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Kärnkraftanläggningar – Kontrollrum

*Nuclear power plants –
Control rooms –
Design*

Som svensk standard gäller europastandarden EN IEC 60964:2019. Den svenska standarden innehåller den officiella engelska språkversionen av EN IEC 60964:2019.

Nationellt förord

Europastandarden EN IEC 60964:2019^{*)}

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 60964, Third edition, 2018 - Nuclear power plants - Control rooms - Design**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 60964, utgåva 1, 2012, gäller ej fr om 2022-06-17.

^{*)}Corrigendum AC:2019-08 till EN IEC 60964:2019 är inarbetat i standarden.

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EUROPEAN STANDARD

EN IEC 60964

NORME EUROPÉENNE

EUROPÄISCHE NORM

June 2019

ICS 27.120.20

Supersedes EN 60964:2010 and all of its amendments
and corrigenda (if any)

English Version

Nuclear power plants - Control rooms - Design (IEC 60964:2018)

Centrales nucléaires de puissance - Salles de commande -
Conception
(IEC 60964:2018)

Kernkraftwerke - Warten - Auslegung
(IEC 60964:2018)

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

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Ref. No. EN IEC 60964:2019 E

SEK Svensk Elstandard

SS-EN IEC 60964, utg 2:2019

European foreword

This document (EN IEC 60964:2019) consists of the text of IEC 60964:2018 prepared by IEC/SC 45A: "Instrumentation, control and electrical power systems of nuclear facilities", of IEC/TC 45: "Nuclear instrumentation".

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2020-06-17
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2022-06-17

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.

This document supersedes EN 60964:2010 and all of its amendments and corrigenda (if any).

The contents of the corrigendum of August 2019 have been included in this copy.

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.

Endorsement notice

The text of the International Standard IEC 60964:2018 was approved by CENELEC as a European Standard without any modification.

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 When 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.

| <u>Publication</u> | <u>Year</u> | <u>Title</u> | <u>EN/HD</u> | <u>Year</u> |
|--------------------|-------------|--|--------------|-------------|
| IEC 60671 | - | Nuclear power plants - Instrumentation and control systems important to safety - Surveillance testing | EN 60671 | - |
| IEC 60709 | - | Nuclear power plants – Instrumentation and control systems important to safety – Separation | EN 60709 | - |
| IEC/IEEE 60780-323 | - | Nuclear power plants – Electrical equipment of the safety system – Qualification | EN 60780-323 | - |
| IEC 60960 | - | Functional design criteria for a safety parameter display system for nuclear power stations | - | - |
| IEC 60965 | - | Nuclear power plants – Control rooms – Supplementary control room for reactor shutdown without access to the main control room | EN 60965 | - |
| IEC 60980 | - | Recommended practices for seismic qualification of electrical equipment of the safety system for nuclear generating stations | - | - |
| IEC 61225 | - | Nuclear power plants - Instrumentation and control systems important to safety - Requirements for electrical supplies | - | - |
| IEC 61226 | - | Nuclear power plants - Instrumentation and control important to safety - Classification of instrumentation and control functions | EN 61226 | - |
| IEC 61227 | - | Nuclear power plants - Control rooms - Operator controls | EN 61227 | - |
| IEC 61513 | - | Nuclear power plants - Instrumentation and control important to safety - General requirements for systems | EN 61513 | - |
| 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 | - |

