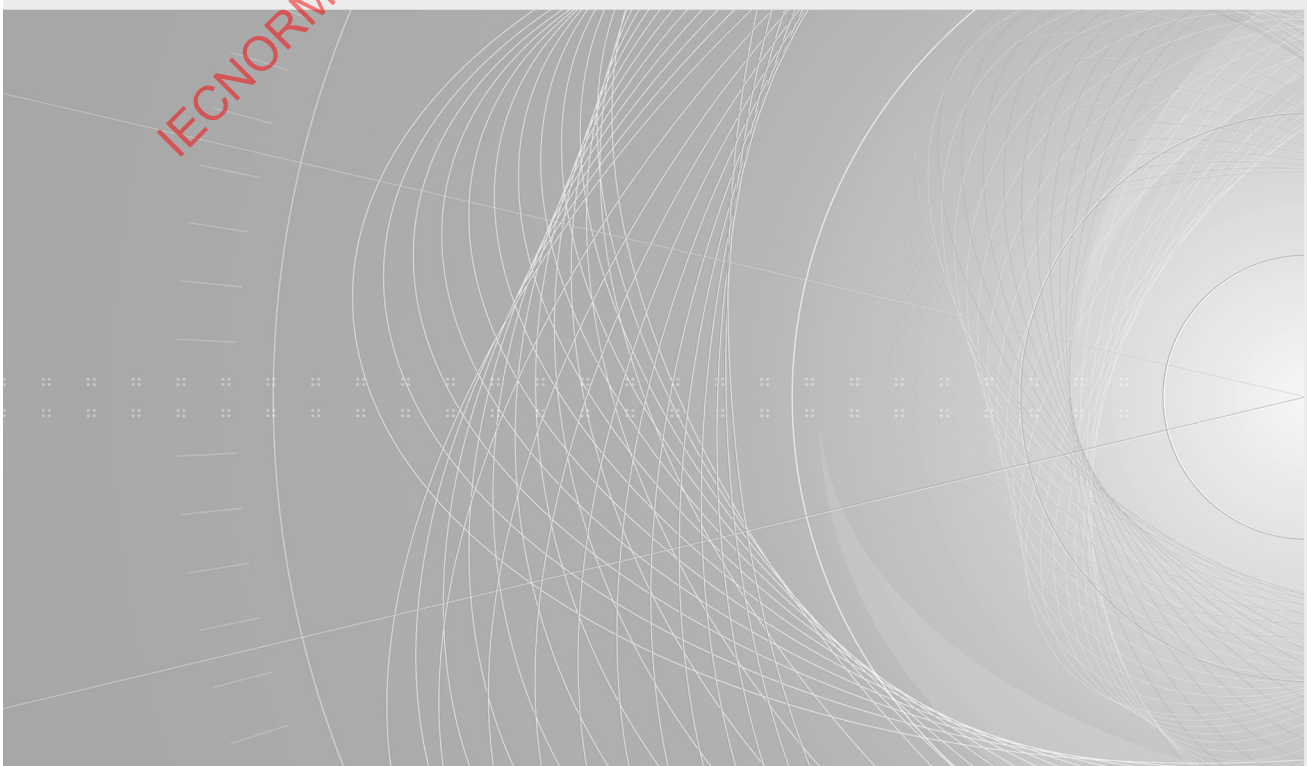
IEC TR 63400

Edition 1.0 2021-11

TECHNICAL REPORT

colour inside

Nuclear facilities – Instrumentation, control and electrical power systems important to safety – Structure of the IEC SC 45A standards series



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NUCLEAR FACILITIES – INSTRUMENTATION, CONTROL AND ELECTRICAL POWER SYSTEMS IMPORTANT TO SAFETY – STRUCTURE OF THE IEC SC 45A STANDARDS SERIES

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

IEC TR 63400 has been prepared by subcommittee 45A: Instrumentation, control and electrical power systems of nuclear facilities, of IEC technical committee 45: Nuclear instrumentation. It is a Technical Report.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
45A/1395/DTR	45A/1406/RVDTR

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under 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 document 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 organisation of the Technical Report

The IEC SC 45A series of standards include the same common description in their Introduction, item d), outlining the overall structure of the series and its relationship with other standards bodies and standards (e.g. specific IAEA safety guides and IEC 61508).

The structure of the IEC SC 45A series at the time of drafting this Technical Report could be described as a “pyramid” extending down from two top-level documents (at level 1) to other documents (at levels 2, 3 and 4).

With the gradual extension of the IEC SC 45A scope to address electrical power systems, cyber security and human factors engineering, and ongoing development of new standards, it had become apparent that the common description could no longer, on its own, adequately fulfil this objective without becoming overly extensive.

This Technical Report is therefore intended to augment the common description that is included in the Introduction, item d), of all IEC SC 45A standards and technical reports (including this Technical Report).

It was agreed at the IEC SC 45A meeting held in Paris in April 2019 that this Technical Report should be primarily for the benefit of the users of the IEC SC 45A standards (including first time users) rather than for the expert members of IEC SC 45A and its working groups.

A revision of this Technical Report should be considered after each SC 45A meeting and, if judged necessary, a revision then undertaken subject to the availability of the appropriate resources.

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

The technical report IEC TR 63400 is a fourth level IEC SC 45A document.

Item d) of this introduction describes the structure of the IEC SC 45A standard series in general terms.

This Technical Report augments that description to enable users of individual IEC SC 45A standards to obtain a more comprehensive understanding of the overall structure of the series and its relationship with other standards bodies and standards. The publication of subsequent editions of this Technical Report should also enable minor changes in the structure to be described without the need for amending the common description that is included in the Introduction, item d), of all IEC SC 45A documents.

c) Recommendations and limitations regarding the application of the Technical Report

It is important to note that a Technical Report is entirely informative in nature. It gathers data collected from different origins and it establishes no requirements.

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 IEC SC 45A standard series comprises a hierarchy of four levels. The top-level documents of the IEC SC45A standard series are IEC 61513 and IEC 63046.

IEC 61513 provides general requirements for instrumentation and control (I&C) systems and equipment that are used to perform functions important to safety in nuclear power plants (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 power systems for nuclear power plants.

IEC 61513 and IEC 63046 refer directly to other IEC SC 45A standards for general requirements for specific topics, such as categorization of functions and classification of systems, qualification, separation, defence against common cause failure, control room design, electromagnetic compatibility, human factors engineering, 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 requirements for specific equipment, technical methods, or activities. Usually these documents, which make reference to second-level documents for general requirements, 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, the IAEA safety guide SSG-51 dealing with human factors engineering in the design of NPPs and the implementing guide NSS17 for computer security at nuclear facilities. The safety and security terminology and definitions used by the 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 9001 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/SC45A 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/SC45A control rooms standards, IEC 63351 (currently in preparation) is intended as the entry document for the human factors engineering 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 TR 63400 (this document) provides a more comprehensive description of the overall structure of the IEC SC 45A standards series and of its relationship with other standards bodies and standards.

NUCLEAR FACILITIES – INSTRUMENTATION, CONTROL AND ELECTRICAL POWER SYSTEMS IMPORTANT TO SAFETY – STRUCTURE OF THE IEC SC 45A STANDARDS SERIES

1 Scope

The IEC SC 45A series of standards include a general description in their Introduction, item d), outlining the overall structure of the series and its relationship with other standards bodies and standards (e.g. specific IAEA safety guides and IEC 61508).

This document is intended to augment that description to enable users of individual IEC SC 45A standards to obtain a more comprehensive understanding of the overall structure of the series and its relationship with other standards bodies and standards.

This document is organized as follows:

- Clause 5 outlines the scope of the IEC SC 45A standards series;
- Clause 6 describes the basic structure of the IEC SC 45A standards series, with particular reference to a hierarchy of levels and subdivision into a set of broad topic areas;
- Clause 7 presents the structure of the IEC SC 45A standards series in diagrammatic form;
- Clause 8 introduces and points to three annexes that include:
  a) the full set of IEC SC 45A standards in tabular form and numerical order,
  b) other (i.e. non IEC SC 45A) documents of particular relevance to IEC SC 45A, and
  c) the IEC SC 45A standards in tabular form for each broad topic area.

NOTE In this edition, the documents listed in the annexes and their status correspond to the situation that applied on 1st May 2021.

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 60515, *Nuclear power plants – Instrumentation important to safety – Radiation detectors – Characteristics and test methods*

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

IEC 60737, *Nuclear power plants – Instrumentation important to safety – Temperature sensors (in-core and primary coolant circuit) – Characteristics and test methods*

IEC 60772, *Nuclear power plants – Instrumentation systems important to safety – Electrical penetration assemblies in containment structures*

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 60987, *Nuclear power plants – Instrumentation and control important to safety – Hardware requirements*

IEC 60988, *Nuclear power plants – Instrumentation important to safety – Acoustic monitoring systems for detection of loose parts: characteristics, design criteria and operational procedures*

IEC 61031, *Nuclear facilities – Instrumentation and control systems – Design, location and application criteria for installed area gamma radiation dose rate monitoring equipment for use during normal operation and anticipated operational occurrences*

IEC 61225, *Nuclear power plants – Instrumentation, control and electrical power systems – Requirements for static uninterruptible DC and AC power supply systems*

IEC 61226, *Nuclear power plants – Instrumentation, control and electrical power systems important to safety – Categorization of functions and classification of systems*

IEC 61250, *Nuclear reactors – Instrumentation and control systems important for safety – Detection of leakage in coolant systems*

IEC 61508-1, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements*

IEC 61508-2, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*

IEC 61508-3, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 3: Software requirements*

IEC 61508-4, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 4: Definitions and abbreviations*

IEC 61508-7, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 7: Overview of techniques and measures*

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

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

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 62340, *Nuclear power plants – Instrumentation and control systems important to safety – Requirements for coping with common cause failure (CCF)*

IEC 62342, *Nuclear power plants – Instrumentation and control systems important to safety – Management of ageing*

IEC 62465, *Nuclear power plants – Instrumentation and control important to safety – Management of ageing of electrical cabling systems*

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

IEC 62645, *Nuclear power plants – Instrumentation, control and electrical power systems – Cybersecurity requirements*

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

IEC 62705, *Nuclear power plants – Instrumentation and control important to safety – Radiation monitoring systems (RMS): Characteristics and lifecycle*

IEC 62808, *Nuclear power plants – Instrumentation and control systems important to safety – Design and qualification of isolation devices*

IEC 62855, *Nuclear power plants – Electrical power systems – Electrical power systems analysis*

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

IEC 63046, *Nuclear power plants – Electrical power system – General requirements*

IEC 63272, *Nuclear facilities – Electrical power systems – AC interruptible power supply systems* (in preparation)

IEC 63298, *Nuclear power plants – Electrical power systems – Coordination and interaction with electric grid* (in preparation)

IEC 63351, *Nuclear facilities – Human Factors Engineering – Application to the design of Human Machine Interfaces* (in preparation)

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

IEC/IEEE 60980-344, *Nuclear facilities – Equipment important to safety – Seismic qualification*

IAEA Safety Glossary, 2018 Edition, IAEA, Vienna, 2019

IAEA Nuclear Security Series Glossary, Version 1.3, November 2015

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 https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
computer-based item
item that relies on software instructions running on microprocessors or microcontrollers

Note 1 to entry: In this term and its definition, the term item can be replaced by the terms: system, or equipment, or device.

Note 2 to entry: A computer-based item is a kind of programmable digital item.

Note 3 to entry: This term is equivalent to software-based item.

Note 4 to entry: See also the definition of E/E/PE item and the associated notes.

3.2
computer-based system
I&C system whose functions are mostly dependent on, or completely performed by using microprocessors, programmed electronic equipment or computers

Note 1 to entry: See also I&C system.

3.3
Electrical/Electronic/Programmable Electronic item
E/E/PE item
item based on electrical (E) and/or electronic (E) and/or programmable electronic (PE) technology

Note 1 to entry: In this term and its definitions, the term item can be replaced by the terms: system, or equipment, or device.

Note 2 to entry: See also the definitions of programmable digital item, of computer-based item, of hardwired item, of programmable logic item and the associated notes.

Note 3 to entry: The definitions of the terms related to the technology: E/E/PE item, programmable digital item, computer-based item, hardwired item, programmable logic item are totally consistent and coherent.

3.4
electrical power system
EPS
system performing electrical power generation, transmission and distribution; performing supply functions to operate plant equipment (pumps, valves, heaters, etc.) and to I&C systems

Note 1 to entry: An electrical system can integrate E/E/PE items to perform its internal electrical control and protection.

3.5
function
specific purpose or objective to be accomplished, that can be specified or described without reference to the physical means of achieving it

3.6
hardwired item
item that relies on relays, on analogue electronic or on discrete digital logic

Note 1 to entry: In this term and its definition, the term item can be replaced by the terms: system, or equipment, or device.

Note 2 to entry: This term used by SC45A is equivalent to the term electrical/electronic item (E/E item) defined according to IEC 61508. Relays are electro-mechanical items which are not electronic items.

Note 3 to entry: Hardwired items are also usually called conventional items.

Note 4 to entry: See also the definitions of E/E/PE item and the associated notes.

3.7
HDL-programmed device
HPD
integrated circuit configured (for NPP I&C systems), with Hardware Description Languages and related software tools

Note 1 to entry: HDLs and related tools (e.g. simulator, synthesizer) are used to implement the requirements in a proper assembly of pre-developed micro-electronic resources.

