IEC TR 63214

Edition 1.0 2019-10

TECHNICAL REPORT

This document is a preview generated by EVS

Nuclear power plants – Control rooms – Human factors engineering



IEC TR 63214:2019-10(en)

THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2019 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

This document is a preview generated by EVS

IEC TR 63214

Edition 1.0 2019-10

TECHNICAL REPORT

This document is a preview generated by EVS

Nuclear power plants – Control rooms – Human factors engineering

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 27.120.20

ISBN 978-2-8322-7528-3

Warning! Make sure that you obtained this publication from an authorized distributor.

® Registered trademark of the International Electrotechnical Commission

CONTENTS

FOREWORD 3
INTRODUCTION 5
1 Scope 7
2 Normative references 7
3 Terms and definitions 8
4 Abbreviated terms 9
5 Identified open points in IEC 60964 concerning HFE 10
5.1 General 10
5.2 Limitation of scope 10
5.3 Supplementary information 10
5.4 Missing information 11
5.5 Outdated information 11
5.6 Industry needs 12
6 Directions for the new human factors IEC standards 12
6.1 General 12
6.2 Proposed "Table of contents" for a new Human Factors Engineering standard 13
6.3 Graphic to guide the design 14
7 Impact on other IEC standards 15
7.1 General 15
7.2 IEC 60964:2009 Control Room Design 15
7.3 IEC 60965 Supplementary Control Room 16
7.4 Series of Control Room Design IEC standards 16
7.5 Other IEC standards referencing IEC 60964 16
8 Ongoing discussions concerning the HFE standard 16
8.1 General 16
8.2 Topics to be discussed during the standard development 16
8.3 References to be considered during the standard development 16
9 Conclusion 17
Bibliography 18

Figure 1 – Human Factors Engineering Process (to be discussed) 15
Figure 2 – New WG 8 document structure (to be discussed) 15

This document is a preview generated by EVS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

NUCLEAR POWER PLANTS – CONTROL ROOMS – HUMAN FACTORS ENGINEERING

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. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 63214, which is a technical report, has been prepared by subcommittee 45A: Instrumentation, control and electrical power systems of nuclear facilities, of IEC technical committee 45: Nuclear instrumentation.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
45A/1226/DTR	45A/1247A/RVDTR

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This document is a preview generated by EVS

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A bilingual version of this publication may be issued at a later date.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "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.

This document is a preview generated by EVS

INTRODUCTION

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

IEC 60964: *Nuclear power plants – Control rooms – Design* includes a detailed set of requirements to be applied when designing a control room and a process to implement Human Factors Engineering. The two topics are mixed and the Human Factors part is incomplete and does not reflect state-of-the-art knowledge and wording. In addition, the standard was written considering only Human Factors within the scope of electrical systems in control room design. The result is that the document does not take a holistic approach towards the design of the plant-wide control rooms and HMI, including e.g. the local control stations located throughout the plant.

The third edition of IEC 60964:2018 considers mainly the wording and the description of task analyses. The authors and the IEC Committee 45A Working Group 8 identified that changing only this aspect is already leading to a set of additional questions (e.g., concerning details of Functional Assignment and HFE V&V) triggered by outdated or incomplete information. Based on this, the Working Group realized that a minor change of the document does not solve all topics in the standard. Instead, it was proposed to publish a technical report to argue and propose a dedicated Human Factors Engineering standard, while limiting IEC 60964 to a pure control room design standard.

In addition, the IAEA is in the process of publishing a Human Factors Guide (DS492) that should also be reflected in IEC standardisation.

This document was developed to define the content of a future IEC HFE standard as a conclusion of the 2017 Shanghai IEC SC45A meeting with participants from Japan, China, Russia, Spain, France, Switzerland, and Germany.

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

The technical report IEC TR 63214 is a fourth level IEC SC 45A document.

This report is not proving the final standard for discussion; it is recommending an international development of the standard, proving the needs and providing a first set of ideas. Outstanding work has still to be conducted.

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 Technical Report

It is important to note that a technical report is entirely informative in nature. It gathers data collected from different origins and it establishes no requirements.

d) Description of the structure of the IEC SC45A standard series and relationships with other IEC documents and other bodies documents (IAEA, ISO)

The top-level documents of the IEC SC45A 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 SC45A standard series and shape a complete framework establishing general requirements for instrumentation, control and electrical systems for nuclear power plants.

This document is a preview generated by EVS

IEC 61513 and IEC 63046 refer directly to other IEC SC45A 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 SC45A 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 SC45 standard series, corresponds to the Technical Reports which are not normative.

The IEC SC45A 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 and the implementing guide NSS17 for computer security at nuclear facilities. The safety and security terminology and definitions used by SC45A 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-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/SC45A 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/SC45A control rooms standards and IEC 62342 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/SC45A domain was extended in 2013 to cover electrical systems. In 2014 and 2015 discussions were held in IEC/SC45A to decide how and where general requirements for the design of electrical systems were to be considered. IEC/SC45A 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/SC45A standards will be suppressed.

This document is a preview generated by EVS

NUCLEAR POWER PLANTS – CONTROL ROOMS – HUMAN FACTORS ENGINEERING

This document is a preview generated by EVS

1 Scope

This document provides a summary of arguments and a technical basis for the development of a new Human Factors Engineering IEC standard and the alignment of IEC 60964. Based on the provided argumentation, the participating members will vote for such an approach. The proposed content of the new standard provides the basis for fruitful discussion within IEC SC 45A WG 8 and raises interest in the development of the new standard.

The scope of the new HFE IEC standard will follow a holistic approach towards the design of the plant-wide control rooms and all HMI, including e.g. the local control stations located throughout the plant. The general principle is to consider the complete nuclear installation design as a sociotechnical system, in a holistic and integrated way.

This document is organized as follows:

- Clause 5 addresses the open points that serve as a basis for the discussion about a new Human Factors standard within IEC.
- Clause 6 proposes a basic structure for the new standard to clearly identify the scope of this development.
- Clause 7 addresses the changes needed to existing IEC standards to be aligned with a new Human Factors standard.

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.

IEC 60964:2009, *Nuclear power plants- Control rooms - Design*

IEC 60965, *Nuclear power plants – Control rooms – Supplementary control room for reactor shutdown without access to the main control room*

IEC 61771, *Nuclear power plants – Main control room – Verification and validation of design*

IEC 61839, *Nuclear power plants – Design of control rooms – Functional analysis and assignments*

ISO 11064 (all parts), *Ergonomic design of control centres*

IAEA Guide DS492 *Human Factors Engineering in the Design of Nuclear Power Plants; Status:* DRAFT