

Recognized as an American National Standard (ANSI)

IEEE Std 845-1988

IEEE Guide to Evaluation of Man-Machine Performance in Nuclear Power Generating Station Control Rooms and Other Peripheries

Sponsor

**Nuclear Power Engineering Committee
of the
IEEE Power Engineering Society**

Approved March 10, 1988

IEEE Standards Board

Approved December 1, 1988

American National Standards Institute

© Copyright 1988 by

The Institute of Electrical Electronics Engineers, Inc

345 East 47th Street, New York, NY 10017, USA

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

IEEE Standards documents are developed within the Technical Committees of the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Board. Members of the committees serve voluntarily and without compensation. They are not necessarily members of the Institute. The standards developed within IEEE represent a consensus of the broad expertise on the subject within the Institute as well as those activities outside of IEEE which have expressed an interest in participating in the development of the standard.

Use of an IEEE Standard is wholly voluntary. The existence of an IEEE Standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE Standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard. Every IEEE Standard is subjected to review at least every five years for revision or reaffirmation. When a document is more than five years old, and has not been reaffirmed, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE Standard.

Comments for revision of IEEE Standards are welcome from any interested party, regardless of membership affiliation with IEEE. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments.

Interpretations: Occasionally questions may arise regarding the meaning of portions of standards as they relate to specific applications. When the need for interpretations is brought to the attention of IEEE, the Institute will initiate action to prepare appropriate responses. Since IEEE Standards represent a consensus of all concerned interests, it is important to ensure that any interpretation has also received the concurrence of a balance of interests. For this reason IEEE and the members of its technical committees are not able to provide an instant response to interpretation requests except in those cases where the matter has previously received formal consideration.

Comments on standards and requests for interpretations should be addressed to:

Secretary, IEEE Standards Board
345 East 47th Street
New York, NY 10017
USA

IEEE Standards documents are adopted by the Institute of Electrical and Electronics Engineers without regard to whether their adoption may involve patents on articles, materials, or processes. Such adoption does not assume any liability to any patent owner, nor does it assume any obligation whatever to parties adopting the standards documents.

Foreword

(This Foreword is not a part of IEEE Std 845-1988, IEEE Guide to Evaluation of Man-Machine Performance in Nuclear Power Generating Station Control Rooms and Other Peripheries.)

Human Factors Engineering has been a part of Nuclear Power Plant design and construction from the beginning, although not under that name. (For example, see H. L. Parris, “A Review of Human Factors R&D in the Nuclear Power Industry” and Leonard C. Pugh, St., “In the Rear-View Mirror: Human Factors in Nuclear Power,” both in American Nuclear Society Transactions, 1986 Annual Meeting, Volume 52, TANSO 52 1-658, 1986). The incident at Three Mile Island, however, brought increased prominence to the Human Factors field in the nuclear power industry. The U.S. Nuclear Regulatory Commission began to consider guidance and regulation concerning the Human Factors aspects of nuclear power plant design, construction, and operation at that time. Part of the industry response to this increasing emphasis on Human Factors was proposals to create Human Factors guidelines as part of the industry standards efforts of the IEEE Nuclear Power Engineering Committee. The Guideline that follows this foreword is one of those efforts, initiated in 1980. These efforts were the subject of an IEEE sponsored meeting held in Monterey, California in June 1985, as documented in “1985 IEEE Third Conference on Human Factors and Power Plant,” report #85CH2235-0.

This IEEE guide is intended to supply basic information as to the available human factors techniques and their applicability to the various human-related issues confronting the commercial nuclear industry today. It provides a brief review of selected, commonly used techniques and guidance as to their use and where further related information can be obtained. The user of this guide will need to interview system designers, operational, and maintenance personnel. In addition, the user will also need to gather historical data about intent, experience, or assumptions regarding the plant’s goals, operations, or conditions and responses to transients.

This guide supplies supplemental information to the discussion found in ANSI/IEEE Std 352-1987, IEEE Guide for General Principles of Reliability Analysis of Nuclear Generating Station Protection Systems, 1985, and ANSI/IEEE Std 567, IEEE Trial Use Standard Criteria for the Design of the Control Room Complex for a Nuclear Power Generating Station, 1980.

IEEE/PES/NPEC Working Group 7.2, does not consider this guide to be the end of the issue. More detailed guidance is needed in specific areas. Therefore, work is proceeding on the development of (P1082), IEEE Guide for General Principles of the Systematic Human Action Reliability Procedure (SHARP) for the analysis of nuclear power generating stations. Consideration is also being given to application of the evaluation process to the issues of life extension and testing and maintenance practices. Additionally, Subcommittee 7 is developing a top-level document “(P1023), IEEE Guide for the Application of Human Factors to Systems, Equipment, and Facilities of Nuclear Power Generating Stations” to integrate all the human factors. This document supplies a means to select applicable control room and periphery evaluation techniques that should be used when supplying human factors to systems, equipment, and facilities of Nuclear Power Generating Stations.