Note 2 to entry: The development of HPDs can use Pre-Developed Blocks.

Note 3 to entry: HPDs are typically based on blank FPGAs (Field Programmable Gate Arrays) or similar programmable integrated circuits.

Note 4 to entry: HPD is a kind of programmable logic item.

Note 5 to entry: See also the definition of E/E/PE item and the associated notes.

3.8
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 “electrical power system”. The terms “electrical power system” and “I&C system” are terms related to the main functions the systems perform; respectively “electrical power generation, transmission and distribution” and “measurement, protection, control and HMI related to the NPP process”. They have to be considered in conjunction and are totally consistent and coherent. with the general requirements established by IEC 61513 and IEC 63046 for instrumentation, control and electrical power systems for nuclear power plants.

Note 4 to entry: See also the definition of E/E/PE item and the associated notes.

Note 5 to entry: According to their typical functionality, IAEA distinguishes between automation / control systems, HMI systems, interlock systems and protection systems.

3.9
nuclear energy generation facilities
nuclear power plants (NPPs), fuel handling and processing plants, interim and final repositories for spent fuel and nuclear waste

3.10
nuclear safety
achievement of proper operating conditions, prevention of accidents and mitigation of accident consequences, resulting in protection of workers, the public and the environment from undue radiation risks

[SOURCE: IAEA Safety Glossary, 2018 edition]

3.11
programmable digital item
item that relies on software instructions or programmable logic to accomplish a function

Note 1 to entry: In this term and its definition, the term item can be replaced by the terms: system, or equipment, or device.

Note 2 to entry: See also the definition of E/E/PE item and the associated notes.

Note 3 to entry: The main kinds of programmable digital items are computer-based items and programmable logic items.

Note 4 to entry: This term used by IEC SC45A is equivalent to programmable electronic item (PE item) defined according to IEC 61508.

3.12
programmable logic item
item that relies on logic components with an integrated circuit that consists of logic elements with an inter-connection pattern, parts of which are user programmable

Note 1 to entry: In this term and its definition, the term item can be replaced by the terms: system, or equipment, or device.

Note 2 to entry: A programmable logic item is a kind of programmable digital item.

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

3.13
standard
document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context

Note 1 to entry: Standards should be based on the consolidated results of science, technology and experience, and aimed at the promotion of optimum community benefits.

[SOURCE: ISO/IEC Directives, Part 2:2021, 3.1.2]

3.14
international standard
standard that is adopted by an international standardizing/standards organization and made available to the public

[SOURCE: ISO/IEC Directives, Part 2:2021, 3.1.3]

3.15
technical report
TR
document published by ISO or IEC containing collected data of a different kind from that normally published as an International Standard or Technical Specification

[SOURCE: ISO/IEC Directives, Part 2:2021, 3.1.8]

4 Abbreviated terms

AC	Administrative Circular

CCF	Common Cause Failure
CBP	Computer Based Procedures
EMI	Electromagnetic Interference
EP	Electrical Power
EPS	Electrical Power System
HFE	Human Factors Engineering
HMI	Human Machine Interface
IAEA	International Atomic Energy Agency
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Organization for Standardization
ITNS	Important To Nuclear Safety
I&C	Instrumentation and Control
L/C	Lifecycle
L1, L2, …	Level 1, Level 2, …
NP	New Work Item Proposal
NPEC	Nuclear Power Engineering Committee (of the IEEE)
NPP	Nuclear Power Plant
NSS	Nuclear Security Series (of the IAEA)
RFI	Radio Frequency Interference
RTD	Resistance Temperature Detector
SC	Subcommittee
TC	Technical committee
TR	Technical Report
WG	Working Group

5 IEC SC 45A scope

5.1 Technical scope

An abridged version of the IEC SC 45A technical scope is as follows:

> To prepare standards applicable to the electronic and electrical functions and associated systems and equipment used in nuclear energy generation facilities (nuclear power plants, fuel handling and processing plants, interim and final repositories for spent fuel and nuclear waste) to improve the efficiency, safety and security of nuclear energy generation.
>
> The standards cover the entire lifecycle of these instrumentation, control and electrical power systems, from conception, through design, manufacture, test, installation, commissioning, operation, maintenance, aging management, modernization and decommissioning.

Refer to the IEC website for the IEC SC 45A full technical scope statement. The following may be used to obtain information relating to IEC SC 45A and the list of IEC TCs / SCs , respectively:

> *https://www.iec.ch/dyn/www/f?p=103:7:::::FSP_ORG_ID:1358*
>
> *https://www.iec.ch/technical-committees-and-subcommittees#tclist*

NOTE For more information about IEC management and activities, see: https://www.iec.ch/homepage.

5.2 Relationship with other standards bodies

5.2.1 General

Many IEC SC 45A standards make reference to other SC 45A standards and, where applicable, also make reference to various non-SC 45A IEC and ISO standards rather than repeating their requirements.

In addition to the above, IEC SC 45A has established a number of liaisons with other IEC technical committees/subcommittees and with technical committees of other standards bodies.

For further details of these, refer to the IEC website as below and then select “Liaisons”:

https://www.iec.ch/dyn/www/f?p=103:29:8332652503242::::FSP_ORG_ID,FSP_LANG_ID:1358,25

The relevance of some of these liaisons to the work of IEC SC 45A is outlined in 5.2.2 to 5.2.4.

5.2.2 Internal IEC liaisons

IEC 61513 and IEC 63046 are the IEC SC 45A nuclear sector standards, covering I&C and the EPS respectively, equivalent to the basic safety publication IEC 61508-1, IEC 61508-2 and IEC 61508-4, the latter standard series being prepared by SC 65A, system aspects, of IEC TC 65, industrial-process measurement, control and automation. The IEC SC 45A standard suite IEC 60880, IEC 62138, IEC 62566, etc., are similarly equivalent to IEC 61508-3.

The IEC SC 45A standards (IEC 61513, IEC 60880, etc.) differ from IEC 61508 in that they take into account the "traditional" nuclear sector deterministic design approach used since the 1950s.

NOTE As a result of the above, systems designed in accordance with the IEC SC 45A standards generally comply with IEC 61508, but the reverse is not true.

It is also worth noting that IEC SC 45A and IEC SC 45B include radiation monitoring for different functions. The IEC SC 45B radiation monitoring standards are therefore of interest to the IEC SC 45A scope.

5.2.3 Liaison with IAEA

The IEC SC 45A standards series consistently implements and details the safety and security principles and basic aspects provided in the relevant International Atomic Energy Agency (IAEA) safety standards and in the relevant documents of the IAEA nuclear security series (NSS). These IAEA documents are introduced in 8.2 and included in Annex B.

In addition, the safety and security terminology and definitions used by IEC SC 45A standards are consistent with those used by the IAEA as described in 5.4.

5.2.4 Liaison with IEEE NPEC

Recognizing the synergies between the IEC SC 45A and the IEEE NPEC nuclear standards organizations, a collaborative programme was established to allow the development of joint IEC/IEEE standards. There are two forms of joint logo standards.

Existing IEEE standards that are adopted by IEC: These receive new IEC identifiers.

Standards that are developed jointly: These receive identifiers of the form IEC/IEEE xxxxx.

To enable this, the following agreements were established between IEC SC 45A and the Nuclear Power Engineering Committee (NPEC) of the Institute of Electrical and Electronic Engineers (IEEE):

AC/138/2002 – Co-operation and Licence Agreement between IEC and IEEE.

AC/24/2007 – IEC-IEEE dual logo maintenance procedure.

AC/22/2008 – IEC-IEEE joint development agreement.

These agreements have made possible:

- The joint development of dual logo IEC/IEEE standards on an agreed set of specific topics;

- The endorsement and publication of selected existing IEEE standards as IEC standards.

The three ACs can be accessed via the IEC web site by following the link (below), clicking on "Selected ACs" and then scrolling down to "IEC/IEEE":

https://www.iec.ch/dyn/www/f?p=103:96:0#2

A guide on IEC/IEEE collaboration can also be accessed via the IEC web site at:

www.iec.ch/resource-centre/guide-iecieee-cooperation

5.3 Criteria for development of SC 45A standards

Generic international standards (e.g. IEC, ISO) have been developed for most types of systems, equipment and methods that are required by industry.

When there is a generic standard for a topic which cannot be used directly or which needs adaptation for the nuclear sector, guidelines are developed for its use or "nuclear equivalent" standards are developed.

In such cases, the IEC SC 45A "application" guidelines and "nuclear equivalent" standards make reference to and adhere as closely as possible to the generic international standard.

5.4 IEC SC 45A terminology policy

The IEC SC 45A terminology policy has the following three broad objectives:

a) to use the IAEA safety and security terminology in the development of the IEC SC 45A standards and any dual logo IEC/IEEE standards;

b) where this is not possible, to use applicable IEV definitions for generic terms in the electrotechnical domain and applicable ISO definitions for generic terms in other domains;

c) where the above are not applicable, to develop new definitions.

Links to the IEC Electropedia and ISO Online browsing platform have already been provided in Clause 3, and the IAEA safety glossary can be found at:

https://www.iaea.org/publications/11098/iaea-safety-glossary-2018-edition

NOTE 1 IEC and ISO terms are developed separately for each TC and SC and so there may be multiple definitions from which to chose for any given term.

Where the definition of a term in the IAEA Safety Glossary or IAEA Nuclear Security Series Glossary (see Clause 2) is judged fully satisfactory, it is included directly into the IEC SC 45A relevant standard.

If an IAEA definition of a term is judged not fully satisfactory for direct use in an IEC SC 45A standard, the original IAEA definition is integrated and a note is added to give precision or introduce some nuance.

If an IAEA definition of a term cannot be used in a specific IEC SC45A standard, a definition is developed for inclusion in the standard and a note is added indicating that the definition is different from the IAEA one and explaining the reason for the discrepancy.

NOTE 2 Where it is judged not possible to use an IAEA definition, a suitably justified proposal is made to the IAEA to evolve their definition so that it may be used in the IEC SC 45A standards series in the future.

6 The IEC SC 45A standards structure

6.1 Details of the basic structure

The basic structure is described below in terms of:

- Technical coverage – see 6.2;
- Hierarchy of levels – see 6.3;
- Subdivision into broad topic areas – see 6.4;
- Use of entry point documents – see 6.5;
- Presentation – see 6.6.

6.2 Technical coverage

The extent of coverage that may be provided by the IEC SC 45A standards series in terms of the types of nuclear facility, discipline areas, types of project, focus of the standards and lifecycle stages is as follows:

- All types of nuclear energy generation facilities (see 3.9);
- All instrumentation and control (I&C) systems and equipment and electrical power systems (EPS) and equipment important to nuclear safety (ITNS);
- All I&C and EPS projects ITNS associated with the design and construction of new nuclear energy generation facilities and/or modernisation for existing nuclear energy generation facilities;
- All system aspects, equipment aspects and methodologies;
- All stages of the lifecycle of the I&C and EP systems and equipment from their conception to their ultimate decommissioning.

The coverage provided by individual IEC SC 45A standards should be indicated by their titles and described in more detail by their scope statements. The scope statements for individual IEC SC 45A standards may therefore refer to them providing requirements for a subset or any combination of the following:

- Either a) nuclear energy generation facilities, or
  b) NPPs (only), or
  c) one or more nuclear energy generation facilities other than NPPs;
- Either a) I&C systems and equipment (only), or
  b) EP systems and equipment (only), or
  c) both of these discipline areas;
- Either a) new plants (only), or
  b) modernisation projects (only), or
  c) both of these project types;
- Either a) system aspects (only), or
  b) equipment aspects (only), or
  c) methods (only), or
  d) some combination of these;
- Specific stages of the overall system lifecycle (e.g. conception, requirements specification, design, manufacture, testing, installation, commissioning, operation, maintenance, ageing management and decommissioning).

NOTE In practice, the majority of the current IEC SC 45A standards address requirements for NPPs (only).

6.3 Hierarchy of levels

6.3.1 General

The basic structure comprises a hierarchy of 4 levels (L1 to L4).

The definitions of these levels are as follows:

L1: General requirements

L2: General requirements for specific topics

L3: Specific requirements for specific topics

L4: Technical Reports (which are not normative)

These 4 levels are described in more detail in 6.3.2 to 6.3.5.

6.3.2 Level 1

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 power systems for nuclear power plants.

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.

With reference to 5.2.2, 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.

6.3.3 Level 2

IEC 61513 and IEC 63046 refer directly to other IEC SC 45A standards for general requirements related to specific topics such as 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.

With reference to 5.2.2, IEC 60880, IEC 62138 and IEC 62566 provide the interpretation of the general requirements of IEC 61508-3 for the nuclear application sector.

6.3.4 Level 3

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

6.3.5 Level 4

The IEC SC 45 standard series is then extended and augmented by a number of Technical Reports. These fourth level documents are not normative.

6.4 Broad topic areas

6.4.1 General

In addition to the hierarchy of 4 levels, the IEC SC 45A standards are structured into a number of broad topic areas, these being:

Two topic areas mainly addressing discipline-based architectures and specifics of that discipline:

- Topic 01: I&C architecture and specifics of I&C;
- Topic 02: Electrical power system architecture and specifics of electrics.

Five topic areas mainly addressing safety and other methodologies:

- Topic 11: Safety fundamentals;
- Topic 12: Equipment qualification and system performance;
- Topic 13: Human factors engineering (HFE);
- Topic 14: Cyber security;
- Topic 15: Ageing management.

