BS EN IEC 61226:2021

BSI Standards Publication

Nuclear power plants — Instrumentation, control and electrical power systems important to safety — Categorization of functions and classification of systems

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National foreword

This British Standard is the UK implementation of EN IEC 61226:2021. It is identical to IEC 61226:2020. It supersedes BS EN 61226:2010, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee NCE/8, Instrumentation, Control & Electrical Systems of Nuclear Facilities.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Amendments/corrigenda issued since publication

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN IEC 61226

July 2021

ICS 27.120.20

Supersedes EN 61226:2010 and all of its amendments and corrigenda (if any)

English Version

Nuclear power plants - Instrumentation, control and electrical power systems important to safety - Categorization of functions and classification of systems (IEC 61226:2020)

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 61226:2020)

Kernkraftwerke - Leittechnische Systeme und elektrische Energiesysteme mit sicherheitstechnischer Bedeutung - Kategorisierung von Funktionen und Klassifizierung von Systemen (IEC 61226:2020)

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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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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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

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European foreword

This document (EN IEC 61226:2021) consists of the text of IEC 61226:2020 prepared by IEC/TC 45 "Nuclear instrumentation".

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2022-07-05
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2024-07-05

This document supersedes EN 61226:2010 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

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 61226:2020 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 60671:2007	NOTE	Harmonized as EN 60671:2011 (not modified)
IEC 61508-1	NOTE	Harmonized as EN 61508-1
IEC 61508-2	NOTE	Harmonized as EN 61508-2
IEC 61508-3	NOTE	Harmonized as EN 61508-3
IEC 61508-4	NOTE	Harmonized as EN 61508-4
ISO/IEC 27001	NOTE	Harmonized as EN ISO/IEC 27001
ISO/IEC 27002	NOTE	Harmonized as EN ISO/IEC 27002

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60709	-	Nuclear power plants - Instrumentation, control and electrical power systems important to safety - Separation	EN IEC 60709	-
IEC 60812	-	Failure modes and effects analysis (FMEA and FMECA)	EN IEC 60812	-
IEC 60880	-	Nuclear power plants - Instrumentation and control systems important to safety - Software aspects for computer-based systems performing category A functions	EN 60880	-
IEC 60964	-	Nuclear power plants - Control rooms - Design	EN IEC 60964 +EN IEC 60964:2019/AC:2019-08	-
IEC 60965	-	Nuclear power plants - Control rooms - Supplementary control room for reactor shutdown without access to the main control room	EN 60965	-
IEC/IEEE 60980-344	--	Nuclear facilities - Equipment important to safety - Seismic qualification	EN IEC/IEEE 60980-344	-
IEC 60987	-	Nuclear power plants - Instrumentation and control important to safety - Hardware requirements	prEN IEC 60987	-
IEC 61000-4	series	Electromagnetic compatibility (EMC) -- Part 4-1: Testing and measurement techniques - Overview of IEC 61000-4 series	EN 61000-4	series
IEC 61500	-	Nuclear power plants - Instrumentation and control systems important to safety - Data communication in systems performing category A functions	EN IEC 61500	-

