Irish Standard
I.S. EN 60671:2011

Nuclear power plants - Instrumentation and control systems important to safety - Surveillance testing (IEC 60671:2007 (EQV))

I.S. EN 60671:2011

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English version

Nuclear power plants - Instrumentation and control systems important to safety - Surveillance testing

(IEC 60671:2007)

Centrales nucléaires de puissance - Systèmes d'instrumentation et de contrôle-commande importants pour la sûreté - Essais de surveillance
(CEI 60671:2007)

Kernkraftwerke - Leittechnik für Systeme mit sicherheitstechnischer Bedeutung - Prüfungen zur Sicherstellung der Funktionsfähigkeit
(IEC 60671:2007)

This European Standard was approved by CENELEC on 2011-08-08. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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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 60671:2007, prepared by SC 45A, Instrumentation and control of nuclear facilities, of IEC TC 45, Nuclear instrumentation, was submitted to the formal vote and was approved by CENELEC as EN 60671 on 2011-08-08 without any modification.

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)	2012-08-08
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2014-08-08

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 standard.

Annex ZA has been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 60671:2007 was approved by CENELEC as a European Standard without any modification.

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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 When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
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 60987	-	Nuclear power plants - Instrumentation and control important to safety - Hardware design requirements for computer-based systems	EN 60987	-
IEC 61226	-	Nuclear power plants - Instrumentation and control important to safety - Classification of instrumentation and control functions	EN 61226	-
IEC 61513	-	Nuclear power plants - Instrumentation and control for systems important to safety - General requirements for systems	-	-
IEC 62138	-	Nuclear power plants - Instrumentation and control important for safety - Software aspects for computer-based systems performing category B or C functions	EN 62138	-
IAEA Safety guide NS-G-1.3	-	Instrumentation and control systems important to safety in nuclear power plants	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

NUCLEAR POWER PLANTS – INSTRUMENTATION AND CONTROL SYSTEMS IMPORTANT TO SAFETY – SURVEILLANCE TESTING

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 60671 has been prepared by subcommittee 45A: Instrumentation and control of nuclear facilities, of IEC technical committee 45: Nuclear instrumentation.

This second edition cancels and replaces the first edition published in 1980 and constitutes a technical revision.

The main technical changes with respect to the previous edition are as follows:

– Expand scope to cover all systems important to safety, and clarify requirement gradation for systems and equipment performing category A, B and C functions.
– Align with the new revisions of IAEA documents NS-R-1 and NS-G-1.3 (replacing D3 and D8).

– Provide references to relevant normative standards.
– Harmonize terminology with the existing standard hierarchy.
– Strengthen the role of computer self-supervision as an alternative to periodic surveillance testing.
– Introduce features of digital I&C that present special opportunities or problems to on-line testing.
– Present design requirements on testing features themselves (categorization, verification, etc.) that derive from the standards adopted since the first issue of IEC 60671, which will thus be updated to become consistent with the newer standards.

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

FDIS	Report on voting
45A/648/FDIS	45A/655/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.

In the United Kingdom some differences exist:

Introduction, Clauses 1, 2 and 4.2: The classification scheme captured in standard IEC 61226 edition 2 (2005-02) is contrary to the custom, practice, and regulatory expectations as set down by the United Kingdom Health and Safety Executive's Nuclear Installations Inspectorate and the understanding in the United Kingdom of IAEA safety guides. Users of this standard are advised that, in the United Kingdom, this standard should be read in conjunction with the edition of IEC 61226 published by the BSI, and the Health and Safety Executive's Nuclear Installations Inspectorate's Safety Assessment Principles to determine the classification of a function or system.

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 organization of the standard

A fundamental requirement for I&C (instrumentation and control) systems important to safety in nuclear power plants is that they be capable of being demonstrated to be ready to perform their safety functions if needed. Surveillance testing may be performed by the execution of functional tests or by self-supervision within the I&C systems important to safety, and is augmented by diagnostic functions and by visual inspections of the I&C systems and their status indicators by the plant operation staff. Depending on the reliability targets and the testing conditions the demonstration of functional readiness may be performed either while the plant is on-line or during plant shutdown. This Standard provides technical requirements and recommendations for the implementation of surveillance testing for I&C systems important to safety.

The object of this standard is:

– in Clause 4:

  to establish the principles for surveillance testing of I&C equipment important to safety.

– in Clauses 5 through 9:

  to give requirements to be fulfilled in the design and operation of I&C equipment important to safety in regards to the surveillance testing.

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

IEC 61513 establishes the top level requirements for I&C systems and equipment important to safety. Among these requirements is the need to demonstrate, on a continuing basis, the operability of the equipment and its readiness to perform its safety or safety related functions.

IEC 61226 establishes the principles of categorization of I&C functions according to their level of importance to safety. The reliability required from any function in categories A, B or C should be determined by either a quantitative probabilistic assessment of the NPP, or by qualitative engineering judgment, and included in the specification.

IEC 60671 provides the bases and requirements for surveillance testing to demonstrate the operability, under normal conditions, of these systems and equipment during their operative life.