Five topic areas mainly addressing specific systems and equipment:

Topic 21: Control rooms and human machine interfaces (HMI);

Topic 22: Sensors and measurement techniques;

Topic 23: Special process measurement;

Topic 24: Radiation monitoring;

Topic 25: Plant wide I&C and electrical equipment.

The scope of these twelve broad topic areas is described in 6.4.2 to 6.4.13.

NOTE 1 The topic areas defined are for administrative purposes, and do not feature in the title or scope of any of the standards within those areas.

NOTE 2 The IEC SC 45A scope applies to all types of nuclear energy generation facilities (see 5.1). However, the majority of the existing IEC SC 45A standards address the requirements for nuclear power plants (only). This suggests that there could be a need in the future for:

- the addition of a small number of new topic areas; and/or
- enhancement of the descriptions for the 12 listed topic areas.

NOTE 3 If there is a future need for additional topics areas, the topic identifiers may also require revision.

6.4.2 I&C architecture and specifics of I&C [topic 01]

This topic area applies to Electrical/Electronic/Programmable Electronic (E/E/PE) based I&C systems which provide functions important to safety in nuclear facilities, including:

- Overall I&C system architecture and general design requirements and verification methods for the I&C systems;
- Assessment and pre-qualification of I&C platforms;
- I&C specific design aspects complementing those general design requirements, such as those relating to:
  - coping with common cause failure;
  - software for computer-based items important to safety;
  - programmable logic items important to safety;
  - data communication;
  - I&C system hardware.

6.4.3 Electrical power system architecture and specifics of electrics [topic 02]

This topic area applies to electrical power systems (EPS) important to safety in nuclear facilities, including:

- Overall EPS architecture and general design requirements and verification methods for the EPS;
- EPS specific design aspects complementing those general requirements;
- Design requirements and verification methods for specific EPS components.

NOTE This topic is considered a potential growth area.

6.4.4 Safety fundamentals [topic 11]

This topic area applies to the fundamental principles for instrumentation, control and electrical power systems important to safety for nuclear facilities, including those relating to:

- Categorisation of safety functions;
- Classification of I&C and electrical power systems and associated functional allocation requirements;
- Defence in depth;
- Denial of service arising from single failures;

- Defence against common cause (CCF) failure (including systematic faults) and the implementation of techniques such as separation, diversity and isolation to achieve independence and protection from internal and external hazards and from random and systematic faults;
- Quantitative reliability evaluation, its assurance by surveillance and proof testing and limitation by consideration of CCF and systematic faults;
- Analysis techniques for the identification and treatment of potential random and systematic faults.

6.4.5 Equipment qualification and system performance [topic 12]

This topic area applies to equipment qualification for robustness toward external stress for I&C systems and EPS used in nuclear facilities, with particular reference to stresses arising from environmental conditions, including seismic events and EMI/RFI.

It applies to aspects related to validation, verification and calibration of instrumentation systems at the system or channel level, including:

- Electronic aspects;
- Processing aspects;
- Safety aspects related to critical safety functions;
- Performance monitoring functions.

NOTE This topic is considered a potential growth area.

6.4.6 Human factors engineering (HFE) [topic 13]

This topic area applies to the application of an HFE programme to HMI of nuclear facilities, including:

- HFE programme management;
- Operating experience review;
- Functional requirements analysis and function allocation;
- Task analysis;
- Staffing, organisation and personnel qualification;
- Treatment of important human tasks;
- Input to HMI design;
- Procedure development;
- Training programme development;
- Human factors verification and validation;
- As-built design conformance;
- Human performance monitoring.

NOTE This topic is considered a potential growth area.

6.4.7 Cyber security [topic 14]

This topic area applies to system robustness toward external stress for I&C systems and EPS used in nuclear facilities, with particular reference to stresses arising from malevolent acts.

It also applies to the coordination of safety and security requirements for I&C systems and EPS for nuclear facilities.

NOTE This topic is considered a potential growth area.

6.4.8 Ageing management [topic 15]

This topic area applies to the ageing management of I&C systems and EPS for nuclear facilities, including:

- the replacement, upgrading and modernization of I&C systems and EPS due to obsolescence, ageing, plant life extension activities and other economically, technically, or safety driven motivating factors;
- the management of ageing and associated condition monitoring and diagnostic methods.

6.4.9 Control rooms and human machine interfaces (HMI) [topic 21]

This topic area applies to the control room areas and HMI of nuclear facilities, including:

- Main control room and associated design methodology;
- Supplementary control room;
- Emergency response facilities;
- Other supplementary control points;
- Controls, displays, alarms and associated support functions;
- Operating and emergency procedures;
- Communication systems.

6.4.10 Sensors and measurement techniques [topic 22]

This topic area applies to the sensors and associated measurement techniques used for I&C systems and EPS in nuclear facilities, including:

- Neutron and gamma detectors;
- Temperature sensors (RTDs and thermocouples);
- In-core and ex-core detectors and measurement techniques.

6.4.11 Special process measurement [topic 23]

This topic area applies to special process measurement used for monitoring:

- Adequate cooling within the cores of light water reactors;
- Leakages from the coolant systems or into the containment of light water reactors;
- Both wet and dry storage facilities and repositories for used nuclear fuel and waste.

6.4.12 Radiation monitoring [topic 24]

This topic area applies to radiation monitoring used for monitoring plant processes, plant control and safety actuation in nuclear facilities.

NOTE IEC SC 45B radiation monitoring standards address similar requirements for normal operation plant states and are therefore of interest to the IEC SC 45A scope.

6.4.13 Plant wide I&C and electrical equipment [topic 25]

This topic area applies to I&C and electrical equipment that is used throughout nuclear facilities, including that at the boundary of two systems, to either allow communication/transfer or to manage their separation.

It is also used for any system or equipment related topics that do not easily adhere to the defined scopes of the preceding topics areas.

6.5 Entry point documents

An entry point document is the term applied to the small number of IEC SC 45A standards that enable a new user of the standards series to most effectively find their way into the series and explore the hierarchy.

In this respect, some topic areas benefit from having a single document that covers the full scope (or a major part of the scope) at a general level and other documents that go into further detail for parts of that scope. In such cases, the single document can act as a convenient entry point to the topic area, provided it explains the relationship between it and the other more detailed documents.

There are two discipline-oriented topic entry point documents to the hierarchy at L1:

I&C architecture and specifics of I&C – IEC 61513;

Electrical architecture and specifics of electrics – IEC 63046.

In addition to the above, there are then a number of other topic-oriented entry point documents to the hierarchy at L2:

Equipment qualification – IEC/IEEE 60780-323;

Human factors engineering – IEC 63351 (new standard under development);

Cyber security – IEC 62645;

Ageing – IEC 62342;

Control rooms and human machine interfaces (HMI) – IEC 60964.

NOTE The two discipline-oriented entry point documents (see above) also act as the entry points for the remaining topic areas that do not have a single document covering the full scope (or major part thereof) at a general level.

6.6 Presentation of the structure in the TR

The structure of the SC 45A standards is presented in the following ways:

- A diagrammatic presentation showing the links between the IEC SC 45A standards at L1 and L2 which encompass the entry point documents and the set of broad topic areas that together define the IEC SC 45A standards hierarchy.

  This presentation is included as Figure 1.

- A tabular presentation in numerical order of the standards, subdivided into:
  - The published IEC SC 45A standards and TRs plus the IEC SC 45B radiation monitoring standards of interest to the IEC SC 45A scope (see 5.2.2);
  - Projected new SC 45A standards shown as approved for development on the IEC website.

  This presentation is introduced in 8.1 and included in Annex A.

- A tabular presentation of the other (i.e. non-IEC SC 45A) documents that are of particular relevance to the IEC SC 45A scope, subdivided into:
  - The IAEA documents with which conformance is sought;
  - Various other IEC, ISO and IEEE standards, such as those that are normatively referenced from one or more IEC SC 45A L1 & L2 standards.

  This presentation is introduced in 8.2 and included in Annex B.

- A tabular presentation of each specific topic area which contains:
  - The published IEC SC 45A standards and TRs that address the topic;
  - Projected new SC 45A standards currently under development for the topic;
  - Other published non-SC 45A standards of particular relevance and/or general interest to the topic;

  This presentation is introduced in 8.3 and included in Annex C.

7 Overview of the IEC SC 45A hierarchy

Figure 1 illustrates the structure of the IEC SC 45A standards series:

- Each rectangular box represents one of the 12 broad topic areas introduced in 6.4;
- The range of levels of the IEC documents (standards and TRs) that may occur within each broad topic area are indicated (i.e. “L1 – L4” for two topics, “L2 – L4” for six topics and “L3 – L4” for four topics);

- The two L1 “entry point” documents for topic areas 01 and 02 (i.e. IEC 61513 and IEC 63046, respectively) and the equivalent L2 “entry point” documents for topic areas 12, 13, 14, 15 and 21 (i.e. IEC/IEEE 60780-323, IEC 63351, IEC 62645 IEC 62342 and IEC 60964, respectively) are shown in bold type;
- Other L2 documents that exist for topic areas 01, 02, 11, 12, 14 and 21 are shown in normal type and selected L3 documents for topic areas 13, 15, 22, 23, 24 and 25 are shown in italics;
- The main relationships between the different topic areas is indicated by the lines linking these.

NOTE It is considered inappropriate to include the full set of IEC SC 45A documents for each topic area in the figure. See Annex C for this information.

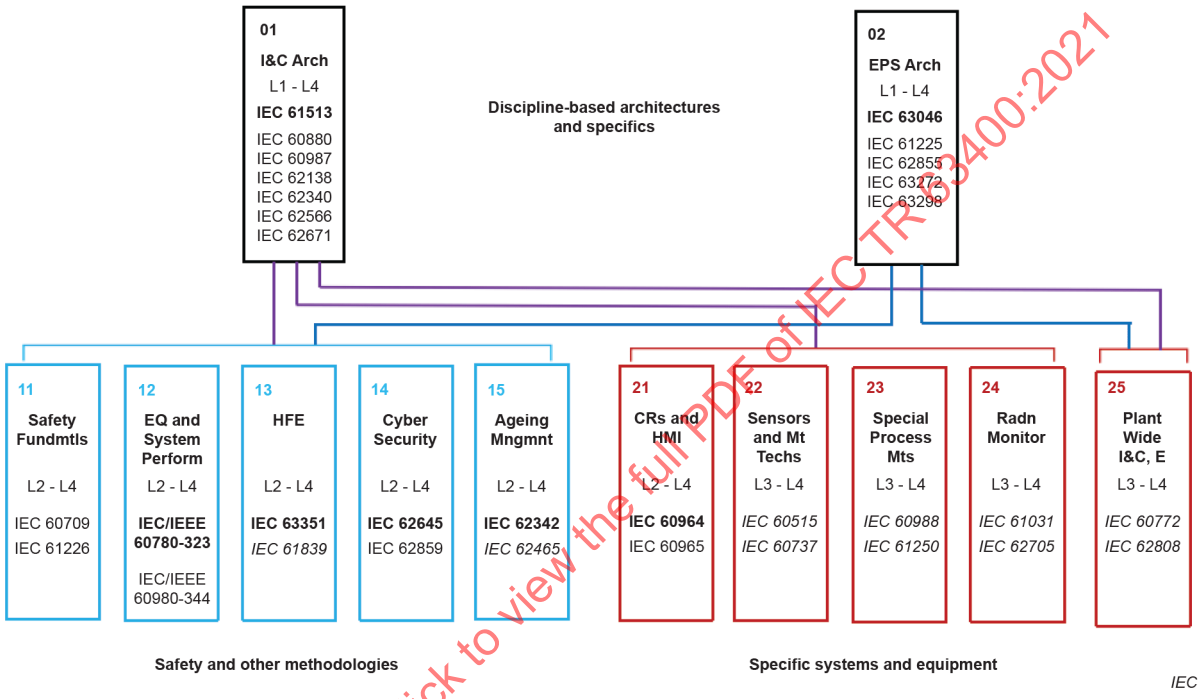

Figure 1 – Structure of the IEC SC 45A standards series

8 Standards corresponding to SC 45A scope

8.1 Standards related to the SC 45A full scope

Annex A includes the following in numerical order:

- The current set of published IEC SC 45A standards (at L1 – L3) and TRs (at L4);
- Draft IEC SC 45A documents (standards and TRs) that have been approved for development and are listed in the SC 45A “projects” section of the IEC website;
- IEC SC 45B radiation monitoring standards that are of specific interest to IEC SC 45A topic area 24.

For the IEC SC 45A documents, the following information is given:

- Edition and year of publication;
- The level within the hierarchy (i.e. L1, L2, L3 or L4);
- The broad topic area to which it is assigned (e.g. “topic 01”).

8.2 Non-SC 45A documents of particular relevance to SC 45A scope

Annex B includes the following:

- The main set of IAEA documents with which the IEC SC 45A standards series seek conformance;

- Various non-IEC SC 45A standards (e.g. other IEC, ISO and IEEE standards, etc.) that are normatively referenced from the IEC SC 45A L1 and L2 standards;
- A few other non-IEC SC 45A publications that are considered of general interest to the SC 45A scope.

NOTE The material included in Annex B is considered indicative rather than exhaustive.

8.3 Standards related to SC 45A specific topics

Annex C includes the same set of published and draft IEC SC 45A standards, and published IEC SC 45B standards, that are included in Annex A.

This annex is subdivided into the 12 broad topic areas and arranged by level within each topic area. In addition, those documents in Annex B that are of particular relevance and/or general interest to each topic area are identified within that part of the annex along with other documents that are only mentioned in Annex C.

For each IEC SC 45A document, the following information is given:

- Its identifier;
- Its edition and year of publication;
- Its level within the hierarchy;
- Where applicable, notes regarding its status (e.g. under revision);
- Its title (in full).

In terms of the coverage provided by each IEC SC 45A document, a definitive description can be found by following the link to the IEC Webstore (see below), selecting the document of interest, and then using the "Look Inside" box to view its Table of Contents, Foreword, Introduction, Scope, and Normative references:

https://www.iec.ch/dyn/www/f?p=103:22:13686702654598::::FSP_ORG_ID,FSP_LANG_ID:1358,25;

This information has been used in Annex C to derive the coverage in terms of:

- NPPs and/or other nuclear facilities;
- I&C systems and equipment and/or electrical power systems and equipment;
- New plants and/or modernisation projects;
- Systems aspects, equipment aspects and/or methods;
- Specific stages of the overall system lifecycle.

Where the description in the IEC Webstore does not specifically address one or more of these aspects, a judgement has been made on whether such coverage is intended.

Annex A
(informative)

List of SC 45A and selected SC 45B standards

A.1 General

This annex includes the following documents in numerical order:

- The current set of published IEC SC 45A standards (at L1 to L3) and TRs (at L4);
- Draft IEC SC 45A documents (standards and TRs) that have been approved for development and are listed in the SC 45A “projects” section of the IEC website;
- IEC SC 45B radiation monitoring standards that are of specific interest to IEC SC 45A topic area 24.

With reference to the corresponding entries in the document list, the four levels (L1 to L4) within the hierarchy are defined in 6.3 and repeated below for convenience:

L1: General requirements

L2: General requirements for specific topics

L3: Specific requirements for specific topics

L4: Technical Reports (which are not normative)

With reference to the corresponding entries in the document list, the twelve topic areas are defined in 6.4 and similarly repeated below for convenience:

- Two topic areas mainly addressing discipline-based architectures and specifics of that discipline:
  - Topic 01: I&C architecture and specifics of I&C;
  - Topic 02: Electrical power system architecture and specifics of electrics.
- Five topic areas mainly addressing safety and other methodologies:
  - Topic 11: Safety fundamentals;
  - Topic 12: Equipment qualification and system performance;
  - Topic 13: Human factors engineering (HFE);
  - Topic 14: Cyber security;
  - Topic 15: Ageing management.
- Five topic areas mainly addressing specific systems and equipment:
  - Topic 21: Control rooms and human machine interfaces (HMI);
  - Topic 22: Sensors and measurement techniques;
  - Topic 23: Special process measurement;
  - Topic 24: Radiation monitoring;
  - Topic 25: Plant wide I&C and electrical equipment.

A.2 Document list

Document identifier	Document edition	Level	Topic area
Title			
IEC 60231:1967	Edition 1.0 (1967-01-01)	L4	22
General principles of nuclear reactor instrumentation			

Document identifier	Document edition	Level	Topic area
Title			
IEC 60515:2007	Edition 2.0 (2007-02-23)	L3	22
Nuclear power plants – Instrumentation important to safety – Radiation detectors – Characteristics and test methods			
IEC 60532:2010	Edition 3.0 (2010-08-31)	*SC45B standard*	
Radiation protection instrumentation – Installed dose rate meters, warning assemblies and monitors – X and gamma radiation of energy between 50 keV and 7 MeV			
IEC 60568:2006	Edition 2.0 (2006-01-23)	L3	22
Nuclear power plants – Instrumentation important to safety – In-core instrumentation for neutron fluence rate (flux) measurements in power reactors			
IEC 60671:2007	Edition 2.0 (2007-05-23)	L3	11
Nuclear power plants – Instrumentation and control systems important to safety – Surveillance testing			
IEC 60709:2018	Edition 3.0 (2018-04-18)	L2	11
Nuclear power plants – Instrumentation, control and electrical power systems important to safety – Separation			
IEC 60737:2010	Edition 2.0 (2010-06-28)	L3	22
Nuclear power plants – Instrumentation important to safety – Temperature sensors (in-core and primary coolant circuit) – Characteristics and test methods			
IEC 60744:2018	Edition 2.0 (2018-05-14)	L3	01
Nuclear power plants – Instrumentation and control systems important to safety – Safety logic assemblies used in systems performing category A functions: Characteristics and test methods			
IEC 60761-1:2002	Edition 2.0 (2002-01-17)	*SC45B standard*	
Equipment for continuous monitoring of radioactivity in gaseous effluents – Part 1: General requirements			
IEC 60761-2:2002	Edition 2.0 (2002-01-17)	*SC45B standard*	
Equipment for continuous monitoring of radioactivity in gaseous effluents – Part 2: Specific requirements for radioactive aerosol monitors including transuranic aerosols			
IEC 60761-3:2002	Edition 2.0 (2002-01-17)	*SC45B standard*	
Equipment for continuous monitoring of radioactivity in gaseous effluents – Part 3: Specific requirements for radioactive noble gas monitors			
IEC 60761-4:2002	Edition 2.0 (2002-01-16)	*SC45B standard*	
Equipment for continuous monitoring of radioactivity in gaseous effluents – Part 4: Specific requirements for radioactive iodine monitors			
IEC 60761-5:2002	Edition 2.0 (2002-01-16)	*SC45B standard*	
Equipment for continuous monitoring of radioactivity in gaseous effluents – Part 5: Specific requirements for radioactive tritium monitors			

Document identifier	Document edition	Level	Topic area
Title			
IEC 60768:2009	Edition 2.0 (2009-04-29)	L3	24
Nuclear power plants – Instrumentation important to safety – Equipment for continuous in-line or on-line monitoring of radioactivity in process streams for normal and incident conditions			
IEC 60772:2018	Edition 2.0 (2018-05-14)	L3	25
Nuclear power plants – Instrumentation systems important to safety – Electrical penetration assemblies in containment structures			
IEC/IEEE 60780-323:2016	Edition 1.0 (2016-02-19)	L2	12
Nuclear facilities – Electrical equipment important to safety – Qualification			
IEC 60860:2014	Edition 2.0 (2014-06-19)	*SC45B standard*	
Radiation protection instrumentation – Warning equipment for criticality accidents			
IEC 60861:2006	Edition 2.0 (2006-08-21)	*SC45B standard*	
Equipment for monitoring of radionuclides in liquid effluents and surface waters			
IEC 60880:2006	Edition 2.0 (2006-05-09)	L2	01
Nuclear power plants – Instrumentation and control systems important to safety – Software aspects for computer-based systems performing category A functions			
IEC 60910:1988	Edition 1.0 (1988-03-30)	L3	23
Containment monitoring instrumentation for early detection of developing deviations from normal operation in light water reactors			
IEC 60911:1987	Edition 1.0 (1987-03-30)	L3	23
Measurements for monitoring adequate cooling within the core of pressurized light water reactors			
IEC 60951-1:2009	Edition 2.0 (2009-06-29)	L3	24
Nuclear power plants – Instrumentation important to safety – Radiation monitoring for accident and post-accident conditions – Part 1: General requirements			
IEC 60951-2:2009	Edition 2.0 (2009-06-29)	L3	24
Nuclear power plants – Instrumentation important to safety – Radiation monitoring for accident and post-accident conditions – Part 2: Equipment for continuous off-line monitoring of radioactivity in gaseous effluents and ventilation air			
IEC 60951-3:2009	Edition 2.0 (2009-06-29)	L3	24
Nuclear power plants – Instrumentation important to safety – Radiation monitoring for accident and post-accident conditions – Part 3: Equipment for continuous high range area gamma monitoring			
IEC 60951-4:2009	Edition 2.0 (2009-06-29)	L3	24
Nuclear power plants – Instrumentation important to safety – Radiation monitoring for accident and post-accident conditions – Part 4: Equipment for continuous in-line or on-line monitoring of radioactivity in process streams			

Document identifier	Document edition	Level	Topic area
Title			
IEC 60960:1988	Edition 1.0 (1988-08-30)	L3	21
Functional design criteria for a safety parameter display system for nuclear power stations			
IEC 60964:2018	Edition 3.0 (2018-11-16)	L2	21
Nuclear power plants – Control rooms – Design			
IEC 60965:2016	Edition 3.0 (2016-02-23)	L2	21
Nuclear power plants – Control rooms – Supplementary control room for reactor shutdown without access to the main control room			
IEC/IEEE 60980-344:2020	Edition 1.0 (2020-10-20)	L2	12
Nuclear facilities – Equipment important to safety – Seismic qualification			
IEC 60987:2021	Edition 3.0 (2021-02-03)	L2	01
Nuclear power plants – Instrumentation and control important to safety – Hardware requirements			
IEC 60988:2009	Edition 2.0 (2009-08-14)	**L3**	**23**
Nuclear power plants – Instrumentation important to safety – Acoustic monitoring systems for detection of loose parts: characteristics, design criteria and operational procedures			
IEC 61031:2020	Edition 2.0 (2020-07-28)	**L3**	**24**
Nuclear facilities – Instrumentation and control systems – Design, location and application criteria for installed area gamma radiation dose rate monitoring equipment for use during normal operation and anticipated operational occurrences			
IEC 61224:1993	Edition 1.0 (1993-05-13)	**L3**	**22**
Nuclear reactors – Response time in resistance temperature detectors (RTD) – In situ measurements			
IEC 61225:2019	Edition 3.0 (2019-02-15)	**L2**	**02**
Nuclear power plants – Instrumentation, control and electrical power systems – Requirements for static uninterruptible DC and AC power supply systems			
IEC 61226:2020	Edition 4.0 (2020-04-29)	**L2**	**11**
Nuclear power plants – Instrumentation, control and electrical power systems important to safety – Categorization of functions and classification of systems			
IEC 61227:2008	Edition 2.0 (2008-04-29)	**L3**	**21**
Nuclear power plants – Control rooms – Operator controls			
IEC 61250:1994	Edition 1.0 (1994-01-31)	**L3**	**23**
Nuclear reactors – Instrumentation and control systems important for safety – Detection of leakage in coolant systems			

Document identifier	Document edition	Level	Topic area
Title			
IEC 61343:1996	Edition 1.0 (1996-03-20)	L3	23
Nuclear reactor instrumentation – Boiling light water reactors (BWR) – Measurements in the reactor vessel for monitoring adequate cooling within the core			
IEC 61468:2021	Edition 2.0 (2021-04-26)	L3	22
Nuclear power plants – Instrumentation systems important to safety – In-core instrumentation: Characteristics and test methods of self-powered neutron detectors			
IEC 61497:1998	Edition 1.0 (1998-10-30)	L3	25
Nuclear power plants – Electrical interlocks for functions important to safety – Recommendations for design and implementation			
IEC 61500:2018	Edition 3.0 (2018-04-20)	L3	01
Nuclear power plants – Instrumentation and control systems important to safety – Data communication in systems performing category A functions			
IEC 61501:1998	Edition 1.0 (1998-11-10)	L3	22
Nuclear reactor instrumentation – Wide range neutron fluence rate meter – Mean square voltage method			
IEC 61502:1999	Edition 1.0 (1999-11-04)	L3	23
Nuclear power plants – Pressurized water reactors – Vibration monitoring of internal structures			
IEC 61504:2017	Edition 2.0 (2017-05-11)	L3	24
Nuclear facilities – Instrumentation and control systems important to safety – Centralized systems for continuous monitoring of radiation and/or levels of radioactivity			
IEC 61513:2011	Edition 2.0 (2011-08-25)	L1	01
Nuclear power plants – Instrumentation and control important to safety – General requirements for systems			
IEC 61559-1:2009	Edition 1.0 (2009-05-26)	*SC45B standard*	
Radiation protection instrumentation in nuclear facilities – Centralized systems for continuous monitoring of radiation and/or levels of radioactivity – Part 1: General requirements			
IEC 61771:1995	Edition 1.0 (1995-12-13)	L3	13
Nuclear power plants – Main control-room – Verification and validation of design			
IEC 61772:2009	Edition 2.0 (2009-04-29)	L3	21
Nuclear power plants – Control rooms – Application of visual display units (VDUs)			
IEC TR 61838:2009	Edition 2.0 (2009-12-14)	L4	11
Nuclear power plants – Instrumentation and control important to safety – Use of probabilistic safety assessment for the classification of functions			
IEC 61839:2000	Edition 1.0 (2000-07-21)	L3	13
Nuclear power plants – Design of control rooms – Functional analysis and assignment			

Document identifier	Document edition	Level	Topic area
Title			
IEC 61888:2002	Edition 1.0 (2002-08-20)	L3	11
Nuclear power plants – Instrumentation important to safety – Determination and maintenance of trip setpoints			
IEC 62003:2020	Edition 2.0 (2020-03-11)	L3	12
Nuclear power plants – Instrumentation, control and electrical power systems – Requirements for electromagnetic compatibility testing			
IEC TR 62096:2009	Edition 2.0 (2009-03-24)	L4	15
Nuclear power plants – Instrumentation and control important to safety – Guidance for the decision on modernization			
IEC 62117:1999	Edition 1.0 (1999-12-10)	L3	23
Nuclear reactor instrumentation – Pressurized light water reactors (PWR) – Monitoring adequate cooling within the core during cold shutdown			
IEC 62138:2018	Edition 2.0 (2018-07-31)	L2	01
Nuclear power plants – Instrumentation and control systems important to safety – Software aspects for computer-based systems performing category B or C functions			
IEC TR 62235:2005	Edition 1.0 (2005-03-17)	L4	23
Nuclear facilities – Instrumentation and control systems important to safety – Systems of interim storage and final repository of nuclear fuel and waste			
IEC 62241:2004	Edition 1.0 (2004-11-02)	L3	21
Nuclear power plants – Main control room – Alarm functions and presentation			
IEC 62302:2007	Edition 1.0 (2007-09-19)	*SC45B standard*	
Radiation protection instrumentation – Equipment for sampling and monitoring radioactive noble gases			
IEC 62303:2008	Edition 1.0 (2008-12-11)	*SC45B standard*	
Radiation protection instrumentation – Equipment for monitoring airborne tritium			
IEC 62340:2007	Edition 1.0 (2007-12-07)	L2	01
Nuclear power plants – Instrumentation and control systems important to safety – Requirements for coping with common cause failure (CCF)			
IEC 62342:2007	Edition 1.0 (2007-08-20)	L2	15
Nuclear power plants – Instrumentation and control systems important to safety – Management of ageing			
IEC 62385:2007	Edition 1.0 (2007-06-21)	L3	12
Nuclear power plants – Instrumentation and control important to safety – Methods for assessing the performance of safety system instrument channels			

Document identifier	Document edition	Level	Topic area
Title			
IEC 62397:2007	Edition 1.0 (2007-05-15)	**L3**	**22**
Nuclear power plants – Instrumentation and control important to safety – Resistance temperature detectors			
IEC 62465:2010	Edition 1.0 (2010-05-11)	**L3**	**15**
Nuclear power plants – Instrumentation and control important to safety – Management of ageing of electrical cabling systems			
IEC 62566:2012	Edition 1.0 (2012-01-26)	**L2**	**01**
Nuclear power plants – Instrumentation and control important to safety – Development of HDL-programmed integrated circuits for systems performing category A functions			
IEC 62566-2:2020	Edition 1.0 (2020-05-07)	**L2**	**01**
Nuclear power plants – Instrumentation and control systems important to safety – Development of HDL-programmed integrated circuits – Part 2: HDL-programmed integrated circuits for systems performing category B or C functions			
IEC/IEEE 62582-1:2011	Edition 1.0 (2011-08-31)	**L3**	**15**
Nuclear power plants – Instrumentation and control important to safety – Electrical equipment condition monitoring methods – Part 1: General			
IEC/IEEE 62582-2:2011+AMD1:2016 CSV	Edition 1.1 (2016-02-25)	**L3**	**15**
Nuclear power plants – Instrumentation and control important to safety – Electrical equipment condition monitoring methods – Part 2:Indenter modulus			
IEC/IEEE 62582-3:2012	Edition 1.0 (2012-12-12)	**L3**	**15**
Nuclear power plants – Instrumentation and control important to safety – Electrical equipment condition monitoring methods – Part 3: Elongation at break			
IEC/IEEE 62582-4:2011	Edition 1.0 (2011-08-31)	**L3**	**15**
Nuclear power plants – Instrumentation and control important to safety – Electrical equipment condition monitoring methods – Part 4: Oxidation induction techniques			
IEC/IEEE 62582-5:2015	Edition 1.0 (2015-06-19)	**L3**	**15**
Nuclear power plants – Instrumentation and control important to safety – Electrical equipment condition monitoring methods – Part 5: Optical time domain reflectometry			
IEC/IEEE 62582-6:2019	Edition 1.0 (2019-10-22)	**L3**	**15**
Nuclear power plants – Instrumentation and control important to safety – Electrical equipment condition monitoring methods – Part 6: Insulation resistance			
IEC 62645:2019	Edition 2.0 (2019-11-13)	**L2**	**14**
Nuclear power plants – Instrumentation, control and electrical power systems – Cybersecurity requirement			
IEC 62646:2016	Edition 2.0 (2016-10-05)	**L3**	**21**
Nuclear power plants – Control rooms – Computer-based procedures			

Document identifier	Document edition	Level	Topic area
Title			
IEC 62651:2013	Edition 1.0 (2013-04-29)	**L3**	**22**
Nuclear power plants – Instrumentation important to safety – Thermocouples: characteristics and test methods			
IEC 62671:2013/COR1:2016	Edition 1.0 (2016-09-29)	**L2**	**01**
Corrigendum 1 – Nuclear power plants – instrumentation and control important to safety – Selection and use of industrial digital devices of limited functionality			
IEC 62705:2014	Edition 1.0 (2014-07-24)	**L3**	**24**
Nuclear power plants – Instrumentation and control important to safety – Radiation monitoring systems (RMS): Characteristics and lifecycle			
IEC 62706:2019	Edition 2.0 (2019-11-27)	*SC45B standard*	
Radiation protection instrumentation – Recommended climatic, electromagnetic and mechanical performance requirements and methods of tests			
IEC 62765-1:2015	Edition 1.0 (2015-04-22)	**L3**	**15**
Nuclear powers plants – Instrumentation and control important to safety – Management of ageing of sensors and transmitters – Part 1: Pressure transmitters+			
IEC 62765-2:2019	Edition 1.0 (2019-01-29)	**L3**	**15**
Nuclear power plants – Instrumentation and control important to safety – Management of ageing of sensors and transmitters – Part 2: Temperature sensors			
IEC 62808:2015+AMD1:2018 CSV	Edition 1.1 (2018-05-17)	**L3**	**25**
Nuclear power plants – Instrumentation and control systems important to safety – Design and qualification of isolation devices			
IEC 62855:2016	Edition 1.0 (2016-08-30)	**L3**	**02**
Nuclear power plants – Electrical power systems – Electrical power systems analysis			
IEC 62859:2016+AMD1:2019 CSV	Edition 1.1 (2019-10-09)	**L2**	**14**
Nuclear power plants – Instrumentation and control systems – Requirements for coordinating safety and cybersecurity			
IEC 62887:2018	Edition 1.0 (2018-05-16)	**L3**	**22**
Nuclear power plants – Instrumentation systems important to safety – Pressure transmitters: Characteristics and test methods			
IEC TR 62918:2014	Edition 1.0 (2014-07-15)	**L4**	**25**
Nuclear power plants – Instrumentation and control important to safety – Use and selection of wireless devices to be integrated in systems important to safety			
IEC 62954:2019	Edition 1.0 (2019-01-24)	L3	21
Nuclear power plants – Control rooms – Requirements for emergency response facilities			

Document identifier	Document edition	Level	Topic area
Title			
IEC TR 62987:2015	Edition 1.0 (2015-09-08)	L4	11
Nuclear power plants – Instrumentation and control systems important to safety – Use of Failure Mode and Effects Analysis (FMEA) and related methods to support the justification of systems			
IEC 62988:2018	Edition 1.0 (2018-05-07)	L3	25
Nuclear power plants – Instrumentation and control systems important to safety – Selection and use of wireless devices			
IEC 63046:2020	Edition 1.0 (2020-10-20)	L1	02
Nuclear power plants – Electrical power system – General requirements			
IEC TR 63084:2017	Edition 1.0 (2017-06-15)	L4	01
Nuclear power plants – Instrumentation and control important to safety – Platform qualification for systems important to safety			
IEC 63096:2020	Edition 1.0 (2020-10-07)	L3	14
Nuclear power plants – Instrumentation, control and electrical power systems – Security controls			
IEC/IEEE 63113:2021	Edition 1.0 (2021-04-20)	L3	23
Nuclear facilities – Instrumentation important to safety – Spent fuel pool instrumentation			
IEC TR 63123:2017	Edition 1.0 (2017-12-14)	L4	11
Nuclear power plants – Instrumentation, control and electrical power systems – Guidance for the application of IEC 63147:2017/IEEE Std 497™ -2016 in the IAEA / IEC framework			
IEC 63147:2017	Edition 1.0 (2017-12-14)	L3	11
Criteria for accident monitoring instrumentation for nuclear power generating stations			
IEC/IEEE 63160	*Under development*	L3	11
Nuclear facilities – Instrumentation, control and electrical power systems important to safety – Common cause failure, system analysis and diversity			
IEC 63186	*Under development*	L3	23
Nuclear power plants – Instrumentation and control systems important to safety – Criteria for seismic trip system			
IEC TR 63192:2019	Edition 1.0 (2019-01-29)	L4	11
Nuclear power plants – Instrumentation and control systems important to safety – Hazard analysis: A review of current approaches			
IEC TR 63214:2019	Edition 1.0 (2019-10-29)	L4	13
Nuclear power plants – Control rooms – Human factors engineering			
IEC 63260:2020	Edition 1.0 (2020-05-25)	L3	13
Guide for incorporating human reliability analysis into probabilistic risk assessments for nuclear power generating stations and other nuclear facilities			

Document identifier	Document edition	Level	Topic area
Title			
IEC 63272	*Under development*	L2	02
Nuclear facilities – Electrical power systems – AC Interruptible power supply systems			
IEC 63298	*Under development*	L2	02
Nuclear Power Plants – Electrical power systems – Coordination and interaction with electric grid			
IEC/IEEE 63332-387	*Under development*	L2	02
Nuclear facilities – Electrical power systems – Part 387: Diesel generator units applied as standby power sources [Adoption of IEEE 387]			
IEC TR 63335:2021	Edition 1.0 (2021-02-04)	L4	25
Nuclear power plants – Instrumentation and control systems, control rooms and electrical power systems – Specific features of small modular reactors and needs regarding standards			
IEC 63351 ED1	*Under development*	L2	13
Nuclear Facilities – Human Factors Engineering – Application to the Design of Human Machine Interfaces			

Key to abbreviations

AMD Amendment
COR Corrigendum
CSV Consolidated Version
PRV Preparation of Report of Voting
RLV Red Line Version

Annex B
(informative)

Other documents of particular relevance to the SC 45A standards

B.1 General

This annex includes the following three categories of documents:

- The main set of IAEA documents with which the IEC SC 45A standards series seek conformance;
- Various non-IEC SC 45A standards (e.g. other IEC, ISO and IEEE standards, etc.) that are normatively referenced in the IEC SC 45A L1 and L2 standards;
- A few other non-IEC SC 45A publications that are considered of general interest to the SC 45A scope.

B.2 IAEA documents

B.2.1 All nuclear facilities

- Leadership and Management for Safety, IAEA Safety Standards Series No. GSR Part 2, IAEA, Vienna (2016). †[1]
- Safety Assessment for Facilities and Activities, IAEA Safety Standards Series No. GSR Part 4 (Rev.1), IAEA, Vienna (2016).
- Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).
- Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSG-2, IAEA, Vienna (2011).
- Occupational Radiation Protection, IAEA Safety Standards Series No. GSG-7, IAEA, Vienna (2018).
- Arrangements for Preparedness for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GS-G-2.1, IAEA, Vienna (2007).
- Application of the Management System for Facilities and Activities, IAEA Safety Standards Series No. GS-G-3.1, IAEA, Vienna (2006). †
- The Management System for the Processing, Handling and Storage of Radioactive Waste, IAEA Safety Standards Series No. GS-G-3.3, IAEA, Vienna (2008).
- The Management System for the Disposal of Radioactive Waste, IAEA Safety Standards Series No. GS-G-3.4, IAEA, Vienna (2008).
- The Management System for Nuclear Installations, IAEA Safety Standards Series No. GS-G-3.5, IAEA, Vienna (2009). †
- Construction for Nuclear Installations, IAEA Safety Standards Series No. SSG-38, IAEA, Vienna (2015).
- Computer Security at Nuclear Facilities, IAEA Nuclear Security Series No. 17, IAEA, Vienna (2011). †
- Computer Security of Instrumentation and Control Systems at Nuclear Facilities, IAEA Nuclear Security Series No. 33-T, IAEA, Vienna (2018).
- IAEA Safety Glossary: 2018 Edition, IAEA, Vienna (2019). †
- IAEA Nuclear Security Series Glossary, Version 1.3, (November 2015). †

[1] The IAEA documents listed provide technical guidance with which the IEC SC 45A standards series seek conformance. The IAEA documents marked thus (†) are considered the most important for application to IEC SC 45A standards for NPPs.

B.2.2 Nuclear Power Plants (NPPs)

- Safety of Nuclear Power Plants: Design, IAEA Safety Standards Series No. SSR-2/1 (Rev.1), IAEA, Vienna (2016). †
- Safety of Nuclear Power Plants: Commissioning and Operation, IAEA Safety Standards Series No. SSR-2/2 (Rev.1), IAEA, Vienna (2016).
- Deterministic Safety Analysis for Nuclear Power Plants, IAEA Safety Standards Series No. SSG-2 (Rev.1), IAEA, Vienna (2020).
- Storage of Spent Nuclear Fuel, IAEA Safety Standards Series No. SSG-15 (Rev.1), IAEA, Vienna (2020).
- Safety Classification of Structures, Systems and Components in Nuclear Power Plants, IAEA Safety Standards Series No. SSG-30, IAEA, Vienna (2014). †
- Design of Electrical Power Systems for Nuclear Power Plants, IAEA Safety Standards Series No. SSG-34, IAEA, Vienna (2016). †
- Design of Instrumentation and Control Systems for Nuclear Power Plants, IAEA Safety Standards Series No. SSG-39, IAEA, Vienna (2016). †
- Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants, IAEA Safety Standards Series No. SSG-48, IAEA, Vienna (2018).
- Human Factors Engineering in the Design of Nuclear Power Plants, IAEA Safety Standards Series No. SSG-51, IAEA, Vienna (2019).
- Accident Management Programmes for Nuclear Power Plants, IAEA Safety Standards Series No. SSG-54, IAEA, Vienna (2019).
- Design of the Reactor Coolant System and Associated Systems for Nuclear Power Plants, IAEA Safety Standards Series No. SSG-56, IAEA, Vienna (2020).
- Design of Fuel Handling and Storage Systems for Nuclear Power Plants, IAEA Safety Standards Series No. SSG-63, IAEA, Vienna (2020).
- Seismic Design and Qualification for Nuclear Power Plants, IAEA Safety Standards Series No. NS-G-1.6, IAEA, Vienna (2003).
- Protection against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants, IAEA Safety Standards Series No. NS-G-1.11, IAEA, Vienna (2004).
- Radiation Protection Aspects of Design for Nuclear Power Plants, IAEA Safety Standards Series No. NS-G-1.13, IAEA, Vienna (2005).
- Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants, IAEA Safety Standards Series No. NS-G-2.2, IAEA, Vienna (2000).
- Modifications to Nuclear Power Plants, IAEA Safety Standards Series No. NS-G-2.3, IAEA, Vienna (2001).
- Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants, IAEA Safety Standards Series No. NS-G-2.6, IAEA, Vienna (2002).
- Conduct of Operations at Nuclear Power Plants, IAEA Safety Standards Series No. NS-G-2.14, IAEA, Vienna (2008).

B.2.3 Fuel Cycle Facilities (FCFs)

- Safety of Nuclear Fuel Cycle Facilities, IAEA Safety Standards Series No. SSR-4, IAEA, Vienna (2017).
- Safety of Conversion Facilities and Uranium Enrichment Facilities, IAEA Safety Standards Series No. SSG-5, IAEA, Vienna (2010).
- Safety of Uranium Fuel Fabrication Facilities, IAEA Safety Standards Series No. SSG-6, IAEA, Vienna (2010).
- Safety of Uranium and Plutonium Mixed Oxide Fuel Fabrication Facilities, IAEA Safety Standards Series No. SSG-7, IAEA, Vienna (2010).

- Storage of Spent Nuclear Fuel, IAEA Safety Standards Series No. SSG-15 (Rev.1), IAEA, Vienna (2020).
- Safety of Nuclear Fuel Reprocessing Facilities, IAEA Safety Standards Series No. SSG-42, IAEA, Vienna (2017).
- Safety of Nuclear Fuel Cycle Research and Development Facilities, IAEA Safety Standards Series No. SSG-43, IAEA, Vienna (2017).

B.2.4 Research Reactors (RRs)

- Safety of Research Reactors, IAEA Safety Standards Series No. SSR-3, IAEA, Vienna (2016).
- Ageing Management for Research Reactors, IAEA Safety Standards Series No. SSG-10, IAEA, Vienna (2010).
- Instrumentation and Control Systems and Software Important to Safety for Research Reactors, IAEA Safety Standards Series No. SSG-37, IAEA, Vienna (2015).
- Maintenance, Periodic Testing and Inspection of Research Reactors, IAEA Safety Standards Series No. NS-G-4.2, IAEA, Vienna (2006).

B.3 Other standards bodies documents[2]

B.3.1 Non-SC 45A IEC documents

- IEC 60034, Rotating electrical machines
- IEC 60038, IEC standard voltages
- IEC 60068-2 (all parts), Environmental testing – Part 2: Tests
- IEC 60071 (all parts), Insulation co-ordination
- 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 60332 (all parts), Tests on electric and optical fibre cables under fire conditions
- IEC 60364-4-41, Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock
- IEC 60364-5-52, Low-voltage electrical installations – Part 5-52: Selection and erection of electrical equipment – Wiring systems
- IEC 60364-5-56, Low-voltage electrical installations – Part 5-56: Selection and erection of electrical equipment – Safety services
- IEC 60529, Degrees of protection provided by enclosures (IP Code)
- IEC 60812, Failure modes and effects analysis (FMEA and FMECA)
- IEC 60909 (all parts), Short-circuit currents in three-phase a.c. systems
- IEC 61000 (all parts), Electromagnetic Compatibility (EMC), *in particular:* Part 4: Testing and measurement techniques, and Part 6: Generic standards
- IEC 61025, Fault tree analysis (FTA)
- IEC 61069-2, Industrial-process measurement, control and automation – Evaluation of system properties for the purpose of system assessment – Part 2: Assessment methodology
- IEC 61439-1, Low voltage switchgear and controlgear assemblies – Part 1: General rules
- IEC 61508 (all parts), Functional safety of electrical/electronic/programmable electronic safety-related systems

2 The other standards bodies documents listed mainly comprise those that are referenced in the SC 45A L1 and L2 standards (or that supersede any documents referenced in the SC 45A L1 and L2 standards which have since been withdrawn).

- IEC 61511 (all parts), Functional safety – Safety instrumented systems for the process industry sector
- IEC 61660 (all parts), Short-circuit currents in d.c. auxiliary installations in power plants and substations
- IEC 62040 (all parts), Uninterruptible power systems (UPS)
- IEC 62443 (all parts), Industrial communication networks – Network and system security

B.3.2 ISO documents

- ISO 2768-1, General tolerances − Part 1: Tolerances for linear and angular dimensions without individual tolerance indications
- ISO 2768-2, General tolerances − Part 2: Geometrical tolerances for features without individual tolerance indications
- ISO 3951-1, Sampling procedures for inspection by variables − Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL
- ISO 3951-2, Sampling procedures for inspection by variables − Part 2: General specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection of independent quality characteristics
- ISO 9001, Quality management systems – Requirements
- ISO 11064 (all parts), Ergonomic design of control centres
- ISO 19443, Quality management systems – Specific requirements for the application of ISO 9001:2015 by organizations in the supply chain of the nuclear energy sector supplying products and services important to nuclear safety (ITNS)

B.3.3 ISO/IEC documents

- ISO/IEC 25010, Systems and software engineering – Systems and software Quality Requirements and Evaluation (SQuaRE) – System and software quality models
- ISO/IEC 27001, Information technology – Security techniques – Information security management systems – Requirements
- ISO/IEC 27002, Information technology – Security techniques – Code of practice for information security controls
- ISO/IEC 27005, Information technology – Security techniques – Information security risk management

B.3.4 IEEE documents

- IEEE Std 382™, IEEE Standard for Qualification of Safety-Related Actuators for Nuclear Power Generating Stations

B.3.5 Other documents

- US NUREG-0711, Rev 3, Human Factors Engineering Program Review Model
- EPRI-1008122, Human Factors Guidance for Control Room and Digital Human-System Interface Design and Modification
- WENRA Report, Safety of New NPP Designs

Annex C
(informative)

List of SC 45A and selected SC 45B standards by topic area

C.1 General

This annex includes the same set of published and draft IEC SC 45A standards, and published IEC SC 45B standards, as included in Annex A.

This annex is subdivided into the 12 broad topic areas and arranged by level within each topic area.

For the IEC SC 45A documents, the following coverage information is given:

- NPPs and/or other nuclear facilities;
- I&C systems and equipment and/or electrical power systems and equipment;
- New plants and/or modernisation projects;
- Systems aspects, equipment aspects and/or methods;
- Specific stages of the overall system lifecycle.

This coverage information is given using the following applicability proforma:

Facilities		Disciplines		Projects		Aspects			Lifecycle stages
NPPs	Other	I&C	EPS	New	Mods	System	Equipt	Methods	As described

The coverage is then indicated as follows:

- where an entry is fully applicable, the text is shown in bold and shaded thus: **text**
- where an entry is partially applicable, the text is shown in italics and shaded thus: *text*
- where an entry is not applicable, the text is struckthrough and "greyed" thus: ~~text~~

In addition, the other documents of particular relevance and/or general interest to each of the 12 topic areas are listed below the corresponding coverage information. These include documents that are already listed in Annex B and other documents that are only mentioned in this annex.

C.2 Document lists for each topic area

C.2.1 Topic 01 – I&C architecture and specifics of I&C

Topic 01 applies to Electrical/Electronic/Programmable Electronic (E/E/PE) based I&C systems which provide functions important to safety in nuclear facilities.

The following SC 45A standards are considered topic 01:

Document identifier				**Document edition**			**Level**		**Notes**
Title									
Facilities		Disciplines		Projects		Aspects			Lifecycle stages
NPPs	Other	I&C	EPS	New	Mods	System	Equipt	Methods	As described
IEC 61513:2011				Edition 2.0 (2011-08-25)			**L1**		
Nuclear power plants – Instrumentation and control important to safety – General requirements for systems									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	**System**	*Equipt*	*Methods*	All lifecycle stages

Document identifier		Document edition				Level			Notes
Title									
Facilities		Disciplines		Projects		Aspects			Lifecycle stages
NPPs	Other	I&C	EPS	New	Mods	System	Equipt	Methods	As described
IEC 60880:2006				Edition 2.0 (2006-05-09)			**L2**		
Nuclear power plants – Instrumentation and control systems important to safety – Software aspects for computer-based systems performing category A functions									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	*System*	**Equipt**	*Methods*	All stages of SW L/C
IEC 60987:2021				Edition 3.0 (2021-02-03)			**L2**		
Nuclear power plants – Instrumentation and control important to safety – Hardware requirements									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	*System*	**Equipt**	*Methods*	All stages of HW L/C
IEC 62138:2018				Edition 2.0 (2018-07-31)			**L2**		
Nuclear power plants – Instrumentation and control systems important to safety – Software aspects for computer-based systems performing category B or C functions									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	*System*	**Equipt**	*Methods*	All stages of SW L/C
IEC 62340:2007				Edition 1.0 (2007-12-07)			**L2**		
Nuclear power plants – Instrumentation and control systems important to safety – Requirements for coping with common cause failure (CCF)									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	**System**	**Equipt**	**Methods**	Reqts specn & design
IEC 62566:2012				Edition 1.0 (2012-01-26)			**L2**		
Nuclear power plants – Instrumentation and control important to safety – Development of HDL-programmed integrated circuits for systems performing category A functions									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	*System*	**Equipt**	*Methods*	All stages of HPD L/C
IEC 62566-2:2020				Edition 1.0 (2020-05-07)			**L2**		
Nuclear power plants – Instrumentation and control systems important to safety – Development of HDL-programmed integrated circuits – Part 2: HDL-programmed integrated circuits for systems performing category B or C functions									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	*System*	**Equipt**	*Methods*	All stages of HPD L/C
IEC 62671:2013				Edition 1.0 (2013-02-20)			**L2**		
Nuclear power plants – Instrumentation and control important to safety – Selection and use of industrial digital devices of limited functionality									
NPPs	~~Other~~	**I&C**	**EPS**	**New**	**Mods**	~~System~~	**Equipt**	*Methods*	All stages of Eqt L/C
IEC 60744:2018				Edition 2.0 (2018-05-14)			**L3**		
Nuclear power plants – Instrumentation and control systems important to safety – Safety logic assemblies used in systems performing category A functions: Characteristics and test method									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	*System*	**Equipt**	*Methods*	All stages of Eqt L/C

Document identifier				Document edition				Level	Notes
Title									
Facilities		Disciplines		Projects		Aspects			Lifecycle stages
NPPs	Other	I&C	EPS	New	Mods	System	Equipt	Methods	As described
IEC 61500:2018				Edition 3.0 (2018-04-20)				L3	
Nuclear power plants – Instrumentation and control systems important to safety – Data communication in systems performing category A functions									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	*System*	**Equipt**	~~Methods~~	All stages of Eqt L/C
IEC TR 63084:2017				Edition 1.0 (2017-06-15)				L4	
Nuclear power plants – Instrumentation and control important to safety – Platform qualification for systems important to safety									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	~~System~~	**Equipt**	**Methods**	All stages of Eqt L/C

For Topic 01, the other non-SC 45A documents of particular relevance and/or general interest are as follows:

IAEA documents

- General Safety Requirements GSR Part 2, Leadership and Management for Safety
- General Safety Requirements GSR Part 4 (Rev.1), Safety Assessment for Facilities and Activities
- Safety Guide No.GS-G-3.1, Application of the Management System for Facilities and Activities
- Safety Requirements No. SSR-2/1 (Rev.1), Safety of Nuclear Power Plant: Design
- Safety Requirements No. SSR-2/2 (Rev.1), Safety of Nuclear Power Plant: Commissioning and Operation
- Safety Requirements No. SSR-3, Safety of Research Reactors
- Safety Requirements No. SSR-4, Safety of Nuclear Fuel Cycle Facilities
- Safety Guide No. SSG-2, Deterministic Safety Analysis for Nuclear Power Plants
- Safety Guide No. SSG-37, Instrumentation and Control Systems and Software Important to Safety for Research Reactors
- Safety Guide No. SSG-39, Design of instrumentation and control systems for nuclear power plants

IEC documents

- IEC 60255 (all parts), Measuring relays and protection equipment
- IEC 61000-4 (all parts), Electromagnetic Compatibility (EMC) – Part 4: Testing and measurement techniques
- IEC 61069-2, Industrial-process measurement, control and automation – Evaluation of system properties for the purpose of system assessment – Part 2: Assessment methodology
- IEC 61508 (all parts), Functional safety of electrical/electronic/programmable electronic safety-related systems
- IEC 61511 (all parts), Functional safety – Safety instrumented systems for the process industry sector

ISO documents

- ISO 2768-2, General tolerances − Part 2: Geometrical tolerances for features without individual tolerance indications
- ISO 3951-1, Sampling procedures for inspection by variables − Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL
- ISO 3951-2, Sampling procedures for inspection by variables − Part 2: General specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection of independent quality characteristics
- ISO 9001, Quality management systems – Requirements
- ISO/IEC 25010, Systems and software engineering – Systems and software Quality Requirements and Evaluation (SQuaRE) – System and software quality models
- ISO 19443, Quality management systems – Specific requirements for the application of ISO 9001:2015 by organizations in the supply chain of the nuclear energy sector supplying products and services important to nuclear safety (ITNS)

Other documents

- WENRA Report, Safety of New NPP Designs

C.2.2 Topic 02 – electrical power system architecture and specifics of electrics

Topic 02 applies to electrical power systems (EPS) important to safety in nuclear facilities.

