# IEC 63046

Edition 1.0 2020-10

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

colour inside

## Nuclear power plants – Electrical power system – General requirements

## Centrales nucléaires de puissance – Système d'alimentation électrique – Exigences générales

IEC 63046:2020-10(en-fr)

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# NUCLEAR POWER PLANTS – ELECTRICAL POWER SYSTEM – 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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International Standard IEC 63046 has been prepared by subcommittee 45A: Instrumentation, control and electrical power systems of nuclear facilities, of IEC technical committee 45: Nuclear instrumentation.

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

| FDIS | Report on voting |
|---|---|
| 45A/1348/FDIS | 45A/1355/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- withdrawn,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

The purpose of this standard is to provide the high level specification and requirement to implement a suitable Electrical Power System in a Nuclear Power Plant (NPP).

The electric power system in NPPs supports reactor systems important to safety. It also allows electric energy production providing the transmission grid with active and reactive power and electro-mechanical inertia.

The designers, operators of NPPs (utilities), equipment suppliers, systems evaluators and licensors, may use this document.

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

The entry point of the IEC SC 45A standard series should be summary report introducing the two first level standards for I&C (IEC 61513) and the Electrical Power System (IEC 63046).

This document is the first level IEC SC 45A document tackling the issue of general requirements for Electrical Power System and sub-systems.

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 Standard

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

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 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 was launched to cover this objective. As IEC 63046 is published, from now on this Note 2 of the introduction of IEC/SC 45A standards will not be included in the newly published standards.

# NUCLEAR POWER PLANTS – ELECTRICAL POWER SYSTEM – GENERAL REQUIREMENTS

## 1 Scope

### 1.1 General

This document:

- provides requirements and recommendations for the overall Electrical Power System. In particular, it covers interruptible and uninterruptible Electrical Power Systems including the systems supplying the I&C systems;
- is consistent and coherent with IEC 61513. Like IEC 61513, this document also highlights the need for complete and precise requirements, derived from the plant safety goals. Those requirements are prerequisites for generating the comprehensive requirements for the overall Electrical Power System architecture, and for the electrical power supply sub-systems;
- has to be considered in conjunction with and at the same level as IEC 61513. These two standards provide a complete framework establishing general requirements for instrumentation, control, and Electrical Power System for Nuclear Power Plants.

This document establishes:

- the high level specification and requirement to implement a suitable Electrical Power System in a NPP that supports reactor systems important to safety. It also enables electrical energy production providing the transmission grid with active and reactive power and electro-mechanical inertia;
- the relationships between:
  - the plant safety requirements and the architecture of the overall Electrical Power System and its sub-systems (see Figure 1) including:
    a) the contribution to the plant Defence in Depth;
    b) the independency and redundancy provisions;
  - the electrical requirements and the architecture of the Electrical Power System and its sub-systems;
  - the functional requirements and the architecture of the Electrical Power System and its sub-systems;
  - the requirements associated with the maintenance strategy and the architecture of the Electrical Power System and its sub-systems;
- the design of Electrical power sub-systems (e.g. interruptible and uninterruptible);
- the requirements for supporting systems of Electrical Power System (HVAC, I&C, etc.);
- the Electrical Power System life-cycle framework.

This document does not cover the specification of:

- I&C systems;
- the transmission lines connecting to substations outside the NPP;
- electrical equipment requirements already defined in the industrial IEC standards;
- electrical power for security systems (e.g., fences, surveillance systems, entrance control);