

Nuclear facilities - Instrumentation and control systems - Design, location and application criteria for installed area gamma radiation dose rate monitoring equipment for use during normal operation and anticipated operational occurrences

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

See Eesti standard EVS-EN IEC 61031:2022 sisaldab Euroopa standardi EN IEC 61031:2022 ingliskeelset teksti.	This Estonian standard EVS-EN IEC 61031:2022 consists of the English text of the European standard EN IEC 61031:2022.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 19.08.2022.	Date of Availability of the European standard is 19.08.2022.
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English Version

**Nuclear facilities - Instrumentation and control systems - Design,  
location and application criteria for installed area gamma  
radiation dose rate monitoring equipment for use during normal  
operation and anticipated operational occurrences  
(IEC 61031:2020)**

Installations nucléaires - Systèmes d'instrumentation et de  
contrôle-commande - Critères de conception, d'implantation  
et d'application pour les matériels de surveillance du débit  
de dose de rayonnement gamma à poste fixe, utilisés  
pendant le fonctionnement normal et lors d'incidents de  
fonctionnement prévus  
(IEC 61031:2020)

Kerntechnische Anlagen - Leittechnische Systeme -  
Auslegungs-, Anordnungs- und Anwendungskriterien für  
fest installierte Einrichtungen zur Umgebungsüberwachung  
der Gammadosisleistung zum Einsatz während  
Normalbetrieb und bei anzunehmenden betrieblichen  
Ereignissen  
(IEC 61031:2020)

This European Standard was approved by CENELEC on 2022-08-08. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

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European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

## European foreword

This document (EN IEC 61031:2022) consists of the text of IEC 61031:2020, prepared by IEC/TC 45 "Instrumentation, control and electrical power systems of nuclear facilities".

The following dates are fixed:

- latest date by which this document has to be (dop) 2023-08-08 implemented at national level by publication of an identical national standard or by endorsement
- latest date by which the national standards (dow) 2025-08-08 conflicting with this document have to be withdrawn

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As stated in the nuclear safety directive 2009/71/EURATOM, Chapter 1, Article 2, item 2, Member States are not prevented from taking more stringent safety measures in the subject-matter covered by the Directive, in compliance with Community law.

In a similar manner, this European standard does not prevent Member States from taking more stringent nuclear safety and/or security measures in the subject-matter covered by this standard.

Any feedback and questions on this document should be directed to the users' national standards body/national committee. A complete listing of these bodies can be found on the CEN and CENELEC websites.

## Endorsement notice

The text of the International Standard IEC 61031:2020 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60761-1:2002	NOTE Harmonized as EN 60761-1:2004 (modified)
IEC 60761-2	NOTE Harmonized as EN 60761-2
IEC 60761-3:2002	NOTE Harmonized as EN 60761-3:2004 (not modified)
IEC 60761-4:2002	NOTE Harmonized as EN 60761-4:2004 (not modified)
IEC 60761-5:2002	NOTE Harmonized as EN 60761-5:2004 (modified)
IEC 60861:2006	NOTE Harmonized as EN 60861:2008 (modified)
IEC 60964:2018	NOTE Harmonized as EN IEC 60964:2019 (not modified)
IEC 61500:2018	NOTE Harmonized as EN IEC 61500:2019 (not modified)
IEC 61508-1:2010	NOTE Harmonized as EN 61508-1:2010 (not modified)
IEC 61508-2:2010	NOTE Harmonized as EN 61508-2:2010 (not modified)

IEC 61508-3:2010	NOTE Harmonized as EN 61508-3:2010 (not modified)
IEC 61508-4:2010	NOTE Harmonized as EN 61508-4:2010 (not modified)
IEC 62645:2019	NOTE Harmonized as EN IEC 62645:2020 (not modified)
IEC 63046:2020	NOTE Harmonized as EN IEC 63046:2021 (not modified)
ISO 4037-1:2019	NOTE Harmonized as EN ISO 4037-1:2021 (not modified)
ISO 4037-3:2019	NOTE Harmonized as EN ISO 4037-3:2021 (not modified)
ISO/IEC 27001:2013	NOTE Harmonized as EN ISO/IEC 27001:2017 (not modified)
ISO/IEC 27002:2013	NOTE Harmonized as EN ISO/IEC 27002:2017 (not modified)

