

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



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

**Centrales nucléaires de puissance –  
Instrumentation et contrôle-commande importants pour la sûreté – Gestion du  
vieillissement des systèmes de câbles électriques**



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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

PRICE CODE  
CODE PRIX

ICS 27.120.20

ISBN 978-2-88910-915-9

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

# **NUCLEAR POWER PLANTS – INSTRUMENTATION AND CONTROL IMPORTANT TO SAFETY – MANAGEMENT OF AGEING OF ELECTRICAL CABLING SYSTEMS**

## FOREWORD

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International Standard IEC 62465 has been prepared by subcommittee 45A: Instrumentation and control of nuclear facilities, of IEC technical committee 45: Nuclear instrumentation.

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

FDIS	Report on voting
45A/795/FDIS	45A/803/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 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 stability 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

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## INTRODUCTION

### a) Technical background, main issues and organisation of the Standard

With the majority of nuclear power plants over 20 years old, the management of ageing of instrumentation and associated electrical cabling systems is currently a relevant topic, especially for those plants that have extended their operating licenses or are considering this option. This International Standard is intended to be used by operators of nuclear power plants (utilities), systems evaluators, and by licensors.

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

IEC 62465 is the third level IEC SC 45A document tackling the specific issue of management of ageing of electrical cabling systems in nuclear power plants for Instrumentation and Control (I&C) systems important to safety.

IEC 62342 is the second level chapeau standard of SC 45A covering the domain of the management of ageing of nuclear instrumentation systems used in nuclear power plants to perform functions important to safety. IEC 62342 is the introduction to a series of standards to be developed by IEC SC 45A covering the management of ageing of specific I&C systems or components such as electrical cabling systems (IEC 62465), sensors, and transmitters.

IEC 62465 is to be read in association with IEC 62342 and IEC 62096, which is the appropriate IEC SC 45A Technical Report that provides guidance on the decision for modernization when management of ageing techniques are no longer successful.

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

### c) Recommendations and limitations regarding the application of this Standard

It is important to note that this International Standard establishes no additional functional requirements for safety systems. Ageing mechanisms have to be prevented and thus detected by performance measurements. Aspects for which special recommendations have been provided in this International Standard are:

- criteria for evaluation of ageing of electrical cabling systems in nuclear power plants;
- steps to be followed to establish cable testing requirements for an ageing management program for nuclear power plant electrical cabling systems; and
- relationship between on-going qualification analysis and ageing management programs with regards to electrical cabling systems.

It is recognized that testing and monitoring techniques used to evaluate the ageing condition of nuclear power plants' electrical cabling systems are continuing to develop at a rapid pace and that it is not possible for a standard such as IEC 62465 to include references to all modern technologies and techniques. However, a number of techniques have been mentioned within this International Standard and are described in Annexes B, C and D.

To ensure that this International Standard will continue to be relevant in future years, the emphasis has been placed on issues of principle, rather than specific technologies.



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

The top-level 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 IMPORTANT TO SAFETY – MANAGEMENT OF AGEING OF ELECTRICAL CABLING SYSTEMS**

## **1 Scope**

This International Standard provides strategies, technical requirements, and recommended practices for the management of normal ageing of cabling systems that are important to safety in nuclear power plants. The main requirements are presented in the body of this International Standard followed by a number of informative annexes with examples of cable testing techniques, procedures, and equipment that are available for the nuclear industry to use to ensure that ageing degradation will not impact plant safety.

This International Standard covers cables and their accessories (e.g., connectors) installed in nuclear power plants (inside and outside the containment). It provides requirements to perform cable testing for the purposes of predictive maintenance, troubleshooting, ageing management, and assurance of plant safety. It is concerned with Instrumentation and Control (I&C) cables, signal cables, and power cables of voltages less than 1 kV. More specifically, this International Standard focuses on in-situ testing techniques that have been established for determining problems in cable conductors (i.e., copper wire) and, to a lesser extent, on insulation material (i.e., polymer). It follows the IEC 62342 standard on “Management of Ageing” that was prepared to provide general guidelines for management of ageing of I&C components in nuclear power plants, including cables. It should be pointed out that cable testing technologies are evolving and new methods are becoming available that are not covered in this International Standard. More specifically, this International Standard covers typical cable testing methods that have been in use in the nuclear power industry over the last decade. It should also be pointed out that a single cable testing technique is unlikely to provide conclusive results, and a reliable diagnosis normally requires a combination of techniques.

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

IEC/TR 62096, *Nuclear power plants – Instrumentation and control important to safety – Guidance for the decision on modernization*

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

IEC 62385, *Nuclear power plants – Instrumentation and control important to safety – Methods for assessing the performance of safety system instrument channels*

IEC/TR 62392, *Suitability of typical electrical insulating material (EIM) for polymer recycling*

## **3 Terms and definitions**

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