

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Nuclear power plants – Instrumentation and control systems important to safety – Selection and use of wireless devices

Centrales nucléaires de puissance – Systèmes d'instrumentation et de contrôle-commande importants pour la sûreté – Sélection et utilisation des appareils sans fil



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CONTENTS

| | |
|--|----|
| FOREWORD..... | 3 |
| INTRODUCTION..... | 5 |
| 1 Scope..... | 7 |
| 2 Normative references | 7 |
| 3 Terms and definitions | 8 |
| 4 Symbols and abbreviations..... | 11 |
| 5 Fundamental requirements | 11 |
| 5.1 Safety classification | 11 |
| 5.2 Physical separation and isolation | 11 |
| 5.3 Cybersecurity..... | 12 |
| 6 Wireless application: system requirements | 12 |
| 6.1 General..... | 12 |
| 6.2 Network architecture | 12 |
| 6.3 Network performance..... | 12 |
| 6.4 Network surveillance and monitoring..... | 12 |
| 6.5 Power supply requirements..... | 13 |
| 6.6 Physical security..... | 13 |
| 6.7 Electromagnetic security..... | 13 |
| 7 Device selection: evidence of correctness and device integration | 13 |
| 7.1 General..... | 13 |
| 7.2 Quality assurance | 13 |
| 7.3 Functional and performance suitability..... | 14 |
| 7.4 Integration into the application..... | 14 |
| 7.5 Device self-monitoring | 14 |
| 7.6 Solution preferences..... | 14 |
| 8 Radio emissions | 14 |
| 8.1 Electromagnetic compatibility..... | 14 |
| 8.2 Radio coverage requirements | 15 |
| 8.3 Spectrum management | 15 |
| 8.3.1 General | 15 |
| 8.3.2 Flexibility | 15 |
| 8.3.3 Mobility..... | 16 |
| 9 Cybersecurity | 16 |
| 9.1 General requirements | 16 |
| 9.2 Wireless-specific requirements | 16 |
| 9.2.1 Data logging | 16 |
| 9.2.2 Site topology | 16 |
| 9.2.3 Connection to a wired network..... | 16 |
| 9.2.4 Network surveillance | 16 |
| 10 Qualification | 17 |
| 10.1 Hardware qualification | 17 |
| 10.2 Software qualification..... | 17 |
| 11 Documentation | 17 |
| Bibliography..... | 18 |

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**NUCLEAR POWER PLANTS – INSTRUMENTATION AND CONTROL
SYSTEMS IMPORTANT TO SAFETY – SELECTION
AND USE OF WIRELESS DEVICES**

FOREWORD

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

| FDIS | Report on voting |
|---------------|------------------|
| 45A/1187/FDIS | 45A/1198/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.

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INTRODUCTION

a) Technical background, main issues and organization of this document

This document sets out requirements applicable to wireless devices that are used to perform functions important to safety in nuclear power plants (NPPs).

It is intended that this document be used by operators of NPPs (utilities), systems evaluators and by licensors.

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

IEC 62988 is a third level IEC SC 45A document covering the selection and use of wireless devices in instrumentation and control (I&C) systems important to safety used in NPPs.

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

It is important to note that this document is applicable to all important to safety systems containing wireless devices, including systems performing category A and B functions (and in such systems, wireless devices are prohibited by this document). Therefore, only systems performing category C functions are required to follow the requirements 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 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, coherent et consistent 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 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 and the implementing guide NSS17 for computer security at nuclear facilities. The safety and security terminology and definitions used by IEC 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, 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.

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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 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.

NUCLEAR POWER PLANTS – INSTRUMENTATION AND CONTROL SYSTEMS IMPORTANT TO SAFETY – SELECTION AND USE OF WIRELESS DEVICES

1 Scope

This document establishes requirements relevant to the selection and use of wireless devices in instrumentation and control (I&C) systems important to safety used in nuclear power plants (NPPs). Those I&C systems may fully consist of wireless devices.

NOTE The word “use” refers to the integration of the device, its qualification, administrative control, and every other activity that may be necessary to use the device in an important to safety application.

This document applies to the I&C of new NPPs and to backfit of I&C in existing NPPs. Every wireless device or wireless system that is important to safety is in the scope of this document. Both fixed and mobile devices and all data types (voice, process data, etc.) are included within the scope if they provide a safety classified function.

