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Nuclear power plants - Instrumentation, control and electrical power systems - Requirements for static uninterruptible DC and AC power supply systems

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 07/20

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EUROPEAN STANDARD

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EUROPÄISCHE NORM

EN IEC 61225

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English Version

Nuclear power plants - Instrumentation, control and electrical power systems - Requirements for static uninterruptible DC and AC power supply systems (IEC 61225:2019)

Centrales nucléaire de puissance - Systèmes d'instrumentation, de contrôle-commande et d'alimentation électrique - Exigences pour les systèmes d'alimentation en courant alternatif et en courant continu statiques sans interruption (IEC 61225:2019)

To be completed (IEC 61225:2019)

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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

Ref. No. EN IEC 61225:2020 E

European foreword

This document (EN IEC 61225:2020) consists of the text of IEC 61225:2019 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) 2020-09-17
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2020-09-17

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 security measures in the subject-matter covered by this standard.

Endorsement notice

The text of the International Standard IEC 61225:2019 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 60964	NOTE	Harmonized as EN IEC 60964
IEC 61000-6-2	NOTE	Harmonized as EN IEC 61000-6-2
IEC 61000-6-4	NOTE	Harmonized as EN IEC 61000-6-4
IEC 61226	NOTE	Harmonized as EN 61226
IEC 62040-3	NOTE	Harmonized as EN 62040-3
IEC 62340	NOTE	Harmonized as EN 62340

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 60038 (mod)	-	IEC standard voltages	EN 60038	-
IEC 60146-1-1	-	Semiconductor converters - General requirements and line commutated converters - Part 1-1: Specification of basic requirements	EN 60146-1-1	-
IEC 60146-2	-	Semiconductor converters - Part 2: Self-commutated semiconductor converters including direct d.c. converters	EN 60146-2	-
IEC 60364-4-41 (mod)	-	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock	HD 60364-4-41	-
			+A11	2017
			+A12	2019
IEC 60709	-		EN IEC 60709	-
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 60980	-	Recommended practices for seismic-qualification of electrical equipment of the safety system for nuclear generating stations		-
IEC 61000-1	series	Electromagnetic compatibility (EMC) - Part 1-2: General - Methodology for the achievement of functional safety of electrical and electronic systems including equipment with regard to electromagnetic phenomena	EN 61000-1	series
IEC 61508	series	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements (see Functional Safety and IEC 61508)	EN 61508	series
IEC 61513	-	Nuclear power plants - Instrumentation and control important to safety - General requirements for systems	EN 61513	-
IEC 62003	-	Nuclear power plants - Instrumentation and-		-

EN IEC 61225:2020 (E)

Publication	Year	Title	EN/HD	Year
		control important to safety - Requirements for electromagnetic compatibility testing		
IEC 62040	series	Uninterruptible power systems (UPS) - Part 1: Safety requirements	EN IEC 62040 +prAA	series
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/IEEE 60780-323	60780--		EN 60780-323	-

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Nuclear power plants – Instrumentation, control and electrical power systems – Requirements for static uninterruptible DC and AC power supply systems

Centrales nucléaires de puissance – Systèmes d'instrumentation, de contrôle-commande et d'alimentation électrique – Exigences pour les systèmes d'alimentation en courant alternatif et en courant continu statiques sans interruption

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INTERNATIONAL STANDARD

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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NUCLEAR POWER PLANTS – INSTRUMENTATION, CONTROL AND ELECTRICAL POWER SYSTEMS – REQUIREMENTS FOR STATIC UNINTERRUPTIBLE DC AND AC POWER SUPPLY 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 61225 has been prepared by subcommittee 45A: Instrumentation, control and electrical power systems of nuclear facilities, of IEC technical committee 45: Nuclear instrumentation.

This third edition cancels and replaces the second edition published in 2005. This edition constitutes a technical revision.

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

a) the principal objective of this edition is to address the requirements on the static uninterruptible power supplies in nuclear power plants;
b) in addition to Instrumentation and Control (I&C) power supplies include all static uninterruptible power supplies;

c) emphasize that the static uninterruptible power supplies shall protect the connected equipment (loads) from transients on the on-site AC distribution system (the immunity concept);

d) in accordance with the defence-in-depth concept, this standard applies to static uninterruptible power supplies for all equipment, not only for equipment important to safety, with a graded approach to verification and validation;

e) addition of the requirement that, when batteries are connected in parallel under abnormal operating conditions, they shall be properly protected with isolation devices to avoid any failure that may impair more than one division of the uninterruptible power supply.

