goals shall be established commensurate with safety and, where practical, consider industrywide operating experience. When the performance or condition of SSCs does not meet established goals, appropriate corrective action shall be taken.

The integrity of SSCs is monitored, in part, through periodic surveillance testing and performance monitoring at a system level. However, surveillance testing and performance monitoring may not specifically focus on each component and may not be sufficient to detect all the aging and degradation mechanisms to which a particular piece of equipment or component is susceptible. Also, while surveillance tests can demonstrate the function and current performance of the equipment and components under test conditions, the tests do not verify the continued successful performance of equipment and components when they are called upon to operate under their worst case design loading conditions for extended periods when aging phenomena can appear (e.g., years of future service), as they would under anticipated normal service operating conditions or under design-basis accident conditions. Therefore, periodic surveillance testing of associated equipment may not provide specific information on the status of aging degradation processes or physical integrity of the aggregate parts and components. Consequently, a component with undetected damage or degraded condition could pass a system functional test but still fail unexpectedly when called upon to function under anticipated environmental conditions or the more severe stresses encountered during a design-basis event (e.g., fully loaded equipment, more extreme environmental conditions, extended operation in a heavily loaded state)

Applicants for and holders of renewed licenses under 10 CFR Part 54 are required to demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation. The scope of the SSCs under this rule includes, for the most part, passive long-lived components, which includes such components as electrical cables, metal enclosed buses, electrical connections, transmission conductors, and switchyard buses.

This RG provides guidelines and methods acceptable to the NRC staff for managing, monitoring, and mitigating aging effects on electrical equipment.

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 the 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 staff considered IAEA Safety Requirements and Safety Guides pursuant to the Commission's International Policy Statement (Ref. 18) and Management Directive and Handbook 6.6, "Regulatory Guides" (Ref. 19).

The NRC staff has actively participated with the IAEA in developing and updating the IAEA International Generic Aging Lessons Learned (IGALL) program. The development of IGALL started with NRC guidance for license renewal from the GALL Report, Revision 2, and the latest updates to IGALL used GALL-SLR technical information as the basis for many of the updates. The NRC continues to review information from IGALL program counterparts and to evaluate the need to make changes to the GALL Report and the GALL-SLR. The staff considered IAEA Safety Reports Series No. 82, "Ageing Management for Nuclear Power Plants: International Generic Ageing Lessons Learned (IGALL)," issued 2015 (Ref. 20), to identify any additional useful information.

Documents Discussed in Staff Regulatory Guidance

This RG endorses in part, the use of one or more codes or standards developed by external organizations (i.e., Institute of Electrical and Electronic Engineers (IEEE), 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 a 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 a 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 NRC staff considers conformance with the provisions in IEEE Standard 1205-2014 to constitute an acceptable method for use in satisfying the Commission's regulations with respect to maintenance and aging management of applicable SSCs subject to aging stressors, aging mechanisms, and aging effects to ensure facility safety throughout the period of initial license operation, extended operation, and subsequent extended operation.

D. IMPLEMENTATION

The NRC staff may use this RG as a reference in its regulatory processes, such as licensing, inspection, or enforcement, as appropriate. However, the NRC staff does not intend to use the guidance in this RG to support NRC staff actions in a manner 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. 21), nor does the NRC staff intend to use the guidance to affect the issue finality of an approval under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The staff also does not intend to use the guidance to support NRC staff actions in a manner that constitutes forward fitting as that term is defined and described in Management Directive 8.4. If a licensee believes that the NRC is using this RG in a manner inconsistent with the discussion in this Implementation section, then the licensee may file a backfitting or forward fitting appeal with the NRC in accordance with the process in Management Directive 8.4.

REFERENCES¹

1. Institute for Electrical and Electronics Engineers (IEEE) Std. 1205-2014, “IEEE Guide for Assessing, Monitoring, and Mitigating Aging Effects on Electrical Equipment Used in Nuclear Power Generating Stations and Other Nuclear Facilities,” Piscataway, NJ.²
2. *U.S. Code of Federal Regulations* (CFR), “Domestic Licensing of Production and Utilization Facilities,” Part 50, Chapter 1, Title 10, “Energy”
3. CFR, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” Part 52, Chapter 1, Title 10, “Energy”
4. CFR, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants,” Part 54, Chapter 1, Title 10, “Energy.”
5. *Atomic Energy Act of 1954*, as amended, Section 42, United States Code (U.S.C.) § 2161, et seq.
6. Energy Reorganization Act of 1974, Public Law 93-438, 88 Stat. 1233.
7. NRC, Regulatory Guide 1.89, “Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants,” Washington DC.
8. U.S. Nuclear Regulatory Commission (NRC), Regulatory Guide 1.160, “Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,” Washington DC.
9. NRC, Regulatory Guide 1.218, “Condition Monitoring Techniques for Electric Cables Used in Nuclear Power Plants,” Washington DC.
10. NRC, NUREG 1537, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors,” Washington, DC, February 1996. (ADAMS Accession Nos. ML042430055 and ML042430048)
11. NRC, “Final Interim Staff Guidance Augmenting NUREG-1537, ‘Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors,’ for Licensing Radioisotope Production Facilities and Aqueous Homogeneous Reactors,” Washington, DC. (ML12156A069 and ML12156A075)
12. NRC, “Endorsement of Appendix A to Oak Ridge National Laboratory Report, ‘Proposed Guidance for Preparing and Reviewing A Molten Salt Non-Power Reactor Application,’ as Guidance for Preparing Applications for the Licensing of Non-Power Liquid Fueled Molten Salt Reactors,” Washington, DC. (ML20251A008)

1 Publicly available NRC published documents are available electronically through the NRC Library on the NRC’s public Web site at <http://www.nrc.gov/reading-rm/doc-collections/> and through the NRC’s Agencywide Documents Access and Management System (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 e-mail pdr_resource@nrc.gov

¹ Copies of Institute of Electrical and Electronics Engineers (IEEE) documents may be purchased from the Institute of Electrical and Electronics Engineers Service Center, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855 or through the IEEE’s public Web site at http://www.ieee.org/publications_standards/index.html

13. Oak Ridge National Laboratory, ORNL/TM-2020/1478, “Proposed Guidance for Preparing and Reviewing a Molten Salt Non-Power Reactor Application, Oak Ridge, TN. (ML20219A771)
14. NRC, NUREG-1800, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants,” Revision 2, Washington DC, December 2010. (ML103490036)
15. NRC, NUREG-1801, “Generic Aging Lessons Learned (GALL) Report,” Revision 2, Washington, DC, December 2010. (ML103490041)
16. NRC, NUREG-2191, Volumes 1 and 2, “Generic Aging Lessons Learned for Subsequent License Renewal (GALL-SLR) Report,” Washington, DC, July 2017. (ML17187A031 and ML17187A204)
17. NRC, NUREG-2192, “Standard Review Plan for Review of Subsequent License Renewal Applications for Nuclear Power Plants—Final Report,” Washington, DC, July 2017. (ML17188A158).
18. NRC, “Nuclear Regulatory Commission International Policy Statement,” *Federal Register*, Vol. 79, No. 132, July 10, 2014, pp. 39415–39418
19. NRC, Management Directive and Handbook 6.6, “Regulatory Guides,” Washington, DC.
20. International Atomic Energy Agency, Safety Reports Series No. 82, “Ageing Management for Nuclear Power Plants: International Generic Ageing Lessons Learned (IGALL),” Vienna, Austria, 2015³
21. NRC, Management Directive 8.4, “Management of Backfitting, Forward Fitting, Issue Finality, and Information Requests,” Washington, DC, September 20, 2019.

3 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.