

Human factors in design for nuclear power plants



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Revision History

N290.12-14, Human factors in design for nuclear power plants

Revision Issued: Errata — Febraury 2015	Revision symbol (in margin)
Technical Committee	Δ

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Standards Update Service

N290.12-14

December 2014

Title: *Human factors in design for nuclear power plants*

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N290.12-14
***Human factors in design for nuclear
power plants***



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*Published in December 2014 by CSA Group
A not-for-profit private sector organization
178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3*

*To purchase standards and related publications, visit our Online Store at store.csagroup.org
or call toll-free 1-800-463-6727 or 416-747-4044.*

ISBN 978-1-77139-458-1

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Preface

This is the first edition of CSA N290.12, *Human factors in design for nuclear power plants*.

The CSA N-Series of Standards provide an interlinked set of requirements for the management of nuclear facilities and activities. The CSA N286 Standard provides overall direction to management to develop and implement sound management practices and controls, while the other CSA nuclear Standards provide technical requirements and guidance that support the management system. This Standard works in harmony with CSA N286 and does not duplicate the generic requirements of CSA N286; however, it may provide more specific direction for those requirements.

This Standard reflects the operating experience of the Canadian nuclear power industry.

Users of this Standard are reminded that the design, manufacture, construction, commissioning, operation, and decