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Responsible committee: NCE/8 Instrumentation, Control &amp; Electrical Systems of Nuclear Facilities

Interested committees:

Title: BS EN IEC 63423 Nuclear Power Plants - Instrumentation and control systems important to safety - Cable assemblies for Harsh Environment Purposes

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## Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

## UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

## Submission of Comments

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## Template for comments and secretariat observations

|                  |                        |
|------------------|------------------------|
| Date: xx/xx/20xx | Document: ISO/DIS xxxx |
|------------------|------------------------|

| 1  | 2                                          | (3)                          | 4               | 5                                                                                                                                  | (6)                                                                      | 7                                                  |
|----|--------------------------------------------|------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------|
| MB | Clause No./ Subclause No./Annex (e.g. 3.1) | Paragraph/Figure/ Table/Note | Type of comment | Commend (justification for change) by the MB                                                                                       | Proposed change by the MB                                                | Secretariat observations on each comment submitted |
|    | 3.1                                        | Definition 1                 | ed              | Definition is ambiguous and needs clarifying.                                                                                      | Amend to read '...so that the mains connector to which no connection...' |                                                    |
|    | 6.4                                        | Paragraph 2                  | te              | The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK. | Delete reference to UV photometer.                                       |                                                    |

PROJECT NUMBER:

**IEC 63423 ED1**

DATE OF CIRCULATION:

**2023-03-24**

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**2023-06-16**

SUPERSEDES DOCUMENTS:

**45A/1402/NP, 45A/1416/RVN**

IEC SC 45A : INSTRUMENTATION, CONTROL AND ELECTRICAL POWER SYSTEMS OF NUCLEAR FACILITIES

SECRETARIAT:

France

SECRETARY:

Mr Jean-Paul Bouard

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 20, TC 23, TC 46

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC☐ ENVIRONMENT☐ QUALITY ASSURANCE☒ SAFETY

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Recipients of this document are invited to submit, with their comments, notification of any local regulations or technical reasons that may exist and should be considered should this proposal proceed, recognizing that failure to address such requirements could result in the need for new or existing "In Some Countries" clauses. (See [AC/22/2007](#) OR [New Guidance.doc](#)).

TITLE:

**Nuclear Power Plants – Instrumentation and control systems important to safety – Cable assemblies for Harsh Environment Purposes**

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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**NUCLEAR POWER PLANTS –  
INSTRUMENTATION SYSTEMS IMPORTANT TO SAFETY –  
CABLE CONNECTOR ASSEMBLIES****FOREWORD**

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IEC 63423 has been prepared by subcommittee SC45A: Instrumentation, control and electrical power systems of nuclear facilities, of IEC technical committee TC45: Nuclear instrumentation. It is an International Standard.

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

| Draft      | Report on voting |
|------------|------------------|
| XX/XX/FDIS | XX/XX/RVD        |

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 International Standard 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](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at <http://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](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.

## INTRODUCTION

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

This International Standard focuses on cable assemblies pertaining to components important to safety that are required to function under conditions of design basis accidents and severe accidents.

Cable assemblies are to be understood as assembly consisting of connectors and cables that are assembled using techniques that ensure the function in case of design basis accidents and severe accidents. Since the opposite part of the connector presents the interface of a component, for instance a sensor, a junction box or an electrical penetration assembly, requirements for the cable connector assembly connector are generally valid for the interface of the connected component. This demand applies at least for counterpart of the connector of the assembly.

Cable assemblies used in systems important to safety in nuclear power plants need to comply with various standards in order to meet their functional safety requirements throughout their qualified life. This goal is accomplished by a thorough design, qualification, manufacturing (assembling), testing, installation and commissioning.

Therefore, this IEC standard focuses on the above-mentioned aspects to greater extent. Other aspects, relating to quality assurance, reliability and selection including validation and verification activities are not part of this standard.

