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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Nuclear ~~power plants~~ facilities – Instrumentation systems important to safety – Radiation monitoring for accident and post-accident conditions – Part 1: General requirements

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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NUCLEAR ~~POWER PLANTS~~ FACILITIES – INSTRUMENTATION SYSTEMS IMPORTANT TO SAFETY – RADIATION MONITORING FOR ACCIDENT AND POST-ACCIDENT CONDITIONS –

Part 1: General requirements

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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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60951-1:2009. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 60951-1 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.

This third edition cancels and replaces the second edition published in 2009. This edition constitutes a technical revision.

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INTRODUCTION

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

This IEC standard specifically focuses on radiation monitoring systems (RMSs) used for ~~accident and post-~~accident operations.

According to the lessons learned from the Fukushima-Daiichi accident, it re-acknowledges a need to provide operators with reliable radiation monitoring data to allow them to understand the plant state during and after the accident conditions. To support the design of such instrumentation, it is necessary to provide general guidance on the design principles and performance criteria for radiation monitoring instrumentation applied during and after the accident conditions. In addition, the scope of IEC 63147 which provides criteria for accident monitoring instrumentation for nuclear power generating stations has evolved to include severe accident (SA) to accident conditions.

Thus, to address the specific lessons learned from the Fukushima-Daiichi accident, this standard categorizes accident condition into design basis accidents (DBA) and design extension conditions (DEC), including severe accident (SA).

This standard is intended for use by purchasers in developing specifications for their plant-specific radiation monitoring systems and by manufacturers to identify needed ~~product~~ equipment characteristics when developing systems for accident monitoring conditions. Some specific instrument characteristics such as measurement range, ~~required~~ energy response, and ~~ambient environment requirements~~ environmental withstanding conditions will depend on the specific application. In such cases, guidance is provided on determining the specific requirements, but specific requirements themselves are not stated.

This standard is one in a series of standards ~~covering post-accident radiation monitors important to safety~~ applicable to equipment for continuous monitoring of radiation level important to safety intended for use during design basis accidents (DBA) and design extension conditions (DEC) including severe accident (SA), and post-accident conditions. The full series is comprised of the following standards.

– IEC 60951-1 – General requirements
– IEC 60951-2 – Equipment for continuous off-line monitoring of radioactivity in gaseous effluents and ventilation air
– IEC 60951-3 – Equipment for continuous high range area gamma monitoring
– IEC 60951-4 – Equipment for continuous in-line or on-line monitoring of radioactivity in process streams.

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

The IEC 60951 series of standards are at the third level in the hierarchy of SC 45A standards. They provide guidance on specification, design and testing of radiation monitoring equipment used for accident and post-accident conditions.

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 streams in normal and incident conditions. Finally, ISO 2889 gives guidance on gas and particulate sampling. ~~The relationship between these various radiation monitoring standards is given in Table 1.~~ In addition, IEC 62705 provides guidance on the application of existing IEC/ISO standards covering design and qualification of RMS. An overview of the standards covering the radiation monitoring in nuclear facilities is given in Table 1.

IEC 63147/IEEE Std 497™ provides general guidance for accident monitoring instrumentation. IEEE Std 497™ was directly adopted as a joint logo standard and a technical report, IEC TR 63123, was prepared to discuss the application of the joint standard within the IEC context.

The structure of this standard is adapted from the structure of IEC 63147/IEEE Std 497™, and the technical requirements of this standard are consistent with the requirements given in IEC 63147/IEEE Std 497™ together with the application guidance given in IEC TR 63123.

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

~~Developer~~	~~ISO~~	~~SC 45A – Process and safety monitoring~~		~~SC 45B – Radiation protection and effluents monitoring~~
~~Scope~~	~~Sampling circuits and methods~~	~~Accident and post-accident conditions~~	~~Normal and incident conditions~~	
~~Gas, particulate and iodine with sampling (OFF-LINE)~~	~~ISO 2889~~	~~IEC 60951-1 and IEC 60951-2~~	~~IEC 60761 series and IEC 62302 (noble gases only)~~	
~~Liquid with sampling (OFF-LINE)~~	~~N/A~~	~~N/A~~	~~IEC 60861~~	
~~Process streams (gaseous effluents, steam or liquid) without sampling (ON or IN-LINE)~~	~~N/A~~	~~IEC 60951-1 and IEC 60951-4~~	~~IEC 60768~~	~~N/A~~
~~Area monitoring~~	~~N/A~~	~~IEC 60951-1 and IEC 60951-3~~	~~IEC 60532~~	
~~Central system~~	~~N/A~~	~~IEC 61504~~		~~IEC 61559 series~~

