



IEEE

IEC/IEEE 62582-6

Edition 1.0 2019-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Nuclear power plants – Instrumentation and control important to safety –
Electrical equipment condition monitoring methods –
Part 6: Insulation resistance**

**Centrales nucléaires de puissance – Instrumentation et contrôle-commande
importants pour la sûreté – Méthodes de surveillance de l'état des matériels
électriques –
Partie 6: Résistance d'isolement**



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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 27.120.20

ISBN 978-2-8322-7050-9

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CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	8
2 Normative references	8
3 Terms and definitions	8
4 Abbreviated terms and acronyms.....	9
5 General description	10
6 Applicability and reproducibility	12
7 Instrumentation.....	12
7.1 Measurement voltage level	12
7.2 Uncertainty	12
7.3 Calibration	13
8 IR measurement procedure	13
8.1 General.....	13
8.2 Requirements on tracking of changes of IR during the simulated accident conditions	13
8.3 Test specimen	13
8.4 Interference	13
8.5 Conditioning.....	13
8.6 IR measurement during the dynamic phase of the simulated accident conditions	14
8.6.1 Set-up for the measurement	14
8.6.2 Connection of IR voltage and start of measurement.....	14
8.6.3 Default voltage	14
8.6.4 Determination of IR value with the specimen not energized during the accident simulation	14
8.6.5 Determination of the IR value with the specimen energized during the accident simulation	15
9 Measurement report	16
Annex A (informative) Example of equivalent diagram for a cable and the measuring device using DC.....	17
Annex B (informative) Measurement of leakage current using AC voltage	18
Annex C (informative) Dependence of IR on temperature only and combined with steam	19
Annex D (informative) Examples of results of measurement of IR on aged cables during simulated accident conditions.....	20
Annex E (informative) Example of a measurement loop and calculation of the time available for stabilization for more than one conductor or group of conductors measured with the same measurement instrument.....	23
E.1 Example of one measurement loop	23
E.2 Total time for each measurement of all combinations during the dynamic phase of the simulated accident conditions	23
Bibliography.....	24
Figure 1 – Time to stabilization of IR measured before LOCA, after 10 min in LOCA and after 60 min in LOCA.....	11

Figure A.1 – Set-up for measurement of IR using a DC voltage source (guard is not needed if the ground plane is close to the insulator)	17
Figure B.1 – Set-up for measurement of IR using an AC voltage source	18
Figure C.1 – Temperature influence on IR of an insulation between 20 °C and 150 °C.....	19
Figure D.1 – Example of result of measurement of IR between conductors and ground/shielding during a LOCA test.....	20
Figure D.2 – Example of measurement of IR between conductor and ground and between conductors	21
Figure D.3 – Example of measurement of IR on a three-conductor cable during LOCA simulation	22
Figure E.1 – Example of one measurement loop	23

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NUCLEAR POWER PLANTS – INSTRUMENTATION AND CONTROL IMPORTANT TO SAFETY – ELECTRICAL EQUIPMENT CONDITION MONITORING METHODS –

Part 6: Insulation resistance

FOREWORD

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International Standard IEC/IEEE 62582-6 has been prepared by subcommittee 45A: Instrumentation, control and electrical power 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 IEEE¹, under the IEC/IEEE Dual Logo Agreement.

It is published as an IEC/IEEE dual logo standard.

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

FDIS	Report on voting
45A/1267/FDIS	45A/1277/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.

A list of all parts in the IEC/IEEE 62582 series, published under the general title *Nuclear power plants – Instrumentation and control important to safety – Electrical equipment condition monitoring methods*, can be found on the IEC website.

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 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.

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¹ A list of IEEE participants can be found at the following URL: <https://iee-SA.imeetcentral.com/p/eAAAAAAQbmGAAAAAct2TZA>

INTRODUCTION

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

This IEC/IEEE standard specifically focuses on insulation resistance measurement methods for monitoring of the dielectric condition of instrumentation and control cables during simulation of design basis events.

This IEC/IEEE standard is the sixth part of the IEC/IEEE 62582-series. It contains detailed descriptions of condition monitoring based on insulation resistance measurements.

The IEC/IEEE 62582-series of standards is issued with a joint logo which makes it applicable to management of ageing of electrical equipment qualified to IEEE as well as IEC Standards.

