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# INTERNATIONAL STANDARD

**Nuclear power plants - Instrumentation systems important to safety - Characteristics and test methods of nuclear reactor reactivity meters**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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IEC 63374 has been prepared by subcommittee 45A: Instrumentation, control and electrical power systems of nuclear facilities, of IEC technical committee 45: Nuclear instrumentation. It is an International Standard.

The text of this International Standard is based on the following documents:

| Draft | Report on voting |
|---|---|
| 45A/1611/FDIS | 45A/1621/RVD |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

# INTRODUCTION

**a) Technical background, main issues and organization of the document**

This document focuses on characteristics and test methods of nuclear reactor reactivity meters. Reactivity is the fundamental parameter that instantaneously characterizes the evolution of the power of a reactor. The measurement of reactivity in a nuclear power plant is used to indicate the deviation of the effective neutron multiplication factor from unity. A reactivity meter directly calculates the reactivity from a measurement of neutron flux of the reactor by solving the kinetic equations of the point reactor model. It is intended that this document be used by operators of nuclear power plants (NPPs), systems evaluators and licensors.

**b) Situation of this document in the structure of the IEC SC 45A standard series**

IEC 63374 is a third level IEC/SC 45A document. For more details on the structure of the IEC SC 45A standard series, see item d) of this Introduction.

**c) Recommendations and limitations regarding the application of this document**

To ensure that this document will continue to be relevant in future years, the emphasis has been placed on issues of principle, rather than specific technologies.

**d) Description of the structure of the IEC SC 45A standard series and relationships with other IEC documents and other bodies' documents (IAEA, ISO)**

The IEC SC 45A standard series comprises a consistent set of documents organised in a hierarchy of four levels. The top-level documents of the IEC SC 45A standard series are IEC 61513 and IEC 63046, covering respectively general requirements for instrumentation and control (I&C) systems and general requirements for electrical power systems of NPPs. IEC 61513 and IEC 63046 adopt an overall system life-cycle framework and constitute, along with the relevant second-level standards, the nuclear implementation of the basic safety series IEC 61508.

IEC 61513 and IEC 63046 refer directly to other IEC SC 45A standards for general requirements for specific topics, such as categorization of functions and classification of systems, qualification, separation, defence against common cause failure, control room design, electromagnetic compatibility, human factors engineering, cybersecurity, software and hardware aspects for programmable digital systems, coordination of safety and security requirements and management of ageing.

At a third level, IEC SC 45A standards not directly referenced by IEC 61513 or by IEC 63046 are standards related to specific requirements for specific equipment, technical methods, or activities. Usually, these documents refer to second-level documents for general requirements and can be used on their own.

A fourth level extending the IEC SC 45A standard series corresponds to Technical Reports which are not normative.

The IEC SC 45A standards series consistently implements and details the safety and security principles and basic aspects provided in the relevant IAEA safety standards and in the relevant documents of the IAEA nuclear security series (NSS). In particular this includes the IAEA requirements SSR-2/1 , establishing safety requirements related to the design of nuclear power plants (NPPs), the IAEA safety guide SSG-30 dealing with the safety classification of structures, systems and components in NPPs, the IAEA safety guide SSG-39 dealing with the design of instrumentation and control systems for NPPs, the IAEA safety guide SSG-34 dealing with the design of electrical power systems for NPPs, the IAEA safety guide SSG-51 dealing with human factors engineering in the design of NPPs and the implementing guide NSS42-G for computer security at nuclear facilities. The safety and security terminology and definitions used by the SC 45A standards are consistent with those used by the IAEA.

IEC 61513 and IEC 63046 refer to ISO 9001 as well as to IAEA GSR part 2 and IAEA GS-G-3.1 and IAEA GS-G-3.5 for topics related to quality assurance (QA).

At level 2, regarding nuclear security, IEC 62645 is the entry document for the IEC/SC 45A security standards. It builds upon the valid high-level principles and main concepts of the generic security standards, in particular ISO/IEC 27001 and ISO/IEC 27002; it adapts them and completes them to fit the nuclear context and coordinates with the IEC 62443 series. At level 2, IEC 60964 is the entry document for the IEC/SC 45A control rooms standards, IEC 63351 is the entry document for the human factors engineering standards and IEC 62342 is the entry document for the ageing management standards.

NOTE IEC TR 63400 provides a more comprehensive description of the overall structure of the IEC SC 45A standards series and of its relationship with other standards bodies and standards.

## 1 Scope

This document specifies the characteristics and test methods for reactivity meters. Other methods for measuring reactivity are not addressed in this document.

This document provides guidance for the design, production and operation of reactivity meters. This document is applicable to various types of nuclear reactors that can be described by the neutron kinetic point reactor model, such as pressurized water reactors (PWRs), boiling-water reactors (BWRs) or fast breeder reactors (FBRs).

This document is applicable to all on-line measuring instruments that directly obtain reactivity values by measuring the neutron flux. The subject relates to the reactor nuclear parameter measurement domain.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60515, *Nuclear power plants - Instrumentation important to safety - Radiation detectors - Characteristics and test methods*

IEC 60880, *Nuclear power plants - Instrumentation and control systems important to safety - Software aspects for computer-based systems performing category A functions*

IEC 62003, *Nuclear power plants - Instrumentation and control important to safety - Requirements for electromagnetic compatibility testing*

IEC 61226, *Nuclear power plants - Instrumentation, control and electrical power systems important to safety - Categorization of functions and classification of systems*

IEC 62138, *Nuclear power plants - Instrumentation and control systems important to safety - Software aspects for computer-based systems performing category B or C functions*

IEC/IEEE 60780-323, *Nuclear facilities - Electrical equipment important to safety - Qualification*

IEC/IEEE 60980-344, *Nuclear facilities - Equipment important to safety - Seismic qualification*