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Publication	Year	Title	EN/HD	Year
IEC 61513	2011	Nuclear power plants - Instrumentation and control important to safety - General requirements for systems	EN 61513	2013
IEC 61771	-	Nuclear power plants - Main control-room - Verification and validation of design	--	-
IEC 61772	-	Nuclear power plants - Control rooms - Application of visual display units (VDUs)	EN 61772	-
IEC 61839	-	Nuclear power plants - Design of control rooms - Functional analysis and assignment	EN 61839	-
IEC 62003	-	Nuclear power plants - Instrumentation, control and electrical power systems - Requirements for electromagnetic compatibility testing	EN IEC 62003	-
IEC 62138	-	Nuclear power plants - Instrumentation and control systems important to safety - Software aspects for computer-based systems performing category B or C functions	EN IEC 62138	-
IEC 62566	-	Nuclear power plants - Instrumentation and control important to safety - Development of HDL-programmed integrated circuits for systems performing category A functions	EN 62566	-
IEC 62645	-	Nuclear power plants - Instrumentation, control and electrical power systems - Cybersecurity requirements	EN IEC 62645	-
IEC 62671	-	Nuclear power plants - Instrumentation and control important to safety - Selection and use of industrial digital devices of limited functionality	-	-
IEC 62859	-	Nuclear power plants - Instrumentation and control systems - Requirements for coordinating safety and cybersecurity	EN IEC 62859	-
IEC 63046	-	Nuclear power plants - Electrical power system - General requirements	EN IEC 63046	-
IAEA GSR Part 2	2016	Leadership and Management for Safety	-	-
IAEA SSG-30	2014	Safety Classification of Structures, Systems and Components in Nuclear Power Plants	-	-
IAEA SSR-2/1 (Rev.1)	2016	Safety of nuclear power plants: Design	-	-
IEC/IEEE 60780-323	--	Nuclear facilities - Electrical equipment important to safety - Qualification	EN 60780-323	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

NUCLEAR POWER PLANTS – INSTRUMENTATION, CONTROL AND ELECTRICAL POWER SYSTEMS IMPORTANT TO SAFETY – CATEGORIZATION OF FUNCTIONS AND CLASSIFICATION OF SYSTEMS

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 61226 has been prepared by subcommittee 45A: Instrumentation, control and electrical power systems of nuclear facilities, of IEC technical committee 45: Nuclear instrumentation.

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

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

a) to align on IAEA requirements, recommendations and terminology, particularly to take into account the replacement of NS-R-1 by SSR 2/1 and publication of SSG 30;
b) to extend the scope to electrical power systems;
c) to move the detailed requirements applying to functions and I&C systems to a normative annex, which will be removed after updating IEC 61513.

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

FDIS	Report on voting
45A/1301/FDIS	45A/1306/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.

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INTRODUCTION

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

This International Standard responds to an International Atomic Energy Agency (IAEA) requirement[1] to identify and classify nuclear power plants important to safety items on the basis of their functions and safety significance. With the application of the concept of Defence in Depth, which is implemented through the combination of a number of consecutive and sufficiently independent levels of protection, the functions important to safety are distributed over several systems or subsystems. In addition, with programmable digital items now being used for NPP instrumentation and control systems, each system or sub-system often performs many functions. Therefore, it is the intent of this standard to establish the criteria and methods to be used to:

– identify and assign the functions important to safety into categories, depending on their contribution to the prevention and mitigation of postulated initiating events (PIE);

– classify accordingly the I&C and electrical power systems which are necessary to perform these functions.

According to IAEA Safety Standard SSR-2/1 (Requirement 22), the method for classifying the items important to safety shall be based primarily on deterministic methods, complemented where appropriate by probabilistic methods. Several possible approaches for use of probabilistic safety assessment (PSA) for classification are described in IEC TR 61838.

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

IEC 61226 is directly referenced by IEC 61513 and is the second level SC 45A document that deals with the categorization of functions and classification of I&C and electrical power systems.

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

c) Recommendation and limitation regarding the application of this document

Correct categorization of functions is essential to ensure the appropriate degree of attention by the plant's designers, operators and regulatory authorities to the specification, design, qualification, quality assurance (QA), manufacturing, installation, maintenance, and testing of the systems that ensure the safety functions.

This standard establishes the criteria and methods to be used to assign the functions of a NPP accomplished by I&C and electrical power systems to three categories A, B and C, which depend on the importance of the function for safety. Functions with no direct safety role are non categorized (NC).

The category to which a function is assigned determines technical requirements based on providing the appropriate level of assurance that the function will be executed on demand with the required performance and reliability and have the necessary environmental durability and QA. The level of assurance to be shown for each of these aspects shall be consistent with the importance of the function 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 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.

[1] IAEA SSR-2/1 requirement 22 considering also requirements 4, 18 and 27.