The following SC 45A standards are considered topic 02:

Document identifier				Document edition				Level	Notes
Title									
Facilities		Disciplines		Projects		Aspects			Lifecycle stages
NPPs	Other	I&C	EPS	New	Mods	System	Equipt	Methods	As described
IEC 63046:2020				Edition 1.0 (2020-10-20)				**L1**	
Nuclear power plants – Electrical power system – General requirements									
NPPs	~~Other~~	~~I&C~~	**EPS**	**New**	**Mods**	**System**	*Equipt*	*Methods*	All lifecycle stages
IEC 61225:2019				Edition 3.0 (2019-02-15)				**L2**	
Nuclear power plants – Instrumentation, control and electrical power systems – Requirements for static uninterruptible DC and AC power supply systems									
NPPs	*Other*	~~I&C~~	**EPS**	**New**	**Mods**	**System**	**Equipt**	*Methods*	All lifecycle stages
IEC 62855:2016				Edition 1.0 (2016-08-30)				**L3**	
Nuclear power plants – Electrical power systems – Electrical power systems analysis									
NPPs	~~Other~~	~~I&C~~	**EPS**	**New**	**Mods**	~~System~~	~~Equipt~~	**Methods**	System design V&V
IEC 63272				Edition 1.0 (in development)				**L2**	NP available
Nuclear facilities – Electrical power systems – AC Interruptible power supply systems									
NPPs	*Other*	~~I&C~~	**EPS**	**New**	**Mods**	**System**	**Equipt**	*Methods*	All lifecycle stages

Document identifier				Document edition				Level	Notes
Title									
Facilities		Disciplines		Projects		Aspects			Lifecycle stages
NPPs	Other	I&C	EPS	New	Mods	System	Equipt	Methods	As described
IEC 63298				Edition 1.0 (in development)				**L2**	NP available
Nuclear Power Plants – Electrical power systems – Coordination and interaction with electric grid									
NPPs	~~Other~~	~~I&C~~	**EPS**	**New**	**Mods**	~~System~~	~~Equipt~~	**Methods**	All stages of NPP L/C
IEC/IEEE 63332-387				Edition 1.0 (in development)				**L2**	NP available
Nuclear facilities – Electrical power systems – Part 387: Diesel generator units applied as standby power sources [Adoption of IEEE 387]									
NPPs	**Other**	~~I&C~~	**EPS**	**New**	**Mods**	**System**	**Equipt**	*Methods*	All lifecycle stages

For Topic 02, the other non-SC 45A documents of particular relevance and/or general interest are as follows:

IAEA documents

- General Safety Requirements GSR Part 2, Leadership and Management for Safety
- Safety Guide No.GS-G-3.1, Application of the Management System for Facilities and Activities
- Safety Guide No. SSG-30, Safety Classification of Structures, Systems and Components in Nuclear Power Plants
- Safety Guide No. SSG-34, Design of Electrical Power Systems for Nuclear Power Plants
- Nuclear Energy Series No. NG-T-3.8, Electric Grid Reliability and Interface with Nuclear Power Plants
- Safety Report Series, No. 91, Impact of Open Phase Conditions on Electrical Power Systems of Nuclear Power Plants

IEC documents

- IEC 60034, Rotating electrical machines
- 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 60909 (all parts), Short-circuit currents in three-phase a.c. systems
- IEC 61000 (all parts), Electromagnetic compatibility (EMC)
- IEC 61439-1, Low voltage switchgear and controlgear assemblies – Part 1: General rules
- IEC 61508 (all parts), Functional safety of electrical/electronic/programmable electronic safety-related systems
- IEC 61660 (all parts), Short-circuit currents in d.c. auxiliary installations in power plants and substations
- IEC 62040 (all parts), Uninterruptible power systems (UPS)

ISO documents

- ISO 9001, Quality management systems – Requirements

Other documents

- WENRA Report, Safety of New NPP Designs

C.2.3 Topic 11 – safety fundamentals

Topic 11 applies to the fundamental principles for instrumentation, control and electrical power systems important to safety for nuclear facilities.

The following SC 45A standards are considered topic 11:

Document identifier				Document edition				Level	Notes
Title									
Facilities		Disciplines		Projects		Aspects			Lifecycle stages
NPPs	Other	I&C	EPS	New	Mods	System	Equipt	Methods	As described
IEC 60709:2018				Edition 3.0 (2018-04-18)				L2	
Nuclear power plants – Instrumentation, control and electrical power systems important to safety – Separation									
NPPs	~~Other~~	**I&C**	**EPS**	**New**	**Mods**	*System*	*Equipt*	**Methods**	All plant stages L/C
IEC 61226:2020				Edition 4.0 (2020-04-29)				L2	
Nuclear power plants – Instrumentation, control and electrical power systems important to safety – Categorization of functions and classification of systems									
NPPs	~~Other~~	**I&C**	**EPS**	**New**	**Mods**	*System*	*Equipt*	**Methods**	Reqts specn & design
IEC 60671:2007				Edition 2.0 (2007-05-23)				L3	
Nuclear power plants – Instrumentation and control systems important to safety – Surveillance testing									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	*System*	*Equipt*	**Methods**	Tests during op life
IEC 61888:2002				Edition 1.0 (2002-08-20)				L3	
Nuclear power plants – Instrumentation important to safety – Determination and maintenance of trip setpoints									
NPPs	**Other**	**I&C**	~~EPS~~	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	All plant stages L/C
IEC 63147:2017				Edition 1.0 (2017-12-14)				L3	
Criteria for accident monitoring instrumentation for nuclear power generating stations									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	Reqts specn & design
IEC/IEEE 63160				Edition 1.0 (in development)				L3	CD available
Nuclear facilities – Instrumentation, control and electrical power systems important to safety – Common cause failure, system analysis and diversity									
NPPs	**Other**	**I&C**	**EPS**	**New**	**Mods**	*System*	~~Equipt~~	**Methods**	Analysis & reqts specn

Document identifier				Document edition				Level	Notes
Title									
Facilities		Disciplines		Projects		Aspects			Lifecycle stages
NPPs	Other	I&C	EPS	New	Mods	System	Equipt	Methods	As described
IEC TR 61838:2009				Edition 2.0 (2009-12-14)				L4	
Nuclear power plants – Instrumentation and control important to safety – Use of probabilistic safety assessment for the classification of functions									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	*System*	*Equipt*	**Methods**	Reqts specn
IEC TR 62987:2015				Edition 1.0 (2015-09-08)				L4	
Nuclear power plants – Instrumentation and control systems important to safety – Use of Failure Mode and Effects Analysis (FMEA) and related methods to support the justification of systems									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	*System*	*Equipt*	**Methods**	Analysis & reqts specn
IEC TR 63123:2017				Edition 1.0 (2017-12-14)				L4	
Nuclear power plants – Instrumentation, control and electrical power systems – Guidance for the application of IEC 63147:2017/IEEE Std 497™ -2016 in the IAEA / IEC framework									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	Reqts specn & design
IEC TR 63192:2019				Edition 1.0 (2019-01-29)				L4	
Nuclear power plants – Instrumentation and control systems important to safety – Hazard analysis: A review of current approaches									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	*System*	~~Equipt~~	**Methods**	Analysis

For Topic 11, the other non-SC 45A documents of particular relevance and/or general interest are as follows:

IAEA documents

- INSAG-10, Defence in Depth in Nuclear Safety
- 75-INSAG-3 Rev. 1 – INSAG 12, Basic Safety Principles for Nuclear Power Plants
- General Safety Requirements GSR Part 2, Leadership and Management for Safety
- General Safety Requirements GSR Part 7, Safety Assessment for Facilities and Activities
- Safety Requirements No. SSR-2/1 (Rev.1), Safety of Nuclear Power Plant: Design
- Safety Requirements No. SSR-2/2 (Rev.1), Safety of Nuclear Power Plant: Commissioning and Operation
- Safety Requirements No. SSR-3, Safety of Research Reactors
- Safety Requirements No. SSR-4, Safety of Nuclear Fuel Cycle Facilities
- Safety Guide No. NS-G-1.11, Protection against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants
- Safety Guide No. SSG-2, Deterministic Safety Analysis for Nuclear Power Plants

- Safety Guide No. SSG-5, Safety of Conversion Facilities and Uranium Enrichment Facilities
- Safety Guide No. SSG-6, Safety of Uranium Fuel Fabrication Facilities
- Safety Guide No. SSG-7, Safety of Uranium and Plutonium Mixed Oxide Fuel Fabrication Facilities
- Safety Guide No. SSG-30, Safety Classification of Structures, Systems and Components in Nuclear Power Plants
- Safety Guide No. SSG-34, Design of Electrical Power Systems for Nuclear Power Plants
- Safety Guide No. SSG-39, Design of instrumentation and control systems for nuclear power plants
- Safety Guide No. SSG-42, Safety of Nuclear Fuel Reprocessing Facilities
- Safety Guide No. SSG-43, Safety of Nuclear Fuel Cycle Research and Development Facilities
- Safety Guide No. SSG-54, Accident Management Programmes for Nuclear Power Plants
- Nuclear Energy Series No. NP-T-1.5, Protecting Against Common Cause Failures in Digital I&C Systems of Nuclear Power Plants

IEC documents

- IEC 60071 (all parts), Insulation co-ordination
- IEC 60332 (all parts), Tests on electric and optical fibre cables under fire conditions
- IEC 60364-4-41, Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock
- IEC 60364-5-52, Low-voltage electrical installations – Part 5-52: Selection and erection of electrical equipment – Wiring systems
- IEC 60364-5-56, Low-voltage electrical installations – Part 5-56: Selection and erection of electrical equipment – Safety services
- IEC 60812, Failure modes and effects analysis (FMEA and FMECA)
- IEC 60909 (all parts), Short-circuit currents in three-phase a.c. systems
- IEC 61000 (all parts), Electromagnetic compatibility (EMC)
- IEC 61025, Fault tree analysis (FTA)
- IEC 61439-1, Low voltage switchgear and controlgear assemblies – Part 1: General rules
- IEC 61508 (all parts), Functional safety of electrical/electronic/programmable electronic safety-related systems
- IEC 61660 (all parts), Short-circuit currents in d.c. auxiliary installations in power plants and substations

IEEE documents

- IEEE Std 7-4.3.2™, IEEE Standard Criteria for Programmable Digital Devices in Safety Systems of Nuclear Power Generating Stations
- IEEE Std 352™, IEEE Guide for General Principles of Reliability Analysis of Nuclear Power Generating Station Systems and Other Nuclear Facilities

- IEEE Std 382™, IEEE Standard for Qualification of Safety-Related Actuators for Nuclear Power Generating Stations and Other Nuclear Facilities
- IEEE Std 577™, IEEE Standard Requirements for Reliability Analysis in the Design and Operation of Safety Systems for Nuclear Power Generating Stations
- IEEE Std 603™, IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations
- IEEE Std 1012™, IEEE Standard for System, Software, and Hardware Verification and Validation

C.2.4 Topic 12 – equipment qualification and system performance

Topic 12 applies to equipment qualification for their robustness toward external stress for I&C systems and EPS used in nuclear facilities. It also applies to aspects related to validation, verification and calibration of instrumentation systems at the system or channel level.

The following SC 45A standards are considered topic 12:

Document identifier				**Document edition**				**Level**	**Notes**
Title									
Facilities		Disciplines		Projects		Aspects			Lifecycle stages
NPPs	Other	I&C	EPS	New	Mods	System	Equipt	Methods	As described
IEC/IEEE 60780-323:2016				Edition 1.0 (2016-02-19)				**L2**	
Nuclear facilities – Electrical equipment important to safety – Qualification									
NPPs	*Other*	**I&C**	**EPS**	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	All stages of Eqt L/C
IEC/IEEE 60980-344:2020				Edition 1.0 (2020-10-20)				**L2**	
Nuclear facilities – Equipment important to safety – Seismic qualification									
NPPs	*Other*	**I&C**	**EPS**	**New**	~~**Mods**~~	~~System~~	*Equipt*	**Methods**	All stages of Eqt L/C
IEC 62003:2020				Edition 2.0 (2020-03-11)				**L3**	
Nuclear power plants – Instrumentation, control and electrical power systems – Requirements for electromagnetic compatibility testing									
NPPs	**Other**	**I&C**	**EPS**	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	Test pre-installation
IEC 62385:2007				Edition 1.0 (2007-06-21)				**L3**	
Nuclear power plants – Instrumentation and control important to safety – Methods for assessing the performance of safety system instrument channels									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	Tests during op life

For Topic 12, the other non-SC 45A documents of particular relevance and/or general interest are as follows:

IAEA documents

- Safety Guide No. NS-G-1.6, Seismic Design and Qualification for Nuclear Power Plants
- Safety Guide No. NS-G-1.11, Protection against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants

IEC documents

- IEC 60068-2 (all parts), Environmental testing – Part 2: Tests
- IEC TR 61000-1-6, Electromagnetic compatibility (EMC) – Part 1-6: General – Guide to the assessment of measurement uncertainty
- IEC TR 61000-2-5, Electromagnetic compatibility (EMC) – Part 2-5: Environment – Description and classification of electromagnetic environments
- IEC 61000-6 (all parts), Electromagnetic compatibility (EMC) – Part 6: Generic standards

IEEE documents

- IEEE Std 382™, IEEE Standard for Qualification of Safety-Related Actuators for Nuclear Power Generating Stations and Other Nuclear Facilities

C.2.5 Topic 13 – human factors engineering (HFE)

Topic 13 applies to the application of an HFE programme to HMI of nuclear facilities.

