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IEEE Guide for General Principles of Reliability Analysis of Nuclear Power Generating Station Systems and Other Nuclear Facilities

IEEE Power and Energy Society

Sponsored by the
Nuclear Power Engineering Committee

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Abstract: General reliability and availability analysis methods that can be applied to structures, systems, and components (SSCs) in nuclear power generating stations and other nuclear facilities are contained in this guide.

Keywords: availability, Class 1E, failure rate, IEEE 352™, MTBF, MTTF, MTTR, nuclear power generating station, reliability

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Introduction

This introduction is not part of IEEE Std 352-2016, IEEE Guide for General Principles of Reliability Analysis of Nuclear Power Generating Station Systems and Other Nuclear Facilities.

This document is basically tutorial and has been prepared to provide the user with the basic principles that are needed to conduct a reliability analysis of safety systems. It is not expected or intended that any individual or organization would need all of the principles that are presented. For example, an organization may be concerned with quantitative analysis and mathematical modeling as discussed in Clause 6. The very important problem of failure data is discussed in Clause 7; the material on probability distributions, estimation, and confidence intervals may be used by those who are concerned with analysis and evaluation of failure and repair rate data that will be accumulated as nuclear power generating station operating experience is accrued. The material on established data programs may be of more immediate use to those who make reliability or availability predictions on current safety system designs.

This document was originally prepared to provide a common and consistent means of reliability analysis for protection systems covered by IEEE Std 279™-1971, IEEE Standard: Criteria for Protection Systems for Nuclear Power Generating Stations. In the intervening years, IEEE Std 279 has been superseded by IEEE Std 603™, and in March, 1984, IEEE Std 279 was withdrawn. This standard has been expanded in revisions since 1971 to include many technical areas as they have become important. In accord with the current version of IEEE Std 603, it has been generalized to apply to safety systems.

The general principles presented in this document, and further information given by the references, are sufficient to conduct the reliability/availability analyses of safety systems, but not every analysis will necessarily employ all of the general principles that are presented. Furthermore, the principles contained herein are not necessarily limited to nuclear power plant safety systems. They may be applied to the analyses of other facilities and systems by selecting those parts of the principles relevant to those other facilities/systems.

The current revision of this document contains much updated information and clarification, but adheres to the general principles put forth in previous editions.

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IEEE Guide for General Principles of Reliability Analysis of Nuclear Power Generating Station Systems and Other Nuclear Facilities

1. Overview

1.1 General

This guide was prepared to provide the designers and operators of nuclear power plant safety systems and concerned regulatory groups with the essential methods and procedures of reliability engineering that are applicable to such systems. By applying the principles given, systems may be analyzed, results may be compared with reliability objectives, and the basis for decisions may be suitably documented.

The quantitative principles are applicable to the analysis of the effects of component failures on safety system reliability. The principles are applicable during any phase of the system's lifetime. They have their greatest value during the design phase. During this phase, reliability engineering can make the greatest contribution toward enhancing safety.

These principles may also be applied during the preoperational phase or at any time during the normal lifetime of a system. When the principles are applied during either of these two phases, they will aid in the evaluation of systems, in the preparation or revision of operating or maintenance procedures, and in improving test programs. Although not inherently limited, these principles are intended for application to systems covered in the scope of IEEE Std 603™ [B24].[1]

1.2 Scope

This guide contains general reliability and availability analysis methods that can be applied to structures, systems, and components (SSCs) in nuclear power generating stations and other nuclear facilities.

[1]The numbers in brackets correspond to those of the references listed in the bibliography in Annex A.

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