Developer	ISO		IEC			
			SC45A			SC45B
Scope	Sampling (Normal operation)	Calibration (Normal operation)	Normal operation, AOO	DBA	DEC	Normal operation
Radioactive noble gas off-line monitoring	ISO 2889	ISO 4037-1, ISO 4037-3	N/A	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	N/A	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	N/A	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	N/A	IEC 60861
Tritium off-line monitoring	N/A	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 60768	IEC 60951-1, IEC 60951-4	N/A	N/A
Area monitoring	N/A	ISO 4037-1, ISO 4037-3	IEC 61031	IEC 60951-1, IEC 60951-3		IEC 60532
Centralized system	N/A	N/A	IEC 61504, IEC 60960		N/A	IEC 61559-1
Classification/basic requirements	N/A	N/A	IEC 61513, IEC 60880, IEC 60987, IEC 61226, IEC 62138, IEC 62566, IEC 62566-2, IEC 62645, IEC 61250		N/A	N/A
Qualification	N/A	N/A	IEC/IEEE 60780-323, IEC/IEEE 60980-344, IEC 62003		N/A	IEC 62706

For more details on the structure of the IEC SC 45A standard series, see the item d) of this introduction.

c) Recommendations and limitations regarding the application of this standard

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

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 document of the IEC SC 45A standard series is IEC 61513. It provides general requirements for I&C systems and equipment that are used to perform functions important to safety in NPPs. IEC 61513 structures the IEC SC 45A standard series.~~

~~IEC 61513 refers directly to other IEC SC 45A standards for general topics related to categorization of functions and classification of systems, qualification, separation of systems, defence against common cause failure, software aspects of computer-based systems, hardware aspects of computer-based systems, and control room design. The standards referenced directly at this second level should be considered together with IEC 61513 as a consistent document set.~~

~~At a third level, IEC SC 45A standards not directly referenced by IEC 61513 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.~~

~~IEC 61513 has adopted a presentation format similar to the basic safety publication IEC 61508 with an overall safety life-cycle framework and a system life-cycle framework and provides an interpretation of the general requirements of IEC 61508-1, IEC 61508-2 and IEC 61508-4, for the nuclear application sector. Compliance with IEC 61513 will facilitate consistency with the requirements of IEC 61508 as they have been interpreted for the nuclear industry. In this framework IEC 60880 and IEC 62138 correspond to IEC 61508-3 for the nuclear application sector.~~

~~IEC 61513 refers to ISO standards as well as to IAEA 50-C-QA (now replaced by IAEA GS-R-3) for topics related to quality assurance (QA).~~

~~The IEC SC 45A standards series consistently implements and details the principles and basic safety aspects provided in the IAEA code on the safety of NPPs and in the IAEA safety series, in particular the Requirements NS-R-1, establishing safety requirements related to the design of Nuclear Power Plants, and the Safety Guide NS-G-1.3 dealing with instrumentation and control systems important to safety in Nuclear Power Plants. The terminology and definitions used by SC 45A standards are consistent with those used by the IAEA.~~

The IEC SC 45A standard series comprises a hierarchy of four levels. The top-level documents of the IEC SC 45A standard series are IEC 61513 and IEC 63046.

IEC 61513 provides general requirements for instrumentation and control (I&C) systems and equipment that are used to perform functions important to safety in nuclear power plants (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 power systems for nuclear power plants.

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. 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 requirements for specific equipment, technical methods, or activities. Usually these documents, which make reference to second-level documents for general requirements, can be used on their own.

A fourth level extending the IEC SC 45 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, the IAEA safety guide SSG-51 dealing with human factors engineering in the design of NPPs and the implementing guide NSS17 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 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 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 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 IEC TR 64000 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.

NUCLEAR ~~POWER PLANTS~~ FACILITIES – INSTRUMENTATION SYSTEMS IMPORTANT TO SAFETY – RADIATION MONITORING FOR ACCIDENT AND POST-ACCIDENT CONDITIONS –

Part 1: General requirements

1 Scope

This part of IEC 60951 provides general guidance on the design principles and performance criteria for equipment to measure radiation and fluid (gaseous effluents or liquids) radioactivity levels at nuclear ~~power plants~~ facilities during and after ~~an accident~~ design basis accidents (DBA) and design extension conditions (DEC), including severe accident (SA). This document is limited to equipment for continuous monitoring of radioactivity in design basis accidents (DBA), design extension conditions (DEC), including severe accident (SA) and post-accident conditions.

The purpose of this document is to lay down ~~mandatory~~ general requirements and give examples of acceptable methods for equipment for continuous monitoring of radioactivity within the ~~plant~~ facility during and after ~~accident conditions in nuclear power plants using light water reactors~~ design basis accidents (DBA), design extension conditions (DEC), including severe accident (SA) in nuclear facilities.

It specifies, for the equipment described above, the general characteristics, general test procedures, radiation, electrical, safety and environmental characteristics and the identification and certification of the equipment. If this equipment is part of a centralized system for continuous radiation monitoring in a nuclear facility, there may be additional requirements from other standards related to this system.

Sample extraction and laboratory analysis, which are essential to a complete programme of effluent monitoring, are not within the scope of this document.

