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Interested committees:

Title: BS EN 61888 Nuclear power plants - Instrumentation important to safety - Determination and maintenance of trip setpoints

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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.

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Submission of Comments

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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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 61888 ED2

DATE OF CIRCULATION:

2024-07-19

CLOSING DATE FOR COMMENTS:

2024-10-11

SUPERSEDES DOCUMENTS:

45A/1499/RR

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

SECRETARIAT:

France

SECRETARY:

Mr Alexander WIGG

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 45, SC 45B

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

Safety

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Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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 important to safety - Determination and maintenance of trip setpoints

NOTE FROM TC/SC OFFICERS:

CD prepared and circulated to IEC NCs for comment in accordance with decision 45A/2023-32 from SC45A plenary meeting (see 45A1509A/RM).

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**NUCLEAR POWER PLANTS –
INSTRUMENTATION IMPORTANT TO SAFETY –
DETERMINATION AND MAINTENANCE OF TRIP SETPOINTS**

FOREWORD

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IEC 61888 has been prepared by subcommittee 45A: Instrumentation, control and electrical power systems of nuclear facilities, of IEC technical committee 45: Nuclear instrumentation. It is an International Standard.

This second edition cancels and replaces the first edition published in 2002. This edition constitutes a technical revision.

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

- IEC 61888 Edition 2 extends the existing conservative uncertainty estimation methodology with an alternative methodology. It enhances clarity and adaptability as follows:
 - Definition updates: The revised definitions are now aligned with the international metrology uncertainty guide, ISO/IEC 98-3 (JCGM 100) and the International Vocabulary of Metrology (VIM, JCGM 200), ensuring clear and consistent terminology, which facilitates global standardisation.

- Calibration traceability: Enhancements to the traceability protocols for calibration of Maintenance and Test Equipment (M&TE) are now in accordance with ISO/IEC 17025:2017 and ISO/IEC 98-3, which ensures improved measurement traceability and reliability across different regulatory environments. These traceability protocols require that calibration certificates include the coverage factor $k=2$, the level of confidence at 95%, and the correction value.
- A New Uncertainty Approach: Introducing an alternative methodology that supplements the traditional conservative approach. This methodology utilizes guidelines from ISO/IEC 98-3 and its Supplement 1 to manage uncertainties practically for non-normal distributions, thereby providing a balanced approach between safety and operational flexibility. This also addresses previous challenges related to conservatism and provides the users with the flexibility to tailor their uncertainty management to specific needs, scenarios, and national regulatory requirements.
- In Edition 2, the conservative method is retained while also introducing recommendations for the flexible application of an alternative setpoint methodology, thereby broadening its usability in accordance with evolving practices.

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. The main document types developed by IEC are described in greater detail at www.iec.ch/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 in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

a) Technical background, main issues and organisation of the standard

The purpose of this International Standard is to provide requirements and recommendations determining and maintaining calculations for instrument setpoints associated with IEC 61513. This standard addresses uncertainty in the channel from the process, including the primary element and sensor, to the final setpoint device. This standard applies to the determination of setpoints used for automatic protective actions. The input data for these uncertainties are primarily obtained from reliable sources. The recommendations may also be used to determine indicator uncertainties for testing or operator decisions.

In general, SSR2/1, SSR2/2 and member country government regulations require that, where an important setpoint is specified for a variable on which an analytical limit has been placed, the setting is so chosen that automatic protective action will correct the most severe abnormal situation anticipated before an analytical limit is exceeded. Guidelines for the determination and maintenance of setpoints in nuclear power plant design and operation are provided in IAEA SSG-37 and SSG-74

Protective instruments are provided with setpoints where specific actions are either initiated, terminated or prohibited. Setpoints need to be kept within prescribed limits as defined by the operating licenses through periodic checks of the ability of the channel to perform its function.

Paragraph 8.19 of SSG-74 requires traceability to certified equipment or reference standards with validated relationships to nationally recognized standards on the calibration of M&TE.

The National Metrology Institute ensures equivalence and traceability of international measurement standards under the International Metrology Commission Mutual Recognition Convention (CIPM MRA), mutually recognizes measurement results in international trade, and the calibration certification body applies International Laboratory Accreditation Cooperation (ILAC) calibration uncertainty policy.

National and international policy of measurement uncertainty established the general requirements for the application of uncertainty of measurement to conformity assessment activities in the electrotechnical sector as recommended by ISO/IEC 98-3.

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

The overall architecture of the IEC TC 45/SC 45A standards is given in Figure 1 and further detailed in IEC TR 63400. IEC 61888 is a level 3 document related to "Topic 11: Safety fundamentals" in Working Group 9A. It is a topic of uncertainty methodology for system level and performance for all the life-cycle stage of power plant modes.

c) Recommendations and limitations regarding the application of this Standard

The traditional and conservative trip setpoint methodology in nuclear power plants has historically, at least since the 1960s, relied on well-established uncertainty data for determination and maintenance.