This IEC standard takes into account:

- IEC/IEEE 60780-323 on qualification in general, and IEC/IEEE 60980-344 on seismic qualification.
- The testing approaches as stated in IEC standard series IEC 60216 and IEC 60544 series to respect the most relevant ageing stressors, temperature, and radiation.
- IEC standards that are specifically focused on cable and connectors.
- IEC standards on electromagnetic compatibility to respect the utilisation of digital electronic equipment in I&C systems. Proper screening and shielding are a mandatory prerequisite to achieve a satisfactory behaviour of the complete measurement chain.
- This standard does not address the design, associated calculations, and test conditions of the material aspects. These aspects are handled in product specific IEC standards.

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**b) Situation of the current Standard in structure of the IEC SC45A standard series**

IEC 63423 is a third level IEC SC 45A document which addresses the design, qualification, manufacturing, manufacturing testing, installation and commissioning of cable assemblies.

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 the Standard**

IEC/IEEE 60780-323 and IEC/IEEE 60980-344 are second level standards that give guidance for specific aspects of functional qualification of electrical equipment important to safety; in particular to environmental and seismic qualification. IEC 63423 is to be read in conjunction with these two documents.

To ensure that the standard will continue to be relevant in future years, the emphasis has been placed on issues of principle, rather than specific technologies. Therefore, it is the task of the manufacturer, architect engineer or operator to adapt this standard to the respective needs.

**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 power supply of 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 SC 45A standard series, corresponds to the Technical Reports which are not normative.

76 The IEC SC 45A standards series consistently implements and details the safety and  
77 security principles and basic aspects provided in the relevant IAEA safety standards and  
78 in the relevant documents of the IAEA nuclear security series (NSS). In particular this  
79 includes the IAEA requirements SSR-2/1, establishing safety requirements related to  
80 the design of nuclear power plants (NPPs), the IAEA safety guide SSG-30 dealing with  
81 the safety classification of structures, systems and components in NPPs, the IAEA safety  
82 guide SSG-39 dealing with the design of instrumentation and control systems for NPPs,  
83 the IAEA safety guide SSG-34 dealing with the design of electrical power systems for  
84 NPPs, the IAEA safety guide draft SSG-69 that focus on equipment qualification and the  
85 implementing guide NSS17 for computer security at nuclear facilities. The safety and  
86 security terminology and definitions used by SC 45A standards are consistent with  
87 those used by the IAEA.

## NUCLEAR POWER PLANTS – INSTRUMENTATION SYSTEMS IMPORTANT TO SAFETY – CABLE CONNECTOR ASSEMBLIES

### 1. SCOPE

This standard applies to cable connector assembly important to safety. It covers the engineering safety aspects to be met in the design, qualification, fabrication, assembly, testing, and installation on site of cable connector assemblies to be operated under normal and accident conditions.

From the view of the electrical function this standard covers cable connector assemblies that are used for:

- signal transmission (pulses, frequency) or
- supply a sensor/actuator or a device (e.g. amplifier) with electrical energy.

Cables used with cable connector assemblies contain either polymer or mineral dielectrics.

Components, which are not included in the scope are listed below:

- Instrumentation and control devices that are connected to the assembly, with the exception of the connector interface.
- Terminals using several connection designs (maxi-termi point, wire wrap, cage clamp etc.)
- Electrical Penetration Assemblies,
- Field splices for cables and
- Junction boxes that serve as housing for connectors.

### 2. NORMATIVE REFERENCES

The following documents are referred to in the text in such a way that some or all of their content constitute requirements of this document. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

- IEC/IEEE 60780-323; Nuclear facilities – Electrical equipment important to safety – Qualification.
- IEC 60156-1; Multicore and symmetrical pair/quad cables for digital communications -Part 1: Generic specification.
- IEC 61196-1; Coaxial communication cables – Part 1: Generic specification – General definition and requirements.
- IEC 61196-1-113; Electrical communication cables – Part 1-113: Electrical test methods – Test for attenuation constant.

