

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Nuclear facilities – Electrical equipment important to safety – Qualification

**Installations nucléaires – Equipements électriques importants pour la sûreté –
Qualification**



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NUCLEAR FACILITIES – ELECTRICAL EQUIPMENT IMPORTANT TO SAFETY – QUALIFICATION

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.

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International Standard IEC/IEEE 60780-323 has been prepared by subcommittee 45A: Instrumentation, control and electrical systems of nuclear facilities, of IEC technical committee 45: Nuclear instrumentation, in cooperation with the Nuclear Power Engineering Committee of the Power & Energy Society of the IEEE, under the IEC/IEEE Dual Logo Agreement between IEC and IEEE.

This publication is published as an IEC/IEEE Dual Logo standard.

NOTE A list of IEEE participants can be found at the following URL:
http://standards.ieee.org/downloads/60780/60780-323-2016/60780-323-2016_wg-participants.pdf

This new edition cancels and replaces the first edition of IEC 60780, published in 1998. It constitutes a technical revision. It also supersedes IEEE Std 323-2003.

The main technical changes with regard to IEC 60780:1998 are as follows:

- to harmonize in a unique standard qualification practices formerly given by IEC 60780:1998 and IEEE Std 323-2003 on initial qualification,
- to take into account the need to reassess and extend the qualified life of electrical equipment regarding projects to extend the operating life of nuclear facilities.

This revision incorporates current practices and lessons learned from the implementation of previous versions of this standard by the nuclear industry.

Several issues are clarified or changed in this revision:

- This standard defines the methods for equipment qualification when it is desired to qualify equipment for the applications in the environments to which it may be exposed. This standard is generally utilized for qualification of all electrical equipment important to safety in accordance with IAEA terminology. The documentation and test requirements are, however, more rigorous for equipment located in a harsh environment.
- The test margins have been updated to better identify the parameters that achieve test margin on design basis event profiles.
- An important concept in equipment qualification is the recognition that significant degradation could be caused by ageing mechanisms occurring from the environments during the service life, and therefore equipment important to safety should be brought to the end of qualified life (operating ageing) prior to imposing design basis event simulations. Previous versions recognised that the period of time for which acceptable performance was demonstrated is the qualified life. The qualified life does not include the time during or after the accident conditions for which qualification is demonstrated (mission time). The concept of qualified life continues in this revision. This revision also recognises that the condition of the equipment for which acceptable performance was demonstrated is the qualified condition. Thus, new license renewal and life extension options are available by ensuring that qualified equipment continues to remain in a qualified condition.

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

FDIS	Report on voting
45A/1058/FDIS	45A/1075/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.

International standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The IEC Technical Committee and IEEE Technical Committee have decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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) Technical background, main issues and organisation of the Standard

This standard is applicable to electrical equipment important to safety and its interfaces that are necessary to perform a safety function, or whose failure could adversely affect the safety functions of other equipment.

Electrical equipment in nuclear facilities shall meet its safety functional requirements throughout its installed life. This is accomplished by a thorough programme of quality assurance, design control, quality control, qualification, production, transportation, storage, installation, maintenance, periodic testing, and surveillance. This IEC/IEEE standard specifically focuses on qualification.

Other aspects, relating to quality assurance, reliability, selection and use of electronic devices, design and modification of digital systems including V&V activities are not part of this standard.

Industry research in the area of equipment qualification and decades of its application have greatly benefited this standard. Future activities of the working group to update this standard will consider the following:

- Experience and knowledge gained by using condition monitoring techniques,
- Knowledge gained on ageing mechanisms and kinetics,
- Significance of refinements in ageing mechanisms, equipment sealing, interfaces, extrapolation, similarity, test sequence and parameters (such as ramp rates, time duration, timing of spray initiation and its duration), and qualification documentation.

It is intended that the Standard be used by operators of NPPs (utilities), systems evaluators, equipment manufacturers, test facilities, qualification laboratories and by licensors.

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

IEC 61513 is a first level IEC SC 45A document and gives guidance applicable to I&C at system level.

These documents are supplemented by guidance on functional classification (IEC 61226), hardware design (IEC 60987), software (IEC 60880 and IEC 62138), selection and use of HDL programmed integrated circuit (IEC 62566) and requirements in order to reduce the possibility and limit the impact of common cause failure of category A functions (IEC 62340).

IEC/IEEE 60780-323 is a second level IEC SC 45A document which focuses on environmental qualification of electrical equipment important to safety.

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 dual logo standard applies to all electrical equipment important to safety in accordance with IAEA terminology including Class 1E equipment in accordance with the IEEE classification scheme and Classes 1, 2 and 3 in accordance with IEC 61226 classification scheme.

For equipment that needs to be qualified for design extension conditions, including severe accident conditions, this international standard shall be applied after a new DBE profile covering these conditions has been fully defined. Conservatism taken into account to define this severe accident profile should nevertheless be adapted.

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.

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 categorisation 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. Regarding nuclear safety, it provides the interpretation of the general requirements of IEC 61508-1, IEC 61508-2 and IEC 61508-4, for the nuclear application sector, regarding nuclear safety. 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 GS-R-3 and IAEA GS-G-3.1 and IAEA GS-G-3.5 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 SSR-2/1, establishing safety requirements related to the design of Nuclear Power Plants, and the Safety Guide SSG-39 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 FACILITIES – ELECTRICAL EQUIPMENT IMPORTANT TO SAFETY – QUALIFICATION

1 Scope and object

This International Standard describes the basic requirements for qualifying electrical equipment important to safety and interfaces (electrical and mechanical) that are to be used in nuclear facilities. The principles, methods, and procedures described are intended to be used for qualifying equipment, maintaining and extending qualification, and updating qualification, as required, if the equipment is modified. The qualification requirements in this standard, when met, demonstrate and document the ability of equipment to perform safety function(s) under applicable service conditions, including design basis events and certain design extension conditions, and reduce the risk of environmentally induced common-cause equipment failure.

This standard does not provide environmental stress levels or performance requirements.

Other aspects, relating to quality assurance, selection and use of electronic devices, design and modification of digital systems are not part of this standard.

Other IEC or IEEE standards that present qualification programmes for specific equipment, specific environments, or specific parts of the qualification programme may be used to supplement this standard, as applicable. The bibliography lists other standards related to equipment qualification.

2 Normative references

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

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

IEEE Std 344™-2013, *IEEE Standard for Seismic Qualification of Equipment for Nuclear Power Generating Stations*

3 Terms and definitions

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

3.1

age conditioning

process of subjecting equipment or a component to elevated stress conditions (environmental and operational) in order to render its physical and electrical properties similar to those it would have at a predetermined natural age when operating under expected operational conditions, corresponding at least to the qualified life

3.2

ageing

general process in which characteristics of a system or component gradually change with time or use