EN IEC 60964:2019 (E)

| | | | | |
|------------------|---|---|--------------|--------|
| IEC 62003 | - | Nuclear power plants - Instrumentation and control important to safety - Requirements for electromagnetic compatibility testing | - | - |
| IEC 62241 | - | Nuclear power plants - Main control room - Alarm functions and presentation | - EN 62241 | - |
| IEC 62645 | - | Nuclear power plants – Instrumentation and control systems – Requirements for security programmes for computer-based systems | - | - |
| IEC 62646 | - | Nuclear power plants – Control rooms – Computer based procedures | - | - |
| IEC 62859 | - | Nuclear power plants – Instrumentation and control systems – Requirements for coordinating safety and cybersecurity | - | - |
| ISO 11064 series | | Ergonomic design of control centres - | EN ISO 11064 | series |
| IAEA NS-G-1.9 | - | Design of the reactor coolant system and associated systems in nuclear power plants | | - |
| IAEA NS-G-1.11 | - | Protection against internal hazards other than fires and explosions in the design of nuclear power plants | | - |
| IAEA NP-T-3.16 | - | Accident Monitoring Systems for Nuclear Power Plants | | - |

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

NUCLEAR POWER PLANTS – CONTROL ROOMS – DESIGN

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 60964 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 2009. This edition constitutes a technical revision.

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

- a) to review the usage of the term "task" ensuring consistency between IEC 60964 and IEC 61839;
- b) to clarify the role, functional capability, robustness and integrity of supporting services for the MCR to promote its continued use at the time of a severe accident or extreme external hazard;
- c) to review the relevance of the standard to the IAEA safety guides and IEC SC 45A standards that have been published since IEC 60964:2009 was developed;
- d) to clarify the role and meaning of "task analysis",

- e) to further delineate the relationships with derivative standards (i.e. IEC 61227, IEC 61771, IEC 61772, IEC 61839, IEC 62241 and others of relevance to the control room design);
- f) to consider its alignment with the Human Factors Engineering principles, specifically with the ones of IAEA safety guide on Human Factors (DS-492) to be issued.

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

| FDIS | Report on voting |
|---------------|------------------|
| 45A/1214/FDIS | 45A/1224/RVD |

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

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

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

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

INTRODUCTION

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

IEC 60964:1989 was developed to supply requirements relevant to the design of the main control room of NPPs and reviewed in 2009. The first two editions of IEC 60964 were used extensively within the nuclear industry. It was however recognized that there was a need to develop an amendment for the 2009 edition to address:

- The usage of the term "task" needed to be examined.
- The role, functional capability, integrity of supporting services and robustness for the MCR should be clarified to promote its continued use at the time of a severe accident or extreme external hazard.
- The relevance of the standard to the IAEA safety guides and SC 45A standards published since 2009.

Given the size of the proposal amendment, it was decided that a new edition of IEC 60964 should be issued instead of an amendment. During the preparation of this third edition, it was agreed that the following points have to be covered:

- to clarify the role and meaning of "task analysis",
- to further delineate the relationships with derivative standards (i.e. IEC 61227, IEC 61771, IEC 61772, IEC 61839, IEC 62241 and others of relevance to the control room design);
- to consider its alignment with the Human Factors Engineering principles, specifically with the ones of IAEA safety guide on Human Factors (DS-492) to be issued.

This IEC standard specifically focuses on the functional designing of the main control room of NPPs. It is intended that the Standard be used by NPP vendors, utilities, and by licensors.

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

IEC 60964 is the second level IEC SC 45A document tackling the generic issue of control room design.

IEC 60964 is to be read in association with the derivative standards mentioned above which are the appropriate IEC SC 45A documents which provide guidance on operator controls, verification and validations of design, application of visual display units, functional analysis and assignment, and alarm functions and presentation.

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 the Standard

This standard is intended for application to new control rooms whose conceptual design is initiated after the publication of this standard. The recommendations of the standard may be used for refits, upgrades and modifications.

The primary purpose of this standard is to provide functional design requirements to be used in the design of the main control room of a nuclear power plant to meet operational and safety requirements.

This standard also provides functional interface requirements which relate to control room staffing, operating procedures and the training programme which are, together with the human-machine interface, constituents of the control room system.

To ensure that the Standard 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 framework establishing general requirements for instrumentation, control and electrical systems for nuclear power plants.

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

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

A fourth level extending the IEC SC 45A standard series, corresponds to the Technical Reports which are not normative.