IEC 60671 supports the achievement of the target reliability by detecting faults within the equipment allowing appropriate measures to be initiated (timely repair or any alternative solutions).

IEC 60671 is the third level SC 45A document tackling the issue of surveillance testing for I&C systems important to safety

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

c) Recommendations and limitations regarding the application of the Standard

IEC 60671 applies to I&C systems and equipment important to safety. It establishes requirements for surveillance testing as a means of demonstrating on a continuing basis the readiness of the systems and equipment to perform their functions important to safety.

Additional requirements relating to reliability and detailed requirements for redundancy and diversity are not given in this standard but can be found in other documents of SC 45A.

The attention of the reader is drawn to the fact that in some countries the scope and the content of periodic testing are defined by regulatory requirements and that these definitions could differ from the ones used in this standard.

In the case of existing plants it may not be possible to apply all of the requirements of this standard. Therefore, at the beginning of a modernization project of an I&C system important to safety the subset of requirements to be applied shall be identified in regards to the overall scope and consequences of modification of the I&C systems.

d) Description of the structure of the 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 50-C/SG-Q) 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 – SURVEILLANCE TESTING

1 Scope

Where functional reliability is required by general safety standards, one aspect of demonstrating this reliability is testing performed on-line during plant operation or during plant shutdown in preparation for return to power operation.

This standard lays down principles for testing I&C systems performing category A, B and C functions, per IEC 61226, during normal power operation and shutdown, so as to check the functional availability especially with regard to the detection of faults that could prevent the proper operation of the functions important to safety. It covers the possibility of testing at short intervals or continuous surveillance, as well as periodic testing at longer intervals. It also establishes basic rules for the design and application of the test equipment and its interface with the systems important to safety. Further, the effect of any test equipment failure on the reliability of the I&C systems is considered.

Types of surveillance tests may include:

– self-tests for I&C equipment;
– test of a group of equipment or components to confirm properties that support the safety function (continuity, power availability, etc.);
– test based on information redundancy or comparison of control signatures (consistency checking for redundant sensors, CRC-checking, Checksum, etc.);
– periodic testing which is related to the correctness of functional behaviour of an I&C system.

The dependability targets of any I&C system is reached using an appropriate combination of tests of the form indicated above.

The extent of the I&C system to be tested is from the interface of the sensors with the process through to the actuation devices (see Figure 1). It is applicable to the installed I&C systems as well as to temporary installations which are part of those I&C systems important to safety (for example, auxiliary equipment for commissioning tests and experiments). This standard also applies to individual electromechanical equipment, such as relays and solenoid actuators.

Additional testing and inspections may be performed on I&C equipment for purposes other than the demonstration of functional capability, such as to optimise preventive maintenance, etc. Such tests are beyond the scope of this standard; however, they may be combined with the surveillance testing discussed herein.

For any on-line tests the potential interaction and fault dependencies between the part of the system under test and the testing part, have to be carefully studied and their influences have to be fully integrated into the reliability assessment of the functions important to safety (in accordance with IEC 61513).

This standard applies to the I&C of new nuclear power plants as well as to I&C upgrading or back-fitting of existing plants. For I&C upgrades, only a subset of the requirements may be applicable; this subset is to be identified at the beginning of any project.

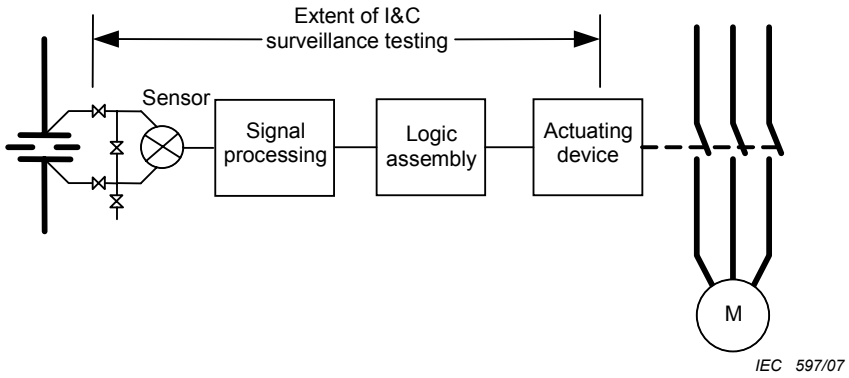

Figure 1 – Extent of I&C surveillance testing

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

IEC 60987, *Nuclear power plants – Instrumentation and control important to safety – Hardware design requirements for computer-based systems*

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

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

IEC 62138, *Nuclear power plants – Instrumentation and control important for safety – Software aspects for computer-based systems performing category B and C functions*

IAEA Safety Guide NS-G-1.3, *Instrumentation and Control Systems Important to Safety in Nuclear Power Plants*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
automatic test
a test in which the operation of all or part of the instrumentation and control system is checked in a completely automatic sequence. The automatic test sequence can be started either manually by the operator, cyclically by a clock or automatically by the verification of a well-defined condition