IEC 60709

Edition 3.0 2018-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

Centrales nucléaires de puissance – Systèmes d'instrumentation, de contrôle-commande et d'alimentation électrique importants pour la sûreté – Séparation

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CONTENTS

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NUCLEAR POWER PLANTS – INSTRUMENTATION, CONTROL AND ELECTRICAL POWER SYSTEMS IMPORTANT TO SAFETY – SEPARATION

FOREWORD

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International Standard IEC 60709 has been prepared by subcommittee 45A: Instrumentation, control and electrical power systems of nuclear facilities, of IEC technical committee 45: Nuclear instrumentation.

This third edition cancels and replaces the second edition published in 2004. This edition constitutes a technical revision.

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

a) include requirements referring to the separation principle in electrical systems important to safety;
b) define separation criteria for I&C and electrical systems in a generic way;
c) restructure the standard following the criteria;
d) consider interferences between I&C and electrical equipment from different safety classes;

e) align with the new revisions of IAEA documents and broaden the scope to include other aspects of separation;

f) cover new technologies that either present unique separation issues or provide new means of achieving separation;

g) enhance requirements and guidance for areas of cable congestion, e.g. control room, cable spreading galleries, etc;

h) introduce the concept of “associated circuits” (from US practice) to deal with equipment not important to safety and cables that are not separated from safety equipment and cables;

i) address the implications of low energy circuits, such as the possible use of analysis to reduce the minimum separation distance;

j) review existing requirements, update terminology and definitions;

k) provide guidance for the application of the standard to existing plants.

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

FDIS	Report on voting
45A/1185/FDIS	45A/1195/RVD

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

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

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

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

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INTRODUCTION

a) Background, main issues and organization of the standard

I&C and electrical systems important to safety in nuclear power plants need to tolerate the effects of plant / equipment faults as well as internal and external hazards. Various techniques are available to increase the level of tolerability of I&C and electrical systems to such effects, including the provision of independent systems, subsystems and equipment. For claims to be made of independence between such systems and equipment, adequate separation should be provided and maintained. This standard provides generic technical requirements and recommendations for the implementation of separation in the design of I&C and electrical systems.

The object of this standard is as follows:

– in Clause 5 to present the principles for separation of I&C and/or electrical systems. Subclause 5.4 focuses on modernization of existing nuclear power plants;

– in Clause 6, to define the separation design basis, including inputs, and to identify a certain number of possible causes of internal and external hazards;

– in Clause 7, to establish the electrical isolation measures for I&C and electrical systems important to safety and also requirements referring isolation devices;

– in Clause 8, to give requirements to be fulfilled for cabling and component separation within an I&C and electrical system important to safety.

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

IEC 60709 is a document of the second level, directly referenced by IEC 61513 and IEC 63046 in regard to physical separation and electrical isolation being required between subsystems of different safety trains of I&C and electrical systems important to safety, and between I&C and electrical systems important to safety and those that are not important to safety and between different defence in depth levels.

IEC 61226, that is consistent with IAEA SSG-30, establishes the principles of categorization of I&C and electrical functions and the classification of structures, systems and components (SSC) according to their level of importance to safety. IEC 61226 refers to IEC 60709 as the normative standard regarding requirements for separation.

For more details on the relation of this standard to IAEA guidelines and IEC 61226, see Annex A to this standard.

c) Recommendations and limitations regarding the application of the Standard

IEC 60709 applies to I&C and electrical systems and equipment important to safety. It establishes requirements for physical and electrical separation as one means to provide independence between the functions performed in those systems and equipment. Other aspects of independence that may be required to address concerns of common cause failure are not included in this standard. Furthermore, separation criteria due to security requirements are also not considered.

The requirements given in this standard for the separation of safety classes can be applied to separation for other design constraints, such as the defence in depth concept. These rules shall be defined at the beginning of a project by a separation concept.

The separation of safety class 1 from other classes, as used in this standard, is only an example of the application of the requirements of the standard.

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

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

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

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

A fourth level extending the IEC SC45A standard series, corresponds to the Technical Reports which are not normative.