- 122 IEC 61196-1-108; Coaxial communication cables - Part 1-108: Electrical test methods - Test for  
123 characteristic impedance, phase and group delay, electrical length and propagation velocity.
- 124 IEC 60664-1; Insulation coordination for equipment within low-voltage supply systems - Part 1:  
125 Principles, requirements and tests.
- 126 IEC 62855; Nuclear power plants - Electrical power systems - Electrical power systems analysis.
- 127 IEC 60529; Degrees of protection provided by enclosures (IP Code).
- 128 IEC 60028; Specifies values of the physical properties of annealed copper and how the conductiv-  
129 ity of commercial annealed copper can be calculated and expressed as a percentage of standard  
130 annealed copper.
- 131 IEC 60189-1; Low-frequency cables and wires with PVC insulation and PVC sheath - Part 1: General  
132 test and measuring methods.
- 133 IEC 60331-21; Tests for electric cables under fire conditions - Circuit integrity - Part 21: Proce-  
134 dures and requirements - Cables of rated voltage up to and including 0,6/1,0 kV.
- 135 IEC 60754-2; Test on gases evolved during combustion of materials from cables - Part 2: Determi-  
136 nation of acidity (by pH measurement) and conductivity.
- 137 IEC 61034-2; Measurement of smoke density of cables burning under defined conditions - Part 2:  
138 Test procedure and requirements.
- 139 IEC 60947-1; Low-voltage switchgear and control gear – Part 1: General rules.
- 140 IEC 60068-2-1; Environmental testing - Part 2-1: Tests - Test A: Cold.
- 141 IEC 60068-2-2; Environmental testing - Part 2-2: Tests - Test B: Dry heat.
- 142 IEC 60068-3-3; Environmental testing - Part 3-3: Supporting documentation and guidance - Seis-  
143 mic test methods for equipment.

144

### 145 3. ABBREVIATED TERMS, SYMBOLS, AND ACRONYMS

|      |                                         |
|------|-----------------------------------------|
| A    | Ampere (unit of the electrical current) |
| AC   | Alternating Current                     |
| DBE  | Design Basis Event                      |
| DC   | Direct Current                          |
| DEC  | Design Extension Conditions             |
| EMC  | Electromagnetic Compatibility           |
| EMI  | Electromagnetic Interference            |
| F    | Farad (unit of the capacitance)         |
| I&C  | Instrumentation and Control             |
| IAEA | International Atomic Energy Agency      |
| ISO  | International Standard Organisation     |
| k    | kilo                                    |
| n    | nano                                    |

|                |                                   |
|----------------|-----------------------------------|
| RIC            | Radiological Induced Conductivity |
| U <sub>R</sub> | Rated Voltage                     |
| V              | Volt (unit of electrical voltage) |

## 4. 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 <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

In addition, the IAEA Safety Glossary, “Terminology used in Nuclear Safety and Radiation Protection”, 2018 Edition applies.

### 4.1

#### Cable connector assembly

Assembly consisting of a cable of the multicore or coaxial type that is terminated using an appropriate connector.

### 4.2

#### Coaxial Cable connector assembly

Assembly of a coaxial cable consisting of inner conductor, the dielectric and the screen, and a coaxial connector consisting of inner conductor pin or socket, the dielectric, and the screen.

### 4.3

#### Multiconductor Cable connector assemblies

Assemblies of twisted pair cables and connectors. The connector contains minimum two connector pins or sockets and the cable consist of minimum one pair of wires.

Note 1 to entry: For purposes of electromagnetic compatibility cables may consist of pairs of wires to minimize the effects of magnetic fields. However, in some cases the cable may consist of single wires only – not twisted.

### 4.4

#### Harsh Environment

Environment that significantly changes as a result of a design basis event, e.g. loss-of-coolant accident (LOCA), high-energy line break (HELB), and main steam line break (MSLB).

[SOURCE: IEEE Standards Dictionary Online, IEC/IEEE 60780-323 terms and definitions]

### 4.5