The IEC SC 45A standards series consistently implements and details the safety and security principles and basic aspects provided in the relevant IAEA safety standards and in the relevant documents of the IAEA nuclear security series (NSS). In particular this includes the IAEA requirements SSR-2/1, establishing safety requirements related to the design of nuclear power plants (NPPs), the IAEA safety guide SSG-30 dealing with the safety classification of structures, systems and components in NPPs, the IAEA safety guide SSG-39 dealing with the design of instrumentation and control systems for NPPs, the IAEA safety guide SSG-34 dealing with the design of electrical power systems for NPPs and the implementing guide NSS17 for computer security at nuclear facilities. The safety and security terminology and definitions used by SC 45A standards are consistent with those used by the IAEA.

IEC 61513 and IEC 63046 have adopted a presentation format similar to the basic safety publication IEC 61508 with an overall life-cycle framework and a system life-cycle framework. Regarding nuclear safety, IEC 61513 and IEC 63046 provide the interpretation of the general requirements of IEC 61508-1, IEC 61508-2 and IEC 61508-4, for the nuclear application sector. In this framework IEC 60880, IEC 62138 and IEC 62566 correspond to IEC 61508-3 for the nuclear application sector. IEC 61513 and IEC 63046 refer to ISO as well as to IAEA GS-R 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 – CONTROL ROOMS – DESIGN

1 Scope

This document establishes requirements for the human-machine interface in the main control rooms of nuclear power plants. The document also establishes requirements for the selection of functions, design consideration and organization of the human-machine interface and procedures which are used systematically to verify and validate the functional design. These requirements reflect the application of human factors engineering principles as they apply to the human-machine interface during plant operational states and accident conditions (including design basis and design extension conditions), as defined in IAEA SSR-2/1 and IAEA NP-T-3.16. This document does not cover special purpose or normally unattended control points, such as those provided for shutdown operations from outside the main control room or for radioactive waste handling, or emergency response facilities. Detailed equipment design is outside the scope of this document.

The primary purpose of this document is to provide functional design requirements to be used in the design of the main control room of a nuclear power plant to meet operational and safety requirements. This document also provides functional interface requirements which relate to control room staffing, operating procedures, and the training programmes which, together with the human-machine interface, constitute the control room system.

This document is intended for application to new control rooms whose conceptual design is initiated after the publication of this document. If it is desired to apply it to an existing control room, special caution must be exercised so that the design basis is kept consistent.

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 60671, *Nuclear power plants – Instrumentation and control systems important to safety – Surveillance testing*

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

IEC/IEEE 60780-323, *Nuclear power plants – Electrical equipment of the safety system – Qualification*

IEC 60960, *Functional design criteria for a safety parameter display system for nuclear power stations*

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*

IEC 61225, *Nuclear power plants – Instrumentation and control systems important for safety – Requirements for electrical supplies*

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

IEC 61227, *Nuclear power plants – Control rooms – Operator controls*

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

IEC 61771, *Nuclear power plants – Main control room – Verification and validation of design*

IEC 61772, *Nuclear power plants – Main control room – Application of visual display units (VDUs)*

IEC 61839, *Nuclear power plants – Design of control rooms – Functional analysis and assignment*

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

IEC 62241, *Nuclear power plants – Main control room – Alarm functions and presentation*

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

IEC 62646, *Nuclear power plants – Control rooms – Computer based procedures*

IEC 62859, *Nuclear power plants – Instrumentation and control systems – Requirements for coordinating safety and cybersecurity*

ISO 11064 (all parts), *Ergonomic design of control centres*

IAEA NS-G-1.9, *Design of the reactor coolant system and associated systems in nuclear power plants*

IAEA, NS-G-1.11, *Protection against internal hazards other than fires and explosions in the design of nuclear power plants*

IAEA NP-T-3.16, *Accident Monitoring Systems for Nuclear Power Plants*