Irish Standard
I.S. EN 62340:2010

Nuclear power plants - Instrumentation and control systems important to safety - Requirements for coping with Common Cause Failure (CCF) (IEC 62340:2007 (EQV))

I.S. EN 62340:2010

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English version

Nuclear power plants - Instrumentation and control systems important to safety - Requirements for coping with Common Cause Failure (CCF)

(IEC 62340:2007)

Centrales nucléaires de puissance - Systèmes d'instrumentation et de contrôle commande importants pour la sûreté - Exigences permettant de faire face aux Défaillances de Cause Commune (DCC)
(CEI 62340:2007)

Kernkraftwerke - Leittechnische Systeme mit sicherheitstechnischer Bedeutung - Anforderungen zur Beherrschung von Versagen aufgrund gemeinsamer Ursache
(IEC 62340:2007)

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CENELEC

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

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Foreword

The text of the International Standard IEC 62340:2007, prepared by SC 45A, Instrumentation and control of nuclear facilities, of IEC TC 45, Nuclear instrumentation, was submitted to the CENELEC formal vote for acceptance as a European Standard and was approved by CENELEC as EN 62340 on 2010-05-01.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2011-05-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2013-05-01

Annex ZA has been added by CENELEC.

As stated in the nuclear safety Directive 2009/71/EURATOM, Chapter 1, Article 2, item 2, Member States are not prevented from taking more stringent safety measures in the subject-matter covered by the Directive, in compliance with Community law. In a similar manner, this European Standard does not prevent Member States from taking more stringent nuclear safety measures in the subject-matter covered by this European Standard.”

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Endorsement notice

The text of the International Standard IEC 62340:2007 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60671	-	Nuclear power plants - Instrumentation and control systems important to safety - Surveillance testing	-	-
IEC 60709	-	Nuclear power plants - Instrumentation and control systems important to safety - Separation	EN 60709	-
IEC 60780	-	Nuclear power plants - Electrical equipment of the safety system - Qualification	-	-
IEC 60880	-	Nuclear power plants - Instrumentation and control systems important to safety - Software aspects for computer-based systems performing category A functions	EN 60880	-
IEC 60980	-	Recommended practices for seismic qualification of electrical equipment of the safety system for nuclear generating stations	-	-
IEC 61000-4	Series	Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques	EN 61000-4	Series
IEC 61226	-	Nuclear power plants - Instrumentation and control systems important to safety - Classification of instrumentation and control functions	-	-
IEC 61513	-	Nuclear power plants - Instrumentation and control for systems important to safety - General requirements for systems	-	-
IAEA Safety Guide NS-G-1.3	-	Instrumentation and control systems important to safety in nuclear power plants	-	-
IAEA Safety Guide SG-D11	-	General design safety principles for nuclear power plants; a safety guide	-	-
IAEA Safety Glossary	2007	Terminology used in nuclear safety and radiation protection	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

NUCLEAR POWER PLANTS – INSTRUMENTATION AND CONTROL SYSTEMS IMPORTANT TO SAFETY – REQUIREMENTS FOR COPING WITH COMMON CAUSE FAILURE (CCF)

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 62340 has been prepared by subcommittee 45A: Instrumentation and control of nuclear facilities, of IEC technical committee 45: Nuclear instrumentation.

The text of this standard is based on the following documents:

FDIS	Report on voting
45A/668/FDIS	45A/676/RVD

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

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

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

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

INTRODUCTION

a) Background, main issues and organisation of this Standard

In order to achieve a high safety level, redundancy is applied as one of the key features for designing instrumentation and control systems (I&C systems) important to safety. Since a Common Cause Failure (CCF) could compromise the effectiveness of redundancy, it is essential to take adequate measures against it. The nuclear industry has pioneered systems design and engineering to address CCF. Over the last thirty years it has implemented and reached consensus on a number of practices to handle and overcome CCF.

The intention of this standard is to address the whole scope of aspects to overcome Common Cause Failures (CCFs) and to provide an overview of the relevant requirements for I&C systems that are used to perform functions important to safety (according to IEC 61226) in nuclear power plants.

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

IEC 62340 is a second level IEC SC 45A document tackling the issue of CCF.

This international standard supplements IEC 61513 and related standards with requirements to reduce and overcome the possibility of CCF of I&C functions of category A. The requirements given by this standard are applicable to category A (IEC 61226) functions if their failure would be unacceptable with respect to the plant safety design.

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

c) Recommendations and limitations regarding the application of this Standard

This standard applies to I&C systems important to safety of new NPPs as well as to the replacement of I&C systems of existing plants. The I&C functions may need to be kept or upgraded if an I&C system is replaced. The requirements of this standard also consider the replacement of I&C which entails changes in the structure of I&C systems.

For existing plants, only a subset of the requirements from this standard may be applicable and this subset should be identified at the beginning of any project. The requirements and recommendations which are not to be implemented in an I&C upgrading or replacement project should be justified on a case by case basis by an overall safety assessment. The potential consequences of not following this standard in some aspects due to plant constrains should be considered in comparison to the added safety gained through the upgrade as a whole.