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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 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 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 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 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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NUCLEAR POWER PLANTS – INSTRUMENTATION, CONTROL AND ELECTRICAL POWER SYSTEMS IMPORTANT TO SAFETY – CATEGORIZATION OF FUNCTIONS AND CLASSIFICATION OF SYSTEMS

1 Scope

This document establishes, for nuclear power plants[2], a method of assignment of the functions specified for the plant into categories according to their importance to safety. Subsequent classification of the I&C and electrical power systems performing or supporting these functions, based on the assigned category, then determines relevant design criteria.

The design criteria, when applied, ensure the achievement of each function in accordance to its importance to safety. In this document, the criteria are those of functionality, reliability, performance, environmental qualification (e.g. seismic) and quality assurance (QA).

This document is applicable to:

- the functions important to safety that are performed by I&C systems and supported by electrical power systems (categorization of I&C functions),
- the I&C systems that enable those functions to be implemented (classification of I&C systems),
- the electrical power systems that support those functions (classification of electrical power systems).

The systems under consideration provide automated protection, closed or open loop control, information to the operating staff, and electrical power supply to systems. These systems keep the NPP conditions inside the safe operating envelope and provide automatic actions, or enable manual actions, that prevent or mitigate accidents, or that prevent or minimize radioactive releases to the site or wider environment. The I&C and electrical power systems that fulfil these roles safeguard the health and safety of the NPP operators and the public.

This document follows the general principles given in IAEA Safety Requirement SSR-2/1 and Safety Guides SSG-30, SSG-34 and SSG-39, and it defines a structured method of applying the guidance contained in those codes and standards to the I&C and electrical power systems that perform functions important to safety in a NPP. This document is read in association with the IAEA guides together with IEC 61513 and IEC 63046 in implementing the requirements of the IEC 61508 series. The overall classification scheme of structures, systems and components for NPPs can be summarized as follows by Figure 1.

[2] The scope of this document is consistent with IAEA SSR-2/1 and SSG-30, upon which it is based.

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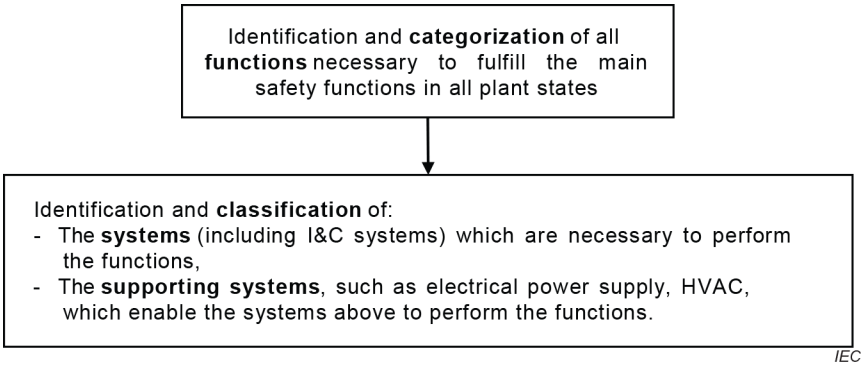

Figure 1 – Overall classification scheme

This 2-phase process is defined for purpose of comprehensiveness; it enables the capture of all the functions and all the systems important to safety, including I&C systems, as well as electrical power systems.

In this scheme, functions are defined and categorized regardless of the physical means that are implemented to fulfill them. In the framework of this document, the functions to be categorized are performed by I&C systems. Accordingly, they are called I&C functions.

This document applies to I&C and electrical power systems for new nuclear power plants as well as for modification and modernization of existing plants.

For existing plants, only a subset of requirements can be applicable, and this subset is identified at the beginning of any project.

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 60709, *Nuclear power plants – Instrumentation, control and electrical power systems important to safety – Separation*

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

IEC 60812, *Failure modes and effects analysis (FMEA and FMECA)*

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

IEC 60964, *Nuclear power plants – Control rooms – Design.*

IEC 60965, *Nuclear power plants – Control rooms – Supplementary control room for reactor shutdown without access to the main control room*.

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

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