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

IEC 61513 and IEC 63046 have adopted a presentation format similar to the basic safety publication IEC 61508 with an overall life-cycle framework and a system life-cycle framework. Regarding nuclear safety, IEC 61513 and IEC 63046 provide the interpretation of the general requirements of IEC 61508-1, IEC 61508-2 and IEC 61508-4, for the nuclear application sector. In this framework IEC 60880, IEC 62138 and IEC 62566 correspond to IEC 61508-3 for the nuclear application sector. IEC 61513 and IEC 63046 refer to ISO as well as to IAEA GS-R part 2 and IAEA GS-G-3.1 and IAEA GS-G-3.5 for topics related to quality assurance (QA). At level 2, regarding nuclear security, IEC 62645 is the entry document for the IEC SC 45A security standards. It builds upon the valid high level principles and main concepts of the generic security standards, in particular ISO/IEC 27001 and ISO/IEC 27002; it adapts them and completes them to fit the nuclear context and coordinates with the IEC 62443 series. At level 2, IEC 60964 is the entry document for the IEC SC 45A control rooms standards and IEC 62342 is the entry document for the ageing management standards.

NOTE 1 It is assumed that for the design of I&C systems in NPPs that implement conventional safety functions (e.g. to address worker safety, asset protection, chemical hazards, process energy hazards) international or national standards would be applied.

NOTE 2 IEC SC 45A domain was extended in 2013 to cover electrical systems. In 2014 and 2015 discussions were held in IEC SC 45A to decide how and where general requirements for the design of electrical systems were to be considered. IEC SC 45A experts recommended that an independent standard be developed at the same level as IEC 61513 to establish general requirements for electrical systems. Project IEC 63046 is now launched to cover this objective. When IEC 63046 will be published this NOTE 2 of the introduction of IEC SC 45A standards will be suppressed.

NUCLEAR POWER PLANTS – INSTRUMENTATION, CONTROL AND ELECTRICAL POWER SYSTEMS IMPORTANT TO SAFETY – SEPARATION

1 Scope

1.1 General

This document is applicable to nuclear power plant instrumentation and control (I&C) and electrical systems and equipment, whose functions are required to be independent due to their contribution to:

- a redundant or diverse safety group;
- different defence in depth levels;
- different safety classes and also with non-classified (NC) systems.

It is also applicable to temporary installations which are part of those I&C and electrical systems important to safety (for example, auxiliary equipment for commissioning tests and experiments or mobile power supply systems). Clause 7 is intended particularly for electrical isolation, Clause 8 is intended particularly for the cabling and the arrangement of equipment of I&C and electrical systems important to safety.

This document applies to I&C and electrical systems of new nuclear power plants and to I&C and electrical upgrading or back-fitting of existing plants. For existing plants see 1.2 and 5.4.

Where independence is required by general safety standards such as IAEA safety guides, IEC 61513 (for I&C), IEC 63046 (for electrical systems) and other project constraints, one aspect of achieving this independence is physical separation and electrical isolation between the systems and their equipment that perform safety functions. This document defines the assessments needed and the technical requirements to be met for I&C and electrical systems, equipment or cables for which separation is required. Those means are to achieve adequate physical separation and electrical isolation between redundant sections of a system and between a higher and lower class systems. This separation is needed to prevent or minimise the impact on safety that could result from faults and failures which could be propagated or affect several sections of a system or several systems.

The requirements for functions, and their associated systems and equipment, to be independent are normally defined in detail in the project documentation; the method of determining and defining these requirements is not the subject of this document.

Following IAEA SSR-2/1 Requirement 21, separation means by physical separation, electrical isolation, functional independence and independence of communication are considered. In this document physical separation and electrical isolation are treated. Functional independence and independence of communication are not considered in this document. More details referring to functional independence, independence from control systems and independence of communication are given in Annex D.

1.2 Application: new and pre-existing plants

This document applies to the I&C and electrical of new nuclear power plants as well as to up-grading or back-fitting of existing plants.

For existing plants, only a subset of requirements is applicable and this subset is normally specified and argued at the beginning of any project.