For aged cables and accessories, the dielectric behaviour during simulated accident conditions generally indicates the condition of the cable during the simulated accident condition.

Significant research has been performed on condition monitoring techniques and the use of these techniques in equipment qualification as noted in NUREG/CR-6704, vol.2 (BNL-NUREG-52610) and JNES-SS-0903, 2009.

It is intended that this Standard be used by test laboratories, operators of nuclear power plants, systems evaluators and licensors.

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

IEC/IEEE 62582-6 is the third level IEC SC 45A document tackling the specific issue of application and performance of insulation resistance measurements during simulated accident conditions in nuclear power plants.

IEC/IEEE 62582-6 is to be read in association with IEC/IEEE 62582-1. IEC/IEEE 62582-1 provides requirements for application of methods for condition monitoring of electrical equipment important to safety of nuclear power plants.

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

It is important to note that this Standard establishes no additional functional requirements for safety systems.

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 supply systems of the 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 45 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-31 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 and the implementing guide NSS17 for computer security at nuclear facilities. The safety and security terminology and definitions used by SC 45A standards are consistent with those used by the IAEA.

IEC 61513 and IEC 63046 have adopted a presentation format similar to the basic safety publication IEC 61508 with an overall life-cycle framework and a system life-cycle framework. Regarding nuclear safety, IEC 61513 and IEC 63046 provide the interpretation of the general requirements of IEC 61508-1, IEC 61508-2 and IEC 61508-4, for the nuclear application sector. In this framework IEC 60880, IEC 62138 and IEC 62566 correspond to IEC 61508-3 for the nuclear application sector. IEC 61513 and IEC 63046 refer to ISO as well as to IAEA GS-R part 2 and IAEA GS-G-3.1 and IAEA GS-C-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 and IEC 60912 is the entry document for the ageing management standards.

NOTE 1 It is assumed that for the design of I&C systems in NPPs that implement conventional safety functions (e.g. to address worker safety, asset protection, chemical hazards, process energy hazards) international or national standards would be applied.

NOTE 2 IEC/SC 45A domain was extended in 2013 to cover electrical systems. In 2014 and 2015 discussions were held in IEC/SC 45A to decide how and where general requirements for the design of electrical systems were to be considered. IEC/SC 45A experts recommended that an independent standard be developed at the same level as IEC 61513 to establish general requirements for electrical systems. Project IEC 63046 is now launched to cover this objective. When IEC 63046 is published, this NOTE 2 of the introduction of IEC/SC 45A standards will be superseded.

NUCLEAR POWER PLANTS – INSTRUMENTATION AND CONTROL IMPORTANT TO SAFETY – ELECTRICAL EQUIPMENT CONDITION MONITORING METHODS –

Part 6: Insulation resistance

1 Scope

This part of IEC/IEEE 62582 contains methods for condition monitoring of organic and polymeric materials in instrumentation and control cables using insulation resistance measurements in the detail necessary to produce accurate and reproducible results during simulated accident conditions. It includes the requirements for the measurement system and measurement procedure, and the reporting of the measurement results.

NOTE Measurement of insulation resistance during simulated accident conditions with the aim of determining the lowest value during the accident in order to assess cable performance involves special requirements given in this document. Methods for measurement under stable (non-accident) conditions are available in other international standards, e.g. IEC 62631-3-3.

The different parts of the IEC/IEEE 62582 series are measurement standards, primarily for use in the management of ageing in initial qualification and after installation. IEC/IEEE 62582-1 includes requirements for the application of the other parts of the IEC/IEEE 62582 series and some elements which are common to all methods. Information on the role of condition monitoring in qualification of equipment important to safety is found in IEC/IEEE 60780-323.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

JCGM 100:2008, *Evaluation of measurement data – Guide to the expression of uncertainty in measurement. First edition 2008. Corrected version 2010*

3 Terms and definitions

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

For definitions not specifically called out in this standard, the following references could be useful:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEEE Standards Online Dictionary: available at <http://dictionary.ieee.org>

3.1

capacitive charging current

current that charges the capacitor formed by the tested insulation between the conducting parts connected to the measuring instrument inputs

Note 1 to entry: At the beginning the capacitor is not charged and high current is flowing. The current drops as the capacitor is being charged.