# INTERNATIONAL STANDARD

**Nuclear facilities – Instrumentation and control systems – Design, location and application criteria for installed area gamma radiation dose rate monitoring equipment for use during normal operation and anticipated operational occurrences**



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67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

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# INTERNATIONAL STANDARD

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**Nuclear facilities – Instrumentation and control systems – Design, location and application criteria for installed area gamma radiation dose rate monitoring equipment for use during normal operation and anticipated operational occurrences**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**NUCLEAR FACILITIES –  
INSTRUMENTATION AND CONTROL SYSTEMS –  
DESIGN, LOCATION AND APPLICATION CRITERIA FOR  
INSTALLED AREA GAMMA RADIATION DOSE RATE MONITORING  
EQUIPMENT FOR USE DURING NORMAL OPERATION AND ANTICIPATED  
OPERATIONAL OCCURRENCES**

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61031 has been prepared by subcommittee 45A: Instrumentation, control and electrical power systems of nuclear facilities, of IEC technical committee 45: Nuclear instrumentation.

This document is to be used in conjunction with IEC 60532:2010.

This second edition cancels and replaces the first edition published in 1990. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) The scope of the standard is extended from nuclear power plants to nuclear facilities and the title is accordingly aligned.
- b) The relevant standards published by IEC SC 45A since the publication of the first edition are taken into account and referred to when relevant.

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

FDIS	Report on voting
45A/1328/FDIS	45A/1341/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

## INTRODUCTION

### **a) Technical background, main issues and organisation of the standard**

This IEC standard specifically focuses on radiation monitoring systems used for normal operation and anticipated operational occurrences in nuclear facilities such as nuclear power plants.

This document is intended for use by purchasers in developing specifications for their plant specific radiation monitoring systems and by manufacturers to identify needed product characteristics when developing systems for normal operation and anticipated operational occurrences. Some specific instrument characteristics such as measurement range, required energy response, and ambient environment requirements will depend upon the specific application. In such cases guidance is provided on determining the specific requirements, but specific requirements themselves are not stated.

This document is intended to be used in conjunction with IEC 60532:2010.

For area gamma radiation dose rate monitoring equipment for accident and post-accident conditions refer to IEC 60951-1 and IEC 60951-3 (not within the scope of this document).

### **b) Situation of the current standard in the structure of the IEC SC 45A standard series**

IEC 61031 is at the third level in the hierarchy of SC 45A standards.

This document provides requirements for equipment for area radiation monitoring in normal conditions in conjunction with IEC 60532. Other standards developed by SC 45A and SC 45B provide guidance on instruments used for monitoring radiation as part of normal operations.

The IEC 60761 series provides requirements for equipment for continuous off-line monitoring of radioactivity in gaseous effluents in normal conditions. IEC 60861 provides requirements for equipment for continuous off-line monitoring of radioactivity in liquid effluents in normal conditions. IEC 60768 provides requirements for equipment for continuous in-line and on-line monitoring of radioactivity in process stream in normal and incident conditions. Finally, ISO 2889 gives guidance on gas and particulate sampling. In addition, IEC 62705 was issued on July 2014. IEC 62705 provides guidance on the application of existing IEC/ISO standards covering design and qualification of system and equipment for RMS, and the overviews of the standards covering the radiation monitoring in nuclear facilities are listed in Table 1 below.