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 60038:~~2002~~2009, *IEC standard voltages*

IEC 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-78:~~2001~~2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60529, *Degrees of protections provided by enclosures (IP code)*

~~IEC 60780, *Nuclear power plants – Electrical equipment of the safety system – Qualification*~~

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

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

~~IEC 60980, *Recommended practices for Seismic qualification of electrical equipment of the safety system for nuclear generating stations*~~

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

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

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:~~2006~~2020, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4:~~2004~~2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:~~2005~~2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6:~~2008~~2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8:~~2001~~2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-12:~~2006~~2017, *Electromagnetic compatibility (EMC) – Part 4-12: Testing and measurement techniques – Ring wave immunity test*

IEC 61000-4-18:2019, *Electromagnetic compatibility (EMC) – Part 4-18: Testing and measurement techniques – Damped oscillatory wave immunity test*

IEC 61000-6-4:~~2006~~2018, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 61069-1:~~1991~~2016, *Industrial-process measurement, control and automation – Evaluation of system properties for the purpose of system assessment – Part 1: ~~General considerations and methodology~~ Terminology and basic concepts*

IEC 61226, *Nuclear power plants – Instrumentation, control and electrical power systems important to safety – ~~Classification of instrumentation and control functions~~ Categorization of functions and classification of systems*

IEC 61504:~~2000~~2017, *Nuclear ~~power plants~~ facilities – Instrumentation and control systems important to safety – ~~Plant-wide radiation monitoring~~ Centralized systems for continuous monitoring of radiation and/or levels of radioactivity*

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

~~IEC 61559-2:2002, *Radiation in nuclear facilities – Centralized systems for continuous monitoring of radiation and/or levels of radioactivity – Part 2: Requirements for discharge, environmental, accident, or post-accident monitoring functions*~~

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

IEC 62262:2002, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

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 62566-2:2020, *Nuclear power plants – Instrumentation and control important to safety – Development of HDL-programmed integrated circuits – Part 2: HDL-programmed integrated circuits for systems performing category B or C functions*

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

ISO 2889:~~2009~~2015, *Sampling airborne radioactive materials from the stacks and ducts of nuclear facilities*

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Nuclear facilities – Instrumentation systems important to safety – Radiation monitoring for accident and post-accident conditions – Part 1: General requirements

Installations nucléaires – Systèmes d'instrumentation importants pour la sûreté – Surveillance des rayonnements pour les conditions accidentelles et post-accidentelles – Partie 1: Exigences générales

IEC 60951-1:2022-11 (en-fr)

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

The IEC 60951 series of standards are at the third level in the hierarchy of SC 45A standards. They provide guidance on specification, design and testing of radiation monitoring equipment used for accident and post-accident conditions.

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 streams in normal and incident conditions. Finally, ISO 2889 gives guidance on gas and particulate sampling. In addition, IEC 62705 provides guidance on the application of existing IEC/ISO standards covering design and qualification of RMS. An overview of the standards covering the radiation monitoring in nuclear facilities is given in Table 1.

IEC 63147/IEEE Std 497™ provides general guidance for accident monitoring instrumentation. IEEE Std 497™ was directly adopted as a joint logo standard and a technical report, IEC TR 63123, was prepared to discuss the application of the joint standard within the IEC context.

The structure of this standard is adapted from the structure of IEC 63147/IEEE Std 497™, and the technical requirements of this standard are consistent with the requirements given in IEC 63147/IEEE Std 497™ together with the application guidance given in IEC TR 63123.

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

Developer	ISO		IEC			
			SC45A			SC45B
Scope	**Sampling (Normal operation)**	**Calibration (Normal operation)**	**Normal operation, AOO**	**DBA**	**DEC**	**Normal operation**
Radioactive noble gas off-line monitoring	ISO 2889	ISO 4037-1, ISO 4037-3	N/A	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	N/A	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	N/A	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	N/A	IEC 60861
Tritium off-line monitoring	N/A	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 60768	IEC 60951-1, IEC 60951-4	N/A	N/A
Area monitoring	N/A	ISO 4037-1, ISO 4037-3	IEC 61031	IEC 60951-1, IEC 60951-3		IEC 60532
Centralized system	N/A	N/A	IEC 61504, IEC 60960		N/A	IEC 61559-1
Classification/basic requirements	N/A	N/A	IEC 61513, IEC 60880, IEC 60987, IEC 61226, IEC 62138, IEC 62566, IEC 62566-2, IEC 62645, IEC 61250		N/A	N/A
Qualification	N/A	N/A	IEC/IEEE 60780-323, IEC/IEEE 60980-344, IEC 62003		N/A	IEC 62706

For more details on the structure of the IEC SC 45A standard series, see the item d) of this introduction.

c) Recommendations and limitations regarding the application of this standard

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

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 hierarchy of four levels. The top-level documents of the IEC SC 45A standard series are IEC 61513 and IEC 63046.

IEC 61513 provides general requirements for instrumentation and control (I&C) systems and equipment that are used to perform functions important to safety in nuclear power plants (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 power systems for nuclear power plants.

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. 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 requirements for specific equipment, technical methods, or activities. Usually these documents, which make reference to second-level documents for general requirements, can be used on their own.