This document restricts the use of wireless devices to systems supporting category C functions according to IEC 61226, excluding explicitly their use for categories A and B.

Non-safety devices and systems may use this document as guidelines, for example to ensure that important to safety devices are not disturbed.

- Clause 5 describes the fundamental requirements regarding safety and cybersecurity.
- Clause 6 gives wireless-specific requirements that have to be included in the system design.
- Clause 7 describes the requirements for the selection and integration of wireless devices.
- Clause 8 deals with electromagnetic compatibility and spectrum management.
- Clause 9 gives wireless-specific requirements regarding cybersecurity.
- Clause 10 describes the requirements for the qualification of wireless devices and their environment.

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

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

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

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

IEC 62645, *Nuclear power plants – Instrumentation and control systems – Requirements for security programmes for computer-based systems*

IEC 62671, *Nuclear power plants – Instrumentation and control important to safety – Selection and use of industrial digital devices of limited functionality*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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>

3.1

authentication

provision of assurance that a claimed characteristic of an entity is correct

[SOURCE: ISO/IEC 27000:2018, 3.5]

3.2

category of an I&C function

one of three possible safety assignments (A, B, C) of I&C functions resulting from considerations of the safety relevance of the function to be performed. An unclassified assignment may be made if the function has no importance to safety.

[IEC 62988:2018](#)

Note 1 to entry: See also "class of an I&C system", <https://standards.itec.org/systems/standards/sist/12005646-1055-47c1-8e2a-6cd27a9d73be/iec-62988-2018>

Note 2 to entry: IEC 61226 defines categories of I&C functions. To each category there corresponds a set of requirements applicable on both the I&C function (concerning its specification, design, implementation, verification and validation) and the whole chain of items which are necessary to implement the function (concerning the properties and the related qualification) regardless of how these items are distributed in a number of interconnected I&C systems. For more clarity, this document defines categories of I&C functions and classes of I&C systems and establishes a relationship between the category of the function and the minimal required class for the associated systems and equipment.

[SOURCE: IEC 61513:2011, 3.4]

3.3

class of an I&C system

one of three possible assignments (1, 2 or 3) of I&C systems important to safety resulting from consideration of their requirement to implement I&C functions of different safety importance. An unclassified assignment is made if the I&C system does not implement functions important to safety.

Note 1 to entry: See also "category of an I&C function", "safety system".

[SOURCE: IEC 61513:2011, 3.6]

3.4

spectrum management

coexistence management

process to establish and to maintain coexistence that includes technical and organizational measures

[SOURCE: IEC 62657-2:2017, 3.1.15, modified – The preferred term "spectrum management" has been added.]

3.5 cybersecurity

set of activities and measures whose objective is to prevent, detect, and react to digital attacks that have the intent to cause:

- disclosures that could be used to perform malicious acts which could lead to an accident, an unsafe situation or plant performance degradation (confidentiality),
- malicious modifications of functions that may compromise the delivery or integrity of the required service by I&C computer-based and HDL programmed device (CB&HPD) systems (including loss of control) which could lead to an accident, an unsafe situation or plant performance degradation (integrity),
- malicious withholding or prevention of access to or communication of information, data or resources (incl. loss of view) that could compromise the delivery of the required service by I&C systems which could lead to an accident, an unsafe situation or plant performance degradation (availability).

Note 1 to entry: This definition is tailored with respect to the scope of this document, focusing on the prevention of, detection of and reaction to malicious acts by digital means on I&C CB&HPD systems. It is recognized that the term "cybersecurity" has a broader meaning in other standards and guidance, often including non-malevolent threats, human errors and protection against natural disasters, which are all out of the scope of this document (see Clause 1).

[SOURCE: IEC 62645:2014, 3.6]

3.6 electrical/electronic/programmable electronic item E/E/PE item

item based on electrical (E) and/or electronic (E) and/or programmable electronic (PE) technology

[SOURCE: IEC 61508-4:2010, 3.3.2, modified] ^{IEC 62988:2018}
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Note 1 to entry: In this term and its definitions, the word "item" can be replaced by the words: system or equipment or device.