**Table 1 – Overview of the standards covering the domain of radiation monitoring in nuclear facilities**

Developer	ISO		IEC		
			SC 45A		SC 45B
Scope	Sampling	Calibration	Accident and post accident conditions	Normal conditions	
Radioactive noble gas off-line monitoring	ISO 2889	ISO 4037-1, ISO 4037-3	IEC 60951-1, IEC 60951-2	N/A	IEC 62302, IEC 60761-1, IEC 60761-3
Radioactive aerosol off-line monitoring	ISO 2889	ISO 4037-1, ISO 4037-3	IEC 60951-1, IEC 60951-2	N/A	IEC 60761-1, IEC 60761-2
Radioactive iodine off-line monitoring	ISO 2889	ISO 4037-1, ISO 4037-3	IEC 60951-1, IEC 60951-2	N/A	IEC 60761-1, IEC 60761-4
Liquid off-line monitoring	N/A	N/A	N/A	N/A	IEC 60861
Tritium off-line monitoring	N/A	N/A	N/A	N/A	IEC 62303 / IEC 60761-1, IEC 60761-5
On-line or in-line monitoring	N/A	ISO 4037-1, ISO 4037-3	IEC 60951-1, IEC 60951-4	IEC 60768	N/A
Area monitoring	N/A	ISO 4037-1, ISO 4037-3	IEC 60951-1, IEC 60951-3	IEC 61031	IEC 60532
Centralized system	N/A	N/A	IEC 61504, IEC 60960		IEC 61559-1
Classification/basic requirements	N/A	N/A	IEC 61513, IEC 60880, IEC 60987, IEC 61226, IEC 62138, IEC 62566, IEC 62645, IEC 61250 IEC 61500, IEC 61504		N/A
Qualification	N/A	N/A	IEC 60980, IEC 62003, IEC/IEEE 60780-323		IEC 62706

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 Standard

It is important to note that this document establishes no additional functional requirements for safety systems.

### 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 top-level documents of the IEC SC 45A standard series are IEC 61513 and IEC 63046. IEC 61513 provides general requirements for I&C systems and equipment that are used to perform functions important to safety in NPPs. IEC 63046 provides general requirements for electrical power systems of NPPs; it covers power supply systems including the supply systems of the I&C systems. IEC 61513 and IEC 63046 are to be considered in conjunction and at the same level. IEC 61513 and IEC 63046 structure the IEC SC 45A standard series and shape a complete framework establishing general requirements for instrumentation, control and electrical systems for nuclear power plants.

IEC 61513 and IEC 63046 refer directly to other IEC SC 45A standards for general topics related to categorization of functions and classification of systems, qualification, separation, defence against common cause failure, control room design, electromagnetic compatibility, cybersecurity, software and hardware aspects for programmable digital systems, coordination of safety and security requirements and management of ageing. The standards referenced directly at this second level should be considered together with IEC 61513 and IEC 63046 as a consistent document set.

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

A fourth level extending the IEC SC 45A standard series, corresponds to the 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 and the implementing guide NSS17 for computer security at nuclear facilities. The safety and security terminology and definitions used by SC 45A standards are consistent with those used by the IAEA.

IEC 61513 and IEC 63046 have adopted a presentation format similar to the basic safety publication IEC 61508 with an overall life-cycle framework and a system life-cycle framework. Regarding nuclear safety, IEC 61513 and IEC 63046 provide the interpretation of the general requirements of IEC 61508-1, IEC 61508-2 and IEC 61508-4, for the nuclear application sector. In this framework IEC 60880, IEC 62138 and IEC 62566 correspond to IEC 61508-3 for the nuclear application sector. IEC 61513 and IEC 63046 refer to ISO as well as to IAEA GS-R-3 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, regarding control rooms, IEC 60964 is the entry document for the IEC/SC 45A control rooms standards and IEC 62342 is the entry document for the IEC/SC 45A ageing management standards.

NOTE 1 It is assumed that for the design of I&C systems in NPPs that implement conventional safety functions (e.g. to address worker safety, asset protection, chemical hazards, process energy hazards) international or national standards would be applied.

NOTE 2 The IEC/SC 45A domain was extended in 2013 to cover electrical systems. In 2014 and 2015 discussions were held in IEC/SC 45A to decide how and where general requirements for the design of electrical systems were to be considered. IEC/SC 45A experts recommended that an independent standard be developed at the same level as IEC 61513 to establish general requirements for electrical systems. Project IEC 63046 is now launched to cover this objective. When IEC 63046 is published this NOTE 2 of the introduction of IEC/SC 45A standards will be suppressed.