A fourth level extending the IEC SC 45 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, the IAEA safety guide SSG-51 dealing with human factors engineering in the design of NPPs and the implementing guide NSS17 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 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 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 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 IEC TR 64000 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.

NUCLEAR FACILITIES – INSTRUMENTATION SYSTEMS IMPORTANT TO SAFETY – RADIATION MONITORING FOR ACCIDENT AND POST-ACCIDENT CONDITIONS –

Part 1: General requirements

1 Scope

This part of IEC 60951 provides general guidance on the design principles and performance criteria for equipment to measure radiation and fluid (gaseous effluents or liquids) radioactivity levels at nuclear facilities during and after design basis accidents (DBA) and design extension conditions (DEC), including severe accident (SA). This document is limited to equipment for continuous monitoring of radioactivity in design basis accidents (DBA), design extension conditions (DEC), including severe accident (SA) and post-accident conditions.

The purpose of this document is to lay down general requirements and give examples of acceptable methods for equipment for continuous monitoring of radioactivity within the facility during and after design basis accidents (DBA), design extension conditions (DEC), including severe accident (SA) in nuclear facilities.

It specifies, for the equipment described above, the general characteristics, general test procedures, radiation, electrical, safety and environmental characteristics and the identification and certification of the equipment. If this equipment is part of a centralized system for continuous radiation monitoring in a nuclear facility, there may be additional requirements from other standards related to this system.

Sample extraction and laboratory analysis, which are essential to a complete programme of effluent monitoring, are not within the scope of this document.

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 60038:2009, *IEC standard voltages*

IEC 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60529, *Degrees of protections provided by enclosures (IP code)*

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

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

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

IEC 60987, *Nuclear power plants – Instrumentation and control important to safety – Hardware requirements*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2020, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-12:2017, *Electromagnetic compatibility (EMC) – Part 4-12: Testing and measurement techniques – Ring wave immunity test*

IEC 61000-4-18:2019, *Electromagnetic compatibility (EMC) – Part 4-18: Testing and measurement techniques – Damped oscillatory wave immunity test*

IEC 61000-6-4:2018, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 61069-1:2016, *Industrial-process measurement, control and automation – Evaluation of system properties for the purpose of system assessment – Part 1: Terminology and basic concepts*

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

IEC 61504:2017, *Nuclear facilities – Instrumentation and control systems important to safety – Centralized systems for continuous monitoring of radiation and/or levels of radioactivity*

IEC 61513:2011, *Nuclear power plants – Instrumentation and control important to safety – General requirements for 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 62262:2002, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

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 62566-2:2020, *Nuclear power plants – Instrumentation and control important to safety – Development of HDL-programmed integrated circuits – Part 2: HDL-programmed integrated circuits for systems performing category B or C functions*

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

ISO 2889:2015, *Sampling airborne radioactive materials from the stacks and ducts of nuclear facilities*

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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INSTALLATIONS NUCLÉAIRES – SYSTÈMES D'INSTRUMENTATION IMPORTANTS POUR LA SÛRETÉ – SURVEILLANCE DES RAYONNEMENTS POUR LES CONDITIONS ACCIDENTELLES ET POST-ACCIDENTELLES –

Partie 1: Exigences générales

AVANT-PROPOS

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L'IEC 60951-1 a été établie par le sous-comité 45A: Systèmes d'instrumentation, de contrôle-commande et d'alimentation électrique des installations nucléaires, du comité d'études 45 de l'IEC: Instrumentation nucléaire. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 2009. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- Le titre a été modifié.
- La catégorisation des conditions accidentelles a été harmonisée.

- Les références aux nouvelles normes publiées depuis la deuxième édition ont été mises à jour.
- Les termes et définitions ont été mis à jour.

Le texte de cette norme est issu des documents suivants:

Projet	Rapport de vote
45A/1440/FDIS	45A/1449/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Une liste de toutes les parties de la série IEC 60951, publiées sous le titre général *Installations nucléaires – Systèmes d'instrumentation importants pour la sûreté – Surveillance des rayonnements pour les conditions accidentelles et post-accidentelles*, se trouve sur le site web de l'IEC.

Les futurs documents de cette série porteront le nouveau titre général cité ci-dessus. Le titre des documents qui existent déjà dans cette série sera mis à jour lors de leur prochaine édition.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

INTRODUCTION

a) Contexte technique, questions importantes et structure de la norme

La présente norme IEC traite spécifiquement des systèmes de surveillance des rayonnements (RMS, *Radiation Monitoring System*) utilisés en conditions accidentelles.

A la lueur des enseignements tirés de l'accident de Fukushima-Daiichi, elle réaffirme le besoin de fournir aux opérateurs des données de surveillance des rayonnements fiables pour leur permettre de comprendre l'état de la centrale en conditions accidentelles et post-accidentelles. Afin d'assurer la conception appropriée d'une telle instrumentation, il est nécessaire de fournir des recommandations générales sur les principes de conception et les critères de performance de l'instrumentation de surveillance des rayonnements utilisée en conditions accidentelles et post-accidentelles. En outre, le domaine d'application de l'IEC 63147, qui fournit des critères applicables à l'instrumentation de surveillance des accidents dans les centrales nucléaires de puissance, a été élargi afin d'inclure les accidents graves (SA, *Severe Accident*) dans les conditions accidentelles.