To avoid overlapping requirements, this standard takes advantage of other existing standards by referring to the relevant (sub)clauses, especially to the nuclear sector standards IEC 61513, IEC 60709, IEC 60780 and IEC 60880. New requirements are given where not covered by these standards.

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 document of the IEC SC 45A standard series is IEC 61513. It provides general requirements for I&C systems and equipment that are used to perform functions important to safety in NPPs. IEC 61513 structures the IEC SC 45A standard series.

IEC 61513 refers directly to other IEC SC 45A standards for general topics related to categorization of functions and classification of systems, qualification, separation of systems,

defence against common cause failure, software aspects of computer-based systems, hardware aspects of computer-based systems, and control room design. The standards referenced directly at this second level should be considered together with IEC 61513 as a consistent document set.

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

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

IEC 61513 has adopted a presentation format similar to the basic safety publication IEC 61508 with an overall safety life-cycle framework and a system life-cycle framework and provides an interpretation of the general requirements of IEC 61508-1, IEC 61508-2 and IEC 61508-4, for the nuclear application sector. Compliance with IEC 61513 will facilitate consistency with the requirements of IEC 61508 as they have been interpreted for the nuclear industry. In this framework IEC 60880 and IEC 62138 correspond to IEC 61508-3 for the nuclear application sector.

IEC 61513 refers to ISO as well as to IAEA 50-C-QA (now replaced by IAEA GS-R-3) for topics related to quality assurance (QA).

The IEC SC 45A standards series consistently implements and details the principles and basic safety aspects provided in the IAEA code on the safety of NPPs and in the IAEA safety series, in particular the Requirements NS-R-1, establishing safety requirements related to the design of Nuclear Power Plants, and the Safety Guide NS-G-1.3 dealing with instrumentation and control systems important to safety in Nuclear Power Plants. The terminology and definitions used by SC 45A standards are consistent with those used by the IAEA.

NUCLEAR POWER PLANTS – INSTRUMENTATION AND CONTROL SYSTEMS IMPORTANT TO SAFETY – REQUIREMENTS FOR COPING WITH COMMON CAUSE FAILURE (CCF)

1 Scope

I&C systems important to safety may be designed using conventional hard-wired equipment, computer-based equipment or by using a combination of both types of equipment. This International Standard provides requirements and recommendations[1] for the overall architecture of I&C systems, which may contain either or both technologies.

The scope of this standard is:

a) to give requirements related to the avoidance of CCF of I&C systems that perform category A functions;

b) to additionally require the implementation of independent I&C systems to overcome CCF, while the likelihood of CCF is reduced by strictly applying the overall safety principles of IEC SC 45A (notably IEC 61226, IEC 61513, IEC 60880 and IEC 60709);

c) to give an overview of the complete scope of requirements relevant to CCF, but not to overlap with fields already addressed in other standards. These are referenced.

This standard emphasises the need for the complete and precise specification of the safety functions, based on the analysis of design basis accidents and consideration of the main plant safety goals. This specification is the pre-requisite for generating a comprehensive set of detailed requirements for the design of I&C systems to overcome CCF.

This standard provides principles and requirements to overcome CCF by means which ensure independence[2]:

a) between I&C systems performing diverse safety functions within category A which contribute to the same safety target;

b) between I&C systems performing different functions from different categories if e.g. a category B function is claimed as back-up of a category A function and;

c) between redundant channels of the same I&C system.

The implementation of these requirements leads to various types of defence against initiating CCF events.

Means to achieve protection against CCF are discussed in this standard in relation to:

a) susceptibility to internal plant hazards and external hazards;

b) propagation of physical effects in the hardware (e.g. high voltages); and

c) avoidance of specific faults and vulnerabilities within the I&C systems notably:

   1) propagation of functional failure in I&C systems or between different I&C systems (e.g. by means of communication, fault or error on shared resources),

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1 To support a clear addressing of all requirements and recommendations these are introduced by a clause number.

2 Independence between I&C systems or between redundant channels of the same I&C system is the capability that in case of a postulated failure of one system or one channel the other systems or channels perform their functions as intended.

2) existence of common faults introduced during design or during system operation (e.g. maintenance induced faults),
3) insufficient system validation so that the system behaviour in response to input signal transients does not adequately correspond to the intended safety functions,
4) insufficient qualification of the required properties of hardware, insufficient verification of software components, or insufficient verification of compatibility between replaced and existing system components.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

IEC 60780, *Nuclear power plants – Electrical equipment of the safety system – Qualification*

IEC 60880, *Nuclear power plants – Instrumentation and control systems important to safety – Software aspects for computer-based systems performing category A functions*

IEC 60980, *Recommended practices for seismic qualification of electrical equipment of the safety system for nuclear generating stations*

IEC 61000-4 (all parts), *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques*

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

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

IAEA Safety Guide NS-G-1.3, *Instrumentation and control systems important to safety in Nuclear Power Plants*

IAEA Safety Guide SG-D11, *General design safety principles for nuclear power plants*

IAEA Safety Glossary Ed.2.0, 2006

3 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 61513 and IEC 61226 apply as well as the following.

3.1
Common Cause Failure (CCF)
failure of two or more structures, systems or components due to a single specific event or cause

[IAEA Safety Glossary, Ed. 2.0, 2006]