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EQUIPMENT FOR USE DURING NORMAL OPERATION AND ANTICIPATED  
OPERATIONAL OCCURRENCES**

## **1 Scope**

This document applies to the design, location and application of installed equipment for monitoring local gamma radiation dose rates within nuclear facilities during normal operation and anticipated operational occurrences. High range area gamma radiation dose rate monitoring equipment for accident conditions currently addressed by IEC 60951-1 and IEC 60951-3 is not within the scope of this document.

This document does not apply to the measurement of neutron dose rate. Additional equipment for neutron monitoring may be required, depending on the plant design, if the neutron dose rate makes a substantial contribution to the total dose equivalent to personnel.

This document provides guidelines for the design principles, the location, the application, the calibration, the operation, and the testing of installed equipment for continuously monitoring local gamma radiation dose rates in nuclear facilities under normal operation conditions and anticipated operational occurrences. These instruments are normally referred to as area radiation monitors. Portable instruments are also used for this purpose but are not covered by this document.

Radiation monitors utilized in area radiation monitoring equipment are addressed in IEC 60532. As discussed in IEC 60532, measurement of gamma radiation may be expressed by a number of alternative quantities depending on national regulations. However, for this type of instrument, the most likely quantity to be measured is the air kerma (Gy), or the ambient dose equivalent  $H^*(10)$ (Sv).

## **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 60050-395:2014, *International Electrotechnical Vocabulary – Part 395: Nuclear instrumentation: Physical phenomena, basic concepts, instruments, systems, equipment and detectors*

IEC 60532:2010, *Radiation protection instrumentation – Installed dose rate meters, warning assemblies and monitors – X and gamma radiation of energy between 50 keV and 7 MeV*

IEC 60880:2006, *Nuclear power plants – Instrumentation and control systems important to safety – Software aspects for computer-based systems performing category A functions*

IEC 60951-1:2009, *Nuclear power plants – Instrumentation important to safety – Radiation monitoring for accident and post-accident conditions – Part 1: General requirements*

IEC 60951-3:2009, *Nuclear power plants – Instrumentation important to safety – Radiation monitoring for accident and post-accident conditions – Part 3: Equipment for continuous high range area gamma monitoring*

IEC 60980:1989, *Recommended practices for seismic qualification of electrical equipment of the safety system for nuclear generating stations*

IEC 60987:2007, *Nuclear power plants – Instrumentation and control important to safety – Hardware design requirements for computer-based systems*

IEC 61226:2009, *Nuclear power plants – Instrumentation and control important to safety – Classification of instrumentation and control functions*

IEC 61513:2011, *Nuclear power plants – Instrumentation and control important to safety – General requirements for systems*

IEC 62003:2020, *Nuclear power plants – Instrumentation, control and electrical power systems – Requirements for electromagnetic compatibility testing*

IEC 62138:2018, *Nuclear power plants – Instrumentation and control systems important to safety – Software aspects for computer-based systems performing category B or C functions*

IEC 62566:2012, *Nuclear power plants – Instrumentation and control important to safety – Development of HDL-programmed integrated circuits for systems performing category A functions*

IEC 62705:2014, *Nuclear power plants – Instrumentation and control important to safety – Radiation monitoring systems (RMS): Characteristics and lifecycle*

IEC/IEEE 60780-323:2016, *Nuclear facilities – Electrical equipment important to safety – Qualification*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-395 as well as the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

NOTE Specific terminology for the radiation monitoring system is given in IEC 62705 and specific terminology for the area radiation monitor is given in IEC 60532

#### 3.1 anticipated operational occurrence

deviation of an operational process from normal operation that is expected to occur at least once during the operating lifetime of a facility but which, in view of appropriate design provisions, does not cause any significant damage to items important to safety or lead to accident conditions

[SOURCE: IAEA Safety Glossary, 2018 edition]