Par conséquent, afin de tirer des enseignements de l'accident de Fukushima-Daiichi, la présente norme classe les conditions accidentelles en accidents de dimensionnement (DBA, *Design Basis Accident*) et en conditions additionnelles de dimensionnement (DEC, *Design Extension Condition*), incluant les accidents graves (SA).

La présente norme est destinée aux acheteurs pour élaborer des spécifications pour les systèmes de surveillance des rayonnements spécifiques à leurs installations et aux fabricants pour identifier les caractéristiques des matériels nécessaires lors du développement de systèmes de surveillance des rayonnements utilisés en conditions accidentelles. Certaines caractéristiques d'instruments spécifiques comme l'étendue de mesure, la réponse en énergie et la tenue aux conditions d'environnement dépendent de l'application spécifique. Dans ce cas, des recommandations sont fournies pour déterminer les exigences spécifiques, mais aucune exigence spécifique proprement dite n'est spécifiée.

La présente norme fait partie d'une série de normes applicables aux matériels de surveillance en continu des niveaux de rayonnement, importants pour la sûreté, destinés à être utilisés lors d'accidents de dimensionnement (DBA), en conditions additionnelles de dimensionnement (DEC), incluant les accidents graves (SA), et en conditions post-accidentelles. La série complète comprend les normes suivantes.

– IEC 60951-1 – Exigences générales
– IEC 60951-2 – Matériels pour la surveillance des rayonnements en continu avec prélèvements dans les effluents gazeux et l'air de ventilation
– IEC 60951-3 – Ensemble de surveillance locale en continu des rayonnements gamma à large gamme
– IEC 60951-4 – Equipement pour la surveillance en continu des rayonnements internes ou externes aux flux de procédé

b) Positionnement de la présente norme dans la structure de la collection de normes du SC 45A de l'IEC

Les normes de la série IEC 60951 se situent au troisième niveau de la hiérarchie des normes du SC 45A. Elles fournissent des recommandations pour la spécification, la conception et les essais des matériels de surveillance des rayonnements utilisés dans des conditions accidentelles et post-accidentelles.

D'autres normes élaborées par le SC 45A et le SC 45B fournissent des recommandations concernant les instruments utilisés pour surveiller les rayonnements dans le cadre des opérations normales. La série IEC 60761 fournit des exigences applicables aux matériels pour la surveillance en continu des rayonnements avec prélèvements dans les effluents gazeux en conditions normales. L'IEC 60861 fournit des exigences applicables aux matériels pour la surveillance en continu des rayonnements avec prélèvements dans les effluents liquides en conditions normales. L'IEC 60768 fournit des exigences applicables aux matériels pour la surveillance en continu, interne et externe, des rayonnements au niveau des fluides de procédés pour les conditions de fonctionnement normal et incidentel. Enfin, l'ISO 2889 fournit des recommandations pour l'échantillonnage de gaz et de particules. En outre, l'IEC 62705 fournit des recommandations pour l'application des normes IEC/ISO existantes qui traitent de la conception et de la qualification des RMS. Le Tableau 1 fournit une vue d'ensemble des normes qui traitent de la surveillance des rayonnements dans les installations nucléaires.

L'IEC 63147/IEEE Std 497™ fournit des recommandations générales pour l'instrumentation de surveillance des accidents. L'IEEE Std 497™ a été adoptée directement en tant que norme double logo et un rapport technique, l'IEC TR 63123, a été établi pour étudier l'application de la norme commune dans le contexte de l'IEC.

La structure de la présente norme est alignée sur la structure de l'IEC 63147/IEEE Std 497™, et les exigences techniques de la présente norme sont cohérentes avec les exigences spécifiées dans l'IEC 63147/IEEE Std 497™ ainsi qu'avec les recommandations d'application fournies dans l'IEC TR 63123.

Tableau 1 – Vue d'ensemble des normes qui traitent de la surveillance des rayonnements dans les installations nucléaires