3.7 encryption

(reversible) transformation of data by a cryptographic algorithm to produce ciphertext, i.e. to hide the information content of the data

[SOURCE: ISO/IEC 18033-1:2015, 2.21]

3.8 access point gateway

network device containing at least one host interface such as serial or Ethernet, acting as ingress or an egress point enabling communication between host applications and wireless devices

[SOURCE: IEC 62591:2016, 3.2.47, modified – The preferred term "access point" has been added.]

3.9 I&C system

system, based on E/E/PE items, performing plant I&C functions as well as service and monitoring functions related to the operation of the system itself.

Note 1 to entry: The term is used as a general term which encompasses all elements of the system such as internal power supplies, sensors and other input devices, data highways and other communication paths, interfaces to actuators and other output devices. The different functions within a system may use dedicated or shared resources.

Note 2 to entry: The elements included in a specific I&C system are defined in the specification of the boundaries of the system.

Note 3 to entry: See also the definition of E/E/PE item and the associated notes.

Note 4 to entry: According to their typical functionality, IAEA distinguishes between automation/control systems, HMI systems, interlock systems and protection systems.

3.10

item important to safety

item that is part of a safety group and/or whose malfunction or failure could lead to radiation exposure of the site personnel or members of the public

Note 1 to entry: Items important to safety include:

- a) those structures, systems and components whose malfunction or failure could lead to undue radiation exposure of the site personnel or members of the public;
- b) those structures, systems and components that prevent anticipated operational occurrences from leading to accident conditions;
- c) those features which are provided to mitigate the consequences of malfunction or failure of structures, systems or components.

[SOURCE: IAEA Safety Glossary, 2016 edition]

3.11

latency

time it takes for a packet to cross a network connection, from sender to receiver

[SOURCE: IEC 62591:2016, 3.2.57]

3.12

mesh network

network topology in which redundant physically-diverse routing paths are available between each pair of network nodes

Note 1 to entry: Wireless mesh topology is usable to extend coverage via multi-hop capability and/or to facilitate communication reliability by providing redundant paths between devices.

[SOURCE: IEC 62734:2014, 3.1.2.95, modified – The term "mesh topology" has been replaced by "mesh network".]

3.13

network

series of devices connected by some type of communication medium

[SOURCE: IEC 62591:2016, 3.2.70, modified – In the definition, "nodes" has been replaced by "devices". Note 1 to entry has been deleted.]

3.14

quality assurance

function of a management system that provides confidence that specific requirements will be fulfilled

Note 1 to entry: This definition is compatible with that of ISO 9000:2015, 3.3.6.

[SOURCE: IAEA Safety Glossary, 2016 Edition, modified – The term "quality management" has been replaced by "quality assurance".]

3.15**redundancy**

provision of alternative (identical or diverse) structures, systems and components, so that any single structure, system or component can perform the required function regardless of the state of operation or failure of any other

[SOURCE: IAEA Safety Glossary, 2016 Edition]

3.16**safety related system**

system important to safety that is not part of a safety system

[SOURCE: IAEA Safety Glossary, 2016 Edition]

3.17**safety system**

system important to safety, provided to ensure the safe shutdown of the reactor or the residual heat removal from the reactor core, or to limit the consequences of anticipated operational occurrences and design basis accidents

[SOURCE: IAEA Safety Glossary, 2016 Edition]

3.18**wireless device**

device that is able to establish a wireless communication with another wireless device, that may or may not be part of a wireless network

4 Symbols and abbreviations

[IEC 62988:2018](#)

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| | |
|-----|----------------------------------|
| CPU | central processing unit |
| DMZ | demilitarized zone |
| EMC | electromagnetic compatibility |
| EMI | electromagnetic interference |
| I&C | instrumentation and control |
| NPP | nuclear power plant |
| RFI | radio frequency interference |
| SRS | system requirement specification |

5 Fundamental requirements**5.1 Safety classification**

The wireless devices shall be limited to use in I&C systems performing category C functions and shall not be used in I&C systems supporting category A and B functions.

The safety class of the wireless communication systems shall be consistent with the I&C category C functions which they support and implement and should be safety class 3.

5.2 Physical separation and isolation

The wireless communication systems shall be electrically isolated and physically separated from wired communication channels of I&C systems supporting category A and B functions.