At the time this guide was approved, the Nuclear Power Engineering Committee of the IEEE Power Engineering Society had the following membership:

J. T. Bauer, *Chair*
N.S. Porter, *Vice Chair*
J. E. Thomas, *Secretary*

R. E. Allen	B. Grim	W. K. Peterson
F. D. Baxter	A. R. Hall	C. A. Petrizzo
W. W. Bowers	R. E. Hall	W. S. Raughley
G. G. Boyle	L. F. Hanes	E. W. Rhoads
D. F. Brosnan	G. K. Henry	B. M. Rice
M. D. Calcamuggio	S. Kasturi	A. R. Roby
S. P. Carfagno	J. T. Keiper	W. G. Schartz
R. C. Carruth	T. S. Killen	A. J. Spurgin
E. F. Dowling	A. Laird	L. Stanley
R. E. Dulski	D. C. Lamken	D. F. Sullivan
J. M. Gallagher	J. D. Lamont	P. Szabados
W. C. Gangloff	A. Marion	L. D. Test
L. W. Gaussa	B. Nemroff	T. R. Vardaro
L. C. Gonzalez	M. Pai	F. J. Volpe
L. P. Gradin	J. R. Penland	

During the development of this guide, the members of the Working Group 7.2 were:

R. E. Hall, *Chair*
D. Schurman*, *Secretary*
M. Maddox, *Chairman of the Writing Task Effort*
J. Wreathall, *Chairman of the Writing Task Effort*

*At the time this guide was approved, D. Schurman was chairman of the Working Group 7.2.

The following list represents the membership of SC 7.2 that attended the meetings and contributed to the effort.

B. Bell*+	W. Livingston	T. Ryan+
K. Comer*	W. Luckas	D. Schurman*+
M. Crews	M. Maddox*+	A. Spurgin
E. Dougherty	J. Martin*	A. Stave+
J. Fragola*+	N. Moray*	J. Voyles*
R. Hall*+	J. Mott*	D. Woods*
L. Hanes	E. O'Hare	J. Wreathall*+

*Members of the writing committee.

+Members of the editing and organization committee.

The following persons were on the balloting committee that approved. this document for submission to the IEEE Standards Board:

R. E. Allen	B. Grim	N. S. Porter
J. T. Bauer	T. L. Gruber	W. S. Rautio
F. D. Baxter	R. E. Hall	W. S. Raughly
G. G. Boyle	L. F. Hanes	B. M. Rice
D. F. Brosnan	G.K. Henry	A. R. Roby
S. P. Carfagno	S. Kasturi	W. G. Schwartz
R. C. Carruth	J. T. Keiper	E. F. Sproat
E. F. Dowling	T. S. Killen	A. J. Spurgin
R. E. Dulski	A. Laird	L. Stanley
E. P. Fogarty	D. C. Lamken	D. F. Sullivan
J. M. Gallagher	B. Nemroff	P. Szabados
W. C. Gangloff	M. Pai	L. D. Test
L. W. Gaussa	J. R. Penland	J. E. Thomas
L. C. Gonzalez	W. K. Peterson	T.R. Vardaro
L. P. Gradin	C. A. Petrizzo	F. J. Volpe

When the IEEE Standards Board approved this standard on March 10, 1988, it had the following membership:

Donald C. Fleckenstein, *Chair*
Marco Migliaro, *Vice Chair*
Andrew G. Salem, *Secretary*

Arthur A. Blaisdell	Jack M. Kinn	L. Bruce McClung
Fletcher J. Buckley	Frank D. Kirschner	Richard E. Mosher
James M. Daly	Frank C. Kitzantides	L. John Rankine
Stephen R. Dillon	Joseph L. Koepfinger*	Gary S. Robinson
Eugene P. Fogarty	Irving Kolodny	Frank L. Rose
Thomas L. Hannan	Edward Lohse	Helen M. Wood
Kenneth D. Hendrix	John E. May, Jr	Karl H. Zaininger
Theodore W. Hissey, Jr	Lawrence V. McCall	Donald W. Zipse

*Member Emeritus

CLAUSE	PAGE
1. Scope	1
2. Purpose	1
3. Definitions	1
4. Introduction	2
5. Evaluating Man-Machine Performance	2
5.1 Evaluation Perspective	2
5.2 Issues for Evaluation	3
5.3 Systematic Framework	3
5.4 Selection Criteria	5
6. Evaluation Techniques	6
6.1 Paper and Pencil Review	7
6.2 Observational	8
6.3 Expert Opinion	9
6.4 Experimental Techniques	11
7. Selection Process	11
Annex A (Informative) Example of Selection Criteria for Human Factors Evaluation Techniques	12
Annex B (Informative) Bibliography	13

IEEE Guide to Evaluation of Man-Machine Performance in Nuclear Power Generating Station Control Rooms and Other Peripheries

1. Scope

This guide provides a basis for the systematic evaluation of man-machine performance in nuclear power-generating station control rooms and other peripheries, as such performance relates to nuclear plant safety.

2. Purpose

The purpose of this document is to provide guidance for the selection and application of human factors techniques to carry out the following tasks:

- 1) Evaluation of a given man-machine design in control rooms and other control areas to ascertain the degree of design adequacy
- 2) Determination, as needed, of changes to increase acceptability of a man-machine design
- 3) Determination of the relative adequacy of alternative designs.

3. Definitions

The terms defined below are used in this document to assist the reader in making judgments concerning the type of evaluation that should be conducted and in selecting appropriate tools for conducting that evaluation:

man-machine interface (MMI): The devices through which personnel receive information from the system or process and the devices through which personnel exercise their control of the system or process.

other peripheries: Other control room areas, such as remote emergency shutdown panels or remote emergency control rooms.