However, as knowledge of uncertainty concepts has accumulated, countries that have become members of the International Bureau of Weights and Measures (BIPM) issued uncertainty evaluation guidelines after 1995, leading to the widespread adoption of ISO/IEC 98-3 (GUM1995). Additionally, in the realm of M&TE traceability, the expression of uncertainty in calibration certificates has been harmonized under the ISO/IEC 17025 standard, which is widely adopted by accredited calibration laboratories in most countries.

Furthermore, the distinction between uncertainty types A and B has been incorporated into the trip setpoint uncertainty methodology, providing a theoretical foundation for the level of confidence that encompasses not only normal distributions but also other distributions for the uncertainty input factors. This standard does not cover the statistical treatment of calibration or measurement uncertainty (type A uncertainty), but covers the type B uncertainty as defined in clause 3.

Edition 2 maintains the established conservative methodology while also facilitating the extension to an alternative setpoint methodology. This update enables adaptability and broadens the operational scope of the standard in response to evolving industry practices.

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 IEC SC 45A standard series comprises a consistent set of documents organised in a hierarchy of four levels. The top-level documents of the IEC SC 45A standard series are IEC 61513 and IEC 63046, covering respectively general requirements for instrumentation and control (I&C) systems and general requirements for electrical power systems of NPPs. IEC 61513 and IEC 63046 adopt an overall system life-cycle framework and constitute, along with the relevant second-level standards, the nuclear implementation of the basic safety series IEC 61508.

IEC 61513 and IEC 63046 refer directly to other IEC SC 45A standards for general requirements for specific topics, such as categorization of functions and classification of systems, qualification, separation, defence against common cause failure, control room design, electromagnetic compatibility, human factors engineering, cybersecurity, software and hardware aspects for programmable digital systems, coordination of safety and security requirements and management of ageing.

At a third level, IEC SC 45A standards not directly referenced by IEC 61513 or by IEC 63046 are standards related to specific requirements for specific equipment, technical methods, or activities. Usually, these documents refer to second-level documents for general requirements and 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.

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, the IAEA safety guide SSG-51 dealing with human factors engineering in the design of NPPs and the implementing guide NSS42-G for computer security at nuclear facilities. The safety and security terminology and definitions used by the SC 45A standards are consistent with those used by the IAEA.

IEC 61513 and IEC 63046 refer to ISO 9001 as well as to IAEA GSR 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, IEC 63351 is the entry document for the human factors engineering standards and IEC 62342 is the entry document for the ageing management standards.

NOTE 1 IEC TR 63400 provides a more comprehensive description of the overall structure of the IEC SC 45A standards series and of its relationship with other standards bodies and standards.

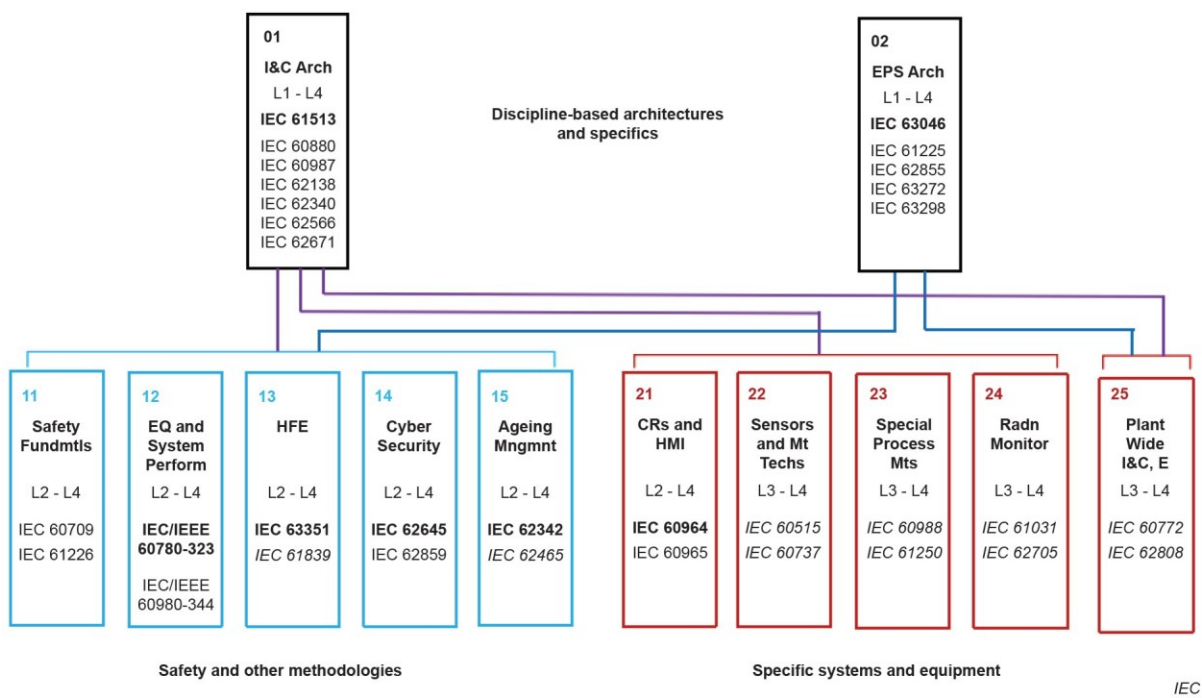


Figure 1 – Structure of the IEC TC 45/SC 45A standards

NUCLEAR POWER PLANTS – INSTRUMENTATION IMPORTANT TO SAFETY – DETERMINATION AND MAINTENANCE OF TRIP SETPOINTS

Scope

This standard establishes the requirements for ensuring that automatic setpoints for nuclear safety system instrumentation, as defined in Clause 3, are accurately established and maintained within specified limits at nuclear power plants and nuclear reactor facilities. It mandates the use of the established conservative methodology for evaluating instrument channel uncertainty to consistently achieve a prescribed probability with a high level of confidence.

This standard also introduces an alternative methodology as an option for situations where existing instrumentation is updated or when establishing new setpoints. This alternative methodology is based on ISO/IEC 98-3(GUM 1995) and expanded through the inclusion of Monte Carlo methods from its Supplement 1, offering a numerical verification approach for handling cases involving non-normal distribution uncertainty input data.

This standard does not cover the statistical treatment of calibration or measurement uncertainty (type A uncertainty), but covers the type B uncertainty as defined in clause 3.

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.

ISO/IEC 98-3, Uncertainty Measurement Part 3, Guide to the expression of uncertainty in measurement (GUM1995), JCGM 100:2008

ISO/IEC 98-3, Uncertainty Measurement Part 3, Supplement1, Guide to the expression of uncertainty in measurement (GUM1995) — Propagation of distributions using a Monte Carlo method, JCGM 101:2008

Definitions

For the purposes of this document, the following terms and definitions apply. IEC and VIM maintain terminological databases for use in standardization available at the following addresses:

IEC Electropedia: available at <http://www.electropedia.org/>

BIPM(VIM) metrology portal: available at <https://jcg.m.bipm.org/vim/en/>

Note1 to entry: Additional definitions related to instrumentation terminology in nuclear safety may be found in 'the IAEA Nuclear Safety and Security Glossary, 2022', 'IEC 60050-395, International Electrotechnical Vocabulary (IEV), 2014', and related to metrology terminology in 'JCGM 200: International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (VIM), Ed3, 2012'.

3.1

adjustment (of a measuring instrument)

set of operations carried out on a measuring instrument in order that it provides given indications corresponding to given values of the measurand

Note 1 to entry: Types of adjustment of a measuring system include zero adjustment of a measuring system, offset adjustment, and span adjustment (sometimes called gain adjustment).

Note 2 to entry: Adjustment of a measuring system should not be confused with calibration, which is a prerequisite for adjustment.

Note 3 to entry: After an adjustment of a measuring system, the measuring system must usually be recalibrated.

[SOURCE: IEV 311-03-16 and VIM3, 3.11]

3.2**allowable value**

a limit value that the trip setpoint may have when tested periodically, beyond which appropriate action shall be taken

3.3**analytical limit (of setpoint)**

limit of a measured or calculated variable established by the safety analysis to ensure that a safety limit is not exceeded.

Note 1 to entry: The margin between the analytical limit (of the setpoint) and the safety limit allows to take into account:

- the response time of the instrument channel,
- the range of transients due to the considered accident.

3.4**as found**

the condition in which a channel, or portion of a channel, is found after a period of operation and before recalibration (if necessary)

3.5**as left**

the condition in which a channel, or portion of a channel, is left after recalibration with an adjustment or final setpoint device setpoint verification

3.6**bias**

A measure of the systematic error between an actual or true value and a prediction by a model or a measured mean value. The bias of a model represents the tendency of a model to overpredict or to underpredict.

[SOURCE: IAEA Nuclear Safety and Security Glossary, 2022]

3.7**calibration**

A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards.

Note 1 to entry: The definition was previously "A measurement of, or adjustment to, an instrument, component or system to

Note 2 to entry: A calibration may be expressed by a statement, calibration function, calibration diagram or calibration curve

Note 3 to entry: Calibration should not be confused with adjustment of a measuring system, often mistakenly called 'self-calibration', or with verification of calibration.

[SOURCE: IAEA Nuclear Safety and Security Glossary, 2022]

3.8**confidence level**

confidence coefficient

$(1 - \alpha)$

the value $(1 - \alpha)$ of the probability associated with a confidence interval or a statistical coverage interval, the value α is the probability of critical level

EXAMPLE If critical level $\alpha = 5\%$, the confidence level $(1 - \alpha) = 95\%$

Note 1 to entry: $(1 - \alpha)$ is often expressed as a percentage.

[SOURCE: ISO/IEC 98-3, C.2.29]

3.9**correction**

compensation for an estimated systematic effect or value added algebraically to the uncorrected result of a measurement to compensate for systematic error

Note 1 to entry: See ISO/IEC Guide 98-3:2008, 3.2.3, for an explanation of 'systematic effect'