The following SC 45A standards are considered topic 13:

Document identifier				Document edition				Level	Notes
Title									
Facilities		Disciplines		Projects		Aspects			Lifecycle stages
NPPs	Other	I&C	EPS	New	Mods	System	Equipt	Methods	As described
IEC 63351 ED1				Edition 1.0 (in development)				**L2**	See IEC TR 63214
Nuclear Facilities – Human Factors Engineering – Application to the Design of Human Machine Interfaces									
NPPs	*Other*	**I&C**	*EPS*	**New**	**Mods**	*System*	*Equipt*	**Methods**	All stages of HMI L/C
IEC 61771:1995				Edition 1.0 (1995-12-13)				**L3**	
Nuclear power plants – Main control-room – Verification and validation of design									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	Design stage
IEC 61839:2000				Edition 1.0 (2000-07-21)				**L3**	
Nuclear power plants – Design of control rooms – Functional analysis and assignment									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	Design stage
IEC 63260:2020				Edition 1.0 (2020-05-25)				**L3**	
Guide for incorporating human reliability analysis into probabilistic risk assessments for nuclear power generating stations and other nuclear facilities									
NPPs	**Other**	*I&C*	*EPS*	**New**	**Mods**	*System*	*Equipt*	**Methods**	Analysis stage
IEC TR 63214:2019				Edition 1.0 (2019-10-29)				**L4**	Basis for IEC 63351
Nuclear power plants – Control rooms – Human factors engineering									
NPPs	*Other*	**I&C**	*EPS*	**New**	**Mods**	*System*	*Equipt*	**Methods**	All stages of HMI L/C

For Topic 13, the other non-SC 45A documents of particular relevance and/or general interest are as follows:

IAEA documents

- Safety Requirements No. SSR-2/1 (Rev.1), Safety of Nuclear Power Plant: Design
- Safety Requirements No. SSR-2/2 (Rev.1), Safety of Nuclear Power Plant: Commissioning and Operation
- Safety Guide No. NS-G-2.14, Conduct of Operations at Nuclear Power Plants
- Safety Guide No. SSG-51, Human Factors Engineering in the Design of Nuclear Power Plants
- Nuclear Energy Series No. NR-T-2.12, Human Factors Engineering Aspects of Instrumentation and Control System Design

IEC documents

- IEC 60073, Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators
- IEC 60447, Basic and safety principles for man-machine interface, marking and identification – Actuating principles

ISO documents

- ISO 9241 (series), Ergonomics of human-system interaction
- ISO 11064 (all parts), Ergonomic design of control centres

IEEE documents

- IEEE Std 1023™, IEEE Recommended Practice for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations and Other Nuclear Facilities

Other documents

- US NUREG-0711, Rev.3, Human Factors Engineering Program Review Model
- US NUREG/CR-6393, Integrated System Validation: Methodology and Review Criteria 1995
- EPRI-1008122, Human Factors Guidance for Control Room and Digital Human-System Interface Design and Modification

C.2.6 Topic 14 – cyber security

Topic 14 applies to system robustness toward external stress for I&C systems and EPS used in nuclear facilities, with particular reference to stresses arising from malevolent acts. It also applies to the coordination of safety and security requirements for I&C systems and EPS for nuclear facilities.

The following SC 45A standards are considered topic 14:

Document identifier				Document edition				Level	Notes
Title									
Facilities		Disciplines		Projects		Aspects			Lifecycle stages
NPPs	Other	I&C	EPS	New	Mods	System	Equipt	Methods	As described
IEC 62645:2019				Edition 2.0 (2019-11-13)				L2	
Nuclear power plants – Instrumentation, control and electrical power systems – Cybersecurity requirement									
NPPs	*Other*	**I&C**	~~EPS~~	**New**	**Mods**	*System*	*Equipt*	**Methods**	All plant stages L/C
IEC 62859:2016				Edition 1.0 (2016-10-28)				L2	
Nuclear power plants – Instrumentation and control systems – Requirements for coordinating safety and cybersecurity									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	*System*	*Equipt*	**Methods**	All plant stages L/C
IEC 63096:2020				Edition 1.0 (2020-10-07)				L3	
Nuclear power plants – Instrumentation, control and electrical power systems – Security controls									
NPPs	*Other*	**I&C**	*EPS*	**New**	**Mods**	*System*	*Equipt*	**Methods**	All plant stages L/C

For Topic 14, the other non-SC 45A documents of particular relevance and/or general interest are as follows:

IAEA documents

- Nuclear Security Series No. 10, Development, Use and Maintenance of the Design Basis Threat
- Nuclear Security Series No. 17, Technical Guidance – Computer Security at Nuclear Facilities
- Nuclear Security Series No. 33-T, Technical Guidance – Computer Security of Instrumentation and Control Systems at Nuclear Facilities
- TLD-006, Conducting Computer Security Assessments at Nuclear Facilities

IEC documents

- IEC 61508 (all parts), Functional safety of electrical/electronic/programmable electronic safety-related systems
- IEC 62443 (all parts), Industrial communication networks – Network and system security

ISO documents

- ISO/IEC 27000, Information technology – Security techniques – Information security management systems – Overview and vocabulary
- ISO/IEC 27001, Information technology – Security techniques – Information security management systems – Requirements
- ISO/IEC 27002, Information technology – Security techniques – Code of practice for information security controls
- ISO/IEC 27005, Information technology – Security techniques – Information security risk management

C.2.7 Topic 15 – ageing management

Topic 15 applies to the ageing management of I&C systems and EPS for nuclear facilities.

The following SC 45A standards are considered topic 15:

Document identifier				Document edition				Level	Notes
Title									
Facilities		Disciplines		Projects		Aspects			Lifecycle stages
NPPs	Other	I&C	EPS	New	Mods	System	Equipt	Methods	As described
IEC 62342:2007				Edition 1.0 (2007-08-20)				**L2**	
Nuclear power plants – Instrumentation and control systems important to safety – Management of ageing									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	All plant stages L/C
IEC 62465:2010				Edition 1.0 (2010-05-11)				**L3**	
Nuclear power plants – Instrumentation and control important to safety – Management of ageing of electrical cabling systems									
NPPs	~~Other~~	**I&C**	*EPS*	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	All plant stages L/C
IEC/IEEE 62582-1:2011				Edition 1.0 (2011-08-31)				**L3**	Under revision
Nuclear power plants – Instrumentation and control important to safety – Electrical equipment condition monitoring methods – Part 1: General									
NPPs	~~Other~~	**I&C**	*EPS*	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	Tests during op life
IEC/IEEE 62582-2:2011				Edition 1.0 (2011-08-31)				**L3**	Under revision (CDV)
Nuclear power plants – Instrumentation and control important to safety – Electrical equipment condition monitoring methods – Part 2: Indenter modulus									
NPPs	~~Other~~	**I&C**	*EPS*	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	Tests during op life
IEC/IEEE 62582-3:2012				Edition 1.0 (2012-12-12)				**L3**	
Nuclear power plants – Instrumentation and control important to safety – Electrical equipment condition monitoring methods – Part 3: Elongation at break									
NPPs	~~Other~~	**I&C**	*EPS*	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	Tests during op life
IEC/IEEE 62582-4:2011				Edition 1.0 (2011-08-31)				**L3**	Under revision (CDV)
Nuclear power plants – Instrumentation and control important to safety – Electrical equipment condition monitoring methods – Part 4: Oxidation induction techniques									
NPPs	~~Other~~	**I&C**	*EPS*	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	Tests during op life
IEC/IEEE 62582-5:2015				Edition 1.0 (2015-06-19)				**L3**	
Nuclear power plants – Instrumentation and control important to safety – Electrical equipment condition monitoring methods – Part 5: Optical time domain reflectometry									
NPPs	~~Other~~	**I&C**	*EPS*	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	Tests during op life

Document identifier				Document edition			Level		Notes
Title									
Facilities		Disciplines		Projects		Aspects			Lifecycle stages
NPPs	Other	I&C	EPS	New	Mods	System	Equipt	Methods	As described
IEC/IEEE 62582-6:2019				Edition 1.0 (2019-10-22)			L3		
Nuclear power plants – Instrumentation and control important to safety – Electrical equipment condition monitoring methods – Part 6: Insulation resistance									
NPPs	~~Other~~	**I&C**	*EPS*	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	Tests during op life
IEC 62765-1:2015				Edition 1.0 (2015-04-22)			L3		
Nuclear powers plants – Instrumentation and control important to safety – Management of ageing of sensors and transmitters – Part 1: Pressure transmitters									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	All stages of Eqt L/C
IEC 62765-2:2019				Edition 1.0 (2019-01-29)			L3		
Nuclear power plants – Instrumentation and control important to safety – Management of ageing of sensors and transmitters – Part 2: Temperature sensors									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	~~System~~	*Equipt*	**Methods**	All stages of Eqt L/C
IEC TR 62096:2009				Edition 2.0 (2009-03-24)			L4		
Nuclear power plants – Instrumentation and control important to safety – Guidance for the decision on modernization									
NPPs	~~Other~~	**I&C**	~~EPS~~	~~New~~	**Mods**	*System*	*Equipt*	**Methods**	Analysis stage

For Topic 15, the other non-SC 45A documents of particular relevance and/or general interest are as follows:

IAEA documents

- Safety Requirements No. SSR-2/1 (Rev.1), Safety of Nuclear Power Plant: Design
- Safety Requirements No. SSR-2/2 (Rev.1), Safety of Nuclear Power Plant: Commissioning and Operation
- Safety Guide No. NS-G-2.3, Modifications to Nuclear Power Plants
- Safety Guide No. NS-G-2.6, Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants
- Safety Guide No. SSG-10, Ageing Management for Research Reactors
- Safety Guide No. SSG-39, Design of instrumentation and control systems for nuclear power plants
- Safety Guide No. SSG-48, Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants

IEC documents

- IEC 60584-1, Thermocouples – Part 1: EMF specifications and tolerances

- IEC 60584-3, Thermocouples – Part 3: Extension and compensating cables – Tolerances and identification system
- IEC 60751, Industrial platinum resistance thermometers and platinum temperature sensors
- IEC 61515, Mineral insulated metal-sheathed thermocouple cables and thermocouples
- IEC 61746-1, Calibration of optical time-domain reflectometers (OTDR) – Part 1: OTDR for single mode fibres
- IEC 61746-2, Calibration of optical time-domain reflectometers (OTDR) – Part 2: OTDR for multimode fibres

ISO documents

- ISO/IEC GUIDE 98-3:2008, Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995) + Supplement 1: 2008, Propagation of distributions using a Monte Carlo method + Supplement 2:2011, Extension to any number of output quantities

C.2.8 Topic 21 – control rooms and human machine interfaces (HMI)

Topic 21 applies to the control room areas and HMI of nuclear facilities.

The following SC 45A standards are considered topic 21:

Document identifier				**Document edition**				**Level**	**Notes**
Title									
Facilities		Disciplines		Projects		Aspects			Lifecycle stages
NPPs	Other	I&C	EPS	New	Mods	System	Equipt	Methods	As described
IEC 60964:2018				Edition 3.0 (2018-11-16)				**L2**	
Nuclear power plants – Control rooms – Design									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	**System**	**Equipt**	*Methods*	Mainly design & test
IEC 60965:2016				Edition 3.0 (2016-02-23)				**L2**	
Nuclear power plants – Control rooms – Supplementary control room for reactor shutdown without access to the main control room									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	**Mods**	**System**	**Equipt**	*Methods*	Mainly design & test
IEC 60965:1988				Edition 1.0 (1988-08-30)				**L3**	
Functional design criteria for a safety parameter display system for nuclear power stations									
NPPs	~~Other~~	**I&C**	~~EPS~~	*New*	**Mods**	**System**	**Equipt**	~~Methods~~	All stages of Eqt L/C
IEC 61227:2008				Edition 2.0 (2008-04-29)				**L3**	
Nuclear power plants – Control rooms – Operator controls									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	*Mods*	~~System~~	**Equipt**	~~Methods~~	Mainly design aspects
IEC 61772:2009				Edition 2.0 (2009-04-29)				**L3**	
Nuclear power plants – Control rooms – Application of visual display units (VDUs)									
NPPs	~~Other~~	**I&C**	~~EPS~~	**New**	*Mods*	~~System~~	**Equipt**	~~Methods~~	Mainly design / V&V