

IEEE Guide for Assessing, Monitoring, and Mitigating Aging Effects on Electrical Equipment Used in Nuclear Power Generating Stations and Other Nuclear Facilities

IEEE Power and Energy Society

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Nuclear Power Engineering Committee

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of the
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Abstract: Guidelines for assessing, monitoring, and mitigating aging degradation effects on electrical equipment used in nuclear power generating stations and other nuclear facilities are provided. This guide also includes informative annexes on aging mechanisms, environmental monitoring, condition monitoring, aging program essential attributes, and examples demonstrating the application of the basic principles described in this guideline.

Keywords: activation energy, aging, aging assessment, aging effects, aging management, Arrhenius, condition monitoring, degradation, environmental monitoring, IEEE 1205™, license renewal, radiation aging model, residual life, stressor, thermal aging model

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Introduction

This introduction is not part of 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.

In 1988, the Nuclear Power Engineering Committee (NPEC) of IEEE recognized a need for, and directed Working Group 3.4 to prepare a guide for, providing guidance and promoting uniformity in the evaluation methods used in aging assessment, monitoring, and mitigation. The working group's effort culminated in 1993 with the original issue of IEEE Std 1205, which reflected the industry focus on identifying and addressing aging mechanisms. The guide was revised in 2000 to incorporate industry feedback and bring the approaches discussed in the guide into closer conformance with the industry philosophy at that time and then was reaffirmed in 2007.

IEEE Std 1205-2014 is the result of a thorough review of IEEE Std 1205-2000 and of present practices in aging management of electrical equipment. This revision incorporates current practices and lessons learned from the implementation of previous versions of this standard by the nuclear industry.

It has never been the intent of this guide to imply that new programs be established for aging assessment. Aging assessments should not be directed toward an endless search for data and information, but rather should be an effort that is practical, cost-effective, and based on collecting and evaluating a minimum set of data and information collected preferably from existing programs.

The working group believes that this guide is useful in supporting equipment qualification program aging assessment updates, failure evaluations related to the Code of Federal Regulations Title 10 Part 50.65 (10CFR50.65) (known as the "Maintenance Rule") [B11], other root cause evaluations, and license renewal aging management reviews. To facilitate these types of uses, the working group changed this guide as follows:

- Expanded the scope to include all electrical equipment instead of only Class 1E equipment in accordance with current industry application of the guide.
- Revised and consolidated the block diagrams that describe the overall aging assessment and management process to be consistent with current industry philosophy and to better show the relationships between the IEEE Std 1205 process steps and other applicable guidance.
- Incorporated Corrigendum 1 to correct the value of Boltzmann's constant and other minor comments received during the prior reaffirmation of the guide.
- Revised Clause 4, Clause 5, Clause 6, and Clause 7 for improved consistency with the new process block diagram.
- Updated Annex A on aging effects to reflect the current state of industry knowledge for polymers, lubricants, and metals, and added a new table for aging mechanisms and effects for printed circuit boards (PCBs).
- Updated Annex C on condition monitoring to more accurately reflect the current industry practice.
- Deleted extraneous example assessments, and updated the remaining examples in Annex D for consistency with the revised process diagram and main body of the guide.
- Added a new Annex E to provide examples of specific applications of the Arrhenius methodology.
- Updated the bibliography in Annex G to reflect recent aging assessment-related research and industry activities.

A future activity of the working group will be to develop a new annex on risk-informed aging management.

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1. Overview

1.1 Scope

This document provides guidelines for assessing, monitoring, and mitigating aging effects on electrical equipment used in nuclear power generating stations and other nuclear facilities.

1.2 Purpose

The purpose of this document is to provide guidance in assessing and monitoring aging effects and in developing and implementing aging management programs for electrical equipment used in nuclear power generating stations and other nuclear facilities.