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

FDIS	Report on voting
45A/1235/FDIS	45A/1250/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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

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

The 1993 issue of IEC 61225 was developed for specifying the requirements relevant to the design of electrical supplies for I&C systems in nuclear power plants. Considering the experience gathered worldwide on this subject, in 2003 working group A2 recommended a revision to this standard so that a new revision, IEC 61225 Ed. 2 (2005), could be consistently integrated into the SC 45A standard series. In 2015, working group A11 recommended a revision to this standard following the publication of the revision of IAEA SSG-34 and that the scope of the standard should cover static uninterruptible power supplies for all types of connected equipment.

International operating experience with electrical supply systems in nuclear power plants has highlighted a number of supply voltage variations and malfunctions, such as:

– voltage perturbations due to disturbances on the internal AC distribution system (with origin off-site or on-site);

– voltage overshoot on loss of grid;

– open phase conditions (one or two phases);

– asymmetrical faults.

These types of perturbations can degrade the performance of static uninterruptible power supplies and ultimately result in failure of connected equipment.

One of the objectives of the uninterruptible power supplies is to protect the connected equipment from voltage variations on the on-site AC distribution system (the immunity concept). The power supplies shall also guarantee an output voltage with specified magnitude and waveform (in case of AC) to connected loads. The power supplies shall have the capacity to supply the relevant loads during a specified time regardless of any voltage variations on the on-site AC distribution system.

Examples of voltage and frequency variations in the incoming feeder to the supplies can be found in informative Annex A. Examples of specifications for static uninterruptible power supplies can be found in informative Annex B.

This standard is applicable to the design of static uninterruptible electrical power supplies in new nuclear power plants, when design work is initiated after the publication of this standard. It also serves as a reference for upgrading and modernizing existing nuclear power plants.

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

IEC 61225 is a second level document specifically addressing the particular topic of requirements for electrical supplies.

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

c) Recommendations and limitations regarding the application of this standard

This standard is to be applied in conjunction with IEC 61513, IEC 60709, IEC 60880, IEC 62138, IEC 62855 and IEC 63046 (to be published).

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

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

IEC 61513 and IEC 63046 refer directly to other IEC SC 45A standards for general topics related to categorization of functions and classification of systems, qualification, separation, defence against common cause failure, control room design, electromagnetic

compatibility, cybersecurity, software and hardware aspects for programmable digital systems, coordination of safety and security requirements and management of ageing. The standards referenced directly at this second level should be considered together with IEC 61513 and IEC 63046 as a consistent document set.

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

A fourth level extending the IEC SC 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.

NUCLEAR POWER PLANTS – INSTRUMENTATION, CONTROL AND ELECTRICAL POWER SYSTEMS – REQUIREMENTS FOR STATIC UNINTERRUPTIBLE DC AND AC POWER SUPPLY SYSTEMS

1 Scope

This document specifies the performance and the functional characteristics of the low voltage static uninterruptible power supply (SUPS) systems in a nuclear power plant and, for applicable parts, in general for nuclear facilities. An uninterruptible power supply is an electrical equipment which draws electrical energy from a source, stores it and maintains supply in a specified form by means inside the equipment to output terminals. A static uninterruptible power supply (SUPS) has no rotating parts to perform its functions.

The specific design requirements for the components of the power supply system are covered by IEC standards and standards listed in the normative references and are otherwise outside 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, *IEC standard voltages*

IEC 60146-1-1, *Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specification of basic requirements*

IEC 60146-2, *Semiconductor converters – Part 2: Self-commutated semiconductor converters including direct d.c. converters*

IEC 60364-4-41, *Low voltage electrical installations – Part 4.41: Protection for safety – Protection against electric shock*

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

IEC/IEEE 60780-323, *Nuclear power plants – 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 61000 (all parts), *Electromagnetic compatibility (EMC)*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

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

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

IEC 62040 (all parts), *Uninterruptible power systems (UPS)*

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

IEC 62566-2, *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* (to be published)