Développeur	ISO		IEC			
			SC 45A			SC 45B
Domaine d'application	Echantillonnage (fonctionnement normal)	Etalonnage (fonctionnement normal)	Fonctionnement normal, IFP	DBA	DEC	Fonctionnement normal
Surveillance avec prélèvements des gaz rares radioactifs	ISO 2889	ISO 4037-1, ISO 4037-3	N/A	IEC 60951-1, IEC 60951-2	N/A	IEC 62302, IEC 60761-1, IEC 60761-3
Surveillance avec prélèvements des aérosols radioactifs	ISO 2889	ISO 4037-1, ISO 4037-3	N/A	IEC 60951-1, IEC 60951-2	N/A	IEC 60761-1, IEC 60761-2
Surveillance avec prélèvements de l'iode radioactif	ISO 2889	ISO 4037-1, ISO 4037-3	N/A	IEC 60951-1, IEC 60951-2	N/A	IEC 60761-1, IEC 60761-4
Surveillance avec prélèvements des liquides	N/A	N/A	N/A	N/A	N/A	IEC 60861
Surveillance avec prélèvements du tritium	N/A	N/A	N/A	N/A	N/A	IEC 62303, IEC 60761-1, IEC 60761-5
Surveillance interne ou externe	N/A	ISO 4037-1, ISO 4037-3	IEC 60768	IEC 60951-1, IEC 60951-4	N/A	N/A
Surveillance de zone	N/A	ISO 4037-1, ISO 4037-3	IEC 61031	IEC 60951-1, IEC 60951-3		IEC 60532
Système centralisé	N/A	N/A	IEC 61504, IEC 60960		N/A	IEC 61559-1
Exigences de classement/de base	N/A	N/A	IEC 61513, IEC 60880, IEC 60987, IEC 61226, IEC 62138, IEC 62566, IEC 62566-2, IEC 62645, IEC 61250		N/A	N/A
Qualification	N/A	N/A	IEC/IEEE 60780-323, IEC/IEEE 60980-344, IEC 62003		N/A	IEC 62706

Pour plus d'informations sur la structure de la collection de normes du SC 45A de l'IEC, voir le point d) de la présente introduction.

c) Recommandations et limites relatives à l'application de la présente norme

Il est important de noter que la présente norme n'établit pas d'exigences fonctionnelles supplémentaires pour les systèmes importants pour la sûreté.

d) Description de la structure de la collection de normes du SC 45A de l'IEC et des relations avec d'autres documents de l'IEC, et avec les documents d'autres organisations (AIEA, ISO)

La collection de normes établies par le SC 45A de l'IEC est structurée en quatre niveaux. Les documents de niveau supérieur dans la collection de normes du SC 45A de l'IEC sont les normes IEC 61513 et IEC 63046.

La norme IEC 61513 établit les exigences générales relatives aux matériels et systèmes d'instrumentation et de contrôle-commande (I&C) utilisés pour réaliser des fonctions importantes pour la sûreté des centrales nucléaires de puissance. La norme IEC 63046 établit les exigences générales relatives aux systèmes d'alimentation électrique des centrales nucléaires de puissance; elle couvre les systèmes d'alimentation électrique y compris les alimentations des systèmes d'I&C.

Les normes IEC 61513 et IEC 63046 doivent être prises en compte ensemble et au même niveau. Les normes IEC 61513 et IEC 63046 structurent la collection de normes du SC 45A de l'IEC et forment un cadre complet qui établit les exigences générales relatives aux systèmes d'I&C et d'alimentation électrique des centrales nucléaires de puissance.

Les normes IEC 61513 et IEC 63046 font directement référence à d'autres normes du SC 45A de l'IEC qui établissent les exigences générales relatives à des sujets spécifiques, tels que la catégorisation des fonctions et le classement des systèmes, la qualification, la séparation des systèmes, la défense contre les défaillances de cause commune, la conception des salles de commande, la compatibilité électromagnétique, l'ingénierie des facteurs humains, la cybersécurité, les aspects logiciels et matériels relatifs aux systèmes numériques programmables, la coordination des exigences de sûreté et de sécurité, et la gestion du vieillissement. Il convient de considérer que ces normes, auxquelles il est fait référence à ce deuxième niveau, forment, avec les normes IEC 61513 et IEC 63046, un ensemble documentaire cohérent.

Au troisième niveau, les normes du SC 45A de l'IEC, qui ne sont généralement pas citées en référence directement par les normes IEC 61513 ou IEC 63046, établissent les exigences particulières aux matériels, méthodes techniques ou activités spécifiques. Généralement, ces documents, qui font référence aux documents de deuxième niveau pour les exigences générales, peuvent être utilisés de façon isolée.

Un quatrième niveau qui est une extension de la collection de normes du SC 45 de l'IEC correspond aux rapports techniques qui ne sont pas des documents normatifs.

Les normes de la collection du SC 45A de l'IEC mettent en œuvre de manière systématique et décrivent les principes de sûreté et de sécurité et les aspects fondamentaux donnés dans les normes de sûreté de l'AIEA pertinentes et dans les documents pertinents de la collection de l'AIEA pour la sécurité nucléaire de puissance (NSS), en particulier avec le document d'exigences SSR-2/1 qui établit les exigences de sûreté relatives à la conception des centrales nucléaires de puissance, avec le guide de sûreté SSG-30 qui traite du classement de sûreté des structures, systèmes et composants des centrales nucléaires de puissance, avec le guide de sûreté SSG-39 qui traite de la conception des systèmes d'I&C des centrales nucléaires de puissance, avec le guide de sûreté SSG-34 qui traite de la conception des systèmes d'alimentation électrique des centrales nucléaires de puissance, avec le guide de sûreté SSG-51 qui traite de l'ingénierie des facteurs humains lors de la conception des centrales nucléaires de puissance et avec le guide de mise en œuvre NSS17 qui traite de la sécurité informatique pour les installations nucléaires. La terminologie et les définitions utilisées pour la sûreté et la sécurité dans les normes établies par le SC 45A sont conformes à celles utilisées par l'AIEA.

Les normes IEC 61513 et IEC 63046 ont adopté une présentation similaire à celle de la publication fondamentale de sécurité IEC 61508, avec un cycle de vie d'ensemble et un cycle de vie des systèmes. En ce qui concerne la sûreté nucléaire, les normes IEC 61513 et IEC 63046 donnent l'interprétation des exigences générales des parties 1, 2 et 4 de l'IEC 61508 pour le secteur nucléaire. Dans ce cadre, l'IEC 60880, l'IEC 62138 et l'IEC 62566 correspondent à la partie 3 de l'IEC 61508 pour le secteur nucléaire.

Les normes IEC 61513 et IEC 63046 font référence à la norme ISO 9001, ainsi qu'aux documents AIEA GSR partie 2 et AIEA GS-G-3.1 et AIEA GS-G-3.5 pour ce qui concerne l'assurance qualité.

Au second niveau, en ce qui concerne la sûreté nucléaire, la norme IEC 62645 est le document chapeau des normes du SC 45A de l'IEC applicables à la cybersécurité. Elle se fonde sur les principes pertinents de haut niveau et sur les concepts principaux des normes génériques de sûreté, en particulier l'ISO/IEC 27001 et l'ISO/IEC 27002; elle les adapte et les complète pour qu'ils deviennent pertinents pour le secteur nucléaire; elle est coordonnée étroitement avec la norme IEC 62443. Au second niveau, la norme IEC 60964 est le document chapeau des normes du SC 45A de l'IEC applicables aux salles de commande, la norme IEC 63351 est le document chapeau des normes du SC 45A de l'IEC applicables à l'ingénierie des facteurs humains et la norme IEC 62342 est le document chapeau des normes du SC 45A de l'IEC applicables à la gestion du vieillissement.

NOTE 1 On considère que pour la conception des systèmes d'I&C qui mettent en œuvre des fonctions de sûreté conventionnelle (par exemple, pour couvrir la sécurité des travailleurs, la protection des biens, la prévention contre les risques chimiques, la prévention contre les risques liés au procédé énergétique), des normes nationales ou internationales sont appliquées.

NOTE 2 L'IEC TR 64000 décrit plus en détail la structure générale de la collection de normes du SC 45A de l'IEC, ainsi que ses relations avec les autres organismes de normalisation et normes.

INSTALLATIONS NUCLÉAIRES – SYSTÈMES D'INSTRUMENTATION IMPORTANTS POUR LA SÛRETÉ – SURVEILLANCE DES RAYONNEMENTS POUR LES CONDITIONS ACCIDENTELLES ET POST-ACCIDENTELLES –

Partie 1: Exigences générales

1 Domaine d'application

La présente partie de l'IEC 60951 fournit des recommandations générales relatives aux principes de conception et aux critères de performance des matériels utilisés pour mesurer les rayonnements et la radioactivité des fluides (effluents gazeux ou liquides) dans les installations nucléaires pendant et après les accidents de dimensionnement (DBA) et les conditions additionnelles de dimensionnement (DEC), incluant les accidents graves (SA). Le présent document ne couvre que les matériels de surveillance en continu de la radioactivité utilisés lors d'accidents de dimensionnement (DBA), en conditions additionnelles de dimensionnement (DEC), incluant les accidents graves (SA), et en conditions post-accidentelles.

Le présent document a pour objet d'établir les exigences générales et de fournir des exemples de méthodes acceptables pour les matériels de surveillance en continu de la radioactivité utilisés dans les installations nucléaires pendant et après les accidents de dimensionnement (DBA) et les conditions additionnelles de dimensionnement (DEC), incluant les accidents graves (SA).

Elle spécifie, pour les matériels décrits ci-dessus, les caractéristiques générales, les procédures d'essai générales, les caractéristiques des rayonnements, les caractéristiques électriques, les caractéristiques de sûreté et d'environnement, ainsi que l'identification et la certification du matériel. Si ce matériel fait partie d'un système centralisé de surveillance en continu des rayonnements d'une installation nucléaire, des exigences supplémentaires peuvent être définies dans d'autres normes applicables à ce système.

La réalisation de prélèvements et les analyses en laboratoire, essentielles pour avoir un programme complet de surveillance des effluents, ne relèvent pas du domaine d'application du présent document.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60038:2009, *Tensions normales de l'IEC*

IEC 60068-2-1:2007, *Essais d'environnement – Partie 2-1: Essais – Essai A: Froid*

IEC 60068-2-2:2007, *Essais d'environnement – Partie 2-2: Essais – Essai B: Chaleur sèche*

IEC 60068-2-6:2007, *Essais d'environnement – Partie 2-6: Essais – Essai Fc: Vibrations (sinusoïdales)*

IEC 60068-2-14:2009, *Essais d'environnement – Partie 2-14 – Essai N: Variations de température*

IEC 60068-2-30:2005, *Essais d'environnement – Partie 2-30: Essais – Essai Db: Essai cyclique de chaleur humide (cycle de 12 h + 12 h)*

IEC 60068-2-78:2012, *Essais d'environnement – Partie 2-78: Essais – Essai Cab: Chaleur humide, essai continu*

IEC 60529, *Degrés de protection procurés par les enveloppes (Code IP)*

IEC/IEEE 60780-323:2016, *Installations nucléaires – Equipements électriques importants pour la sûreté – Qualification*

IEC 60880, *Centrales nucléaires de puissance – Instrumentation et contrôle-commande importants pour la sûreté – Aspects logiciels des systèmes programmés réalisant des fonctions de catégorie A*

IEC/IEEE 60980-344, *Nuclear facilities – Equipment important to safety – Seismic qualification* (disponible en anglais seulement)

IEC 60987, *Centrales nucléaires de puissance – Systèmes d'instrumentation et de contrôle-commande importants pour la sûreté – Exigences applicables au matériel*

IEC 61000-4-2:2008, *Compatibilité électromagnétique (CEM) – Partie 4-2: Techniques d'essai et de mesure – Essai d'immunité aux décharges électrostatiques*

IEC 61000-4-3:2020, *Compatibilité électromagnétique (CEM) – Partie 4-3: Techniques d'essai et de mesure – Essai d'immunité aux champs électromagnétiques rayonnés aux fréquences radioélectriques*

IEC 61000-4-4:2012, *Compatibilité électromagnétique (CEM) – Partie 4-4: Techniques d'essai et de mesure – Essais d'immunité aux transitoires électriques rapides en salves*

IEC 61000-4-5:2014, *Compatibilité électromagnétique (CEM) – Partie 4-5: Techniques d'essai et de mesure – Essai d'immunité aux ondes de choc*

IEC 61000-4-6:2013, *Compatibilité électromagnétique (CEM) – Partie 4-6: Techniques d'essai et de mesure – Immunité aux perturbations conduites, induites par les champs radioélectriques*

IEC 61000-4-8:2009, *Compatibilité électromagnétique (CEM) – Partie 4-8: Techniques d'essai et de mesure – Essai d'immunité au champ magnétique à la fréquence du réseau*

IEC 61000-4-12:2017, *Compatibilité électromagnétique (CEM) – Partie 4-12: Techniques d'essai et de mesure – Essai d'immunité à l'onde sinusoïdale fortement amortie*

IEC 61000-4-18:2019, *Compatibilité électromagnétique (CEM) – Partie 4-18: Techniques d'essai et de mesure – Essai d'immunité à l'onde oscillatoire amortie*

IEC 61000-6-4:2018, *Compatibilité électromagnétique (CEM) – Partie 6-4: Normes génériques – Norme sur l'émission pour les environnements industriels*

IEC 61069-1:2016, *Mesure, commande et automation dans les processus industriels – Appréciation des propriétés d'un système en vue de son évaluation – Partie 1: Terminologie et principes de base*

IEC 61226, *Centrales nucléaires de puissance – Systèmes d'instrumentation, de contrôle-commande et d'alimentation électrique importants pour la sûreté – Catégorisation des fonctions et classement des systèmes*

IEC 61504:2017, *Installations nucléaires – Systèmes d'instrumentation et de contrôle-commande importants pour la sûreté – Systèmes centralisés pour la surveillance en continu des rayonnements et/ou des niveaux de radioactivité*

IEC 61513:2011, *Centrales nucléaires de puissance – Instrumentation et contrôle-commande importants pour la sûreté – Exigences générales pour les systèmes*

IEC 62138, *Centrales nucléaires – Systèmes d'instrumentation et de contrôle-commande importants pour la sûreté – Aspects logiciels des systèmes informatisés réalisant des fonctions de catégorie B ou C*

IEC 62262:2002, *Degrés de protection procurés par les enveloppes de matériels électriques contre les impacts mécaniques externes (Code IK)*

IEC 62566:2012, *Centrales nucléaires de puissance – Instrumentation et contrôle-commande importants pour la sûreté – Développement des circuits intégrés programmés en HDL pour les systèmes réalisant des fonctions de catégorie A*

IEC 62566-2:2020, *Centrales nucléaires de puissance – Instrumentation et contrôle-commande importants pour la sûreté – Développement des circuits intégrés programmés en HDL – Partie 2: Circuits intégrés programmés en HDL pour les systèmes réalisant des fonctions de catégorie B ou C*

IEC 62705, *Installations nucléaires – Instrumentation et contrôle-commande importants pour la sûreté – Systèmes de surveillance des rayonnements (RMS): Caractéristiques et cycle de vie*

ISO 2889:2015, *Echantillonnage des substances radioactives en suspension dans l'air dans les émissaires de rejet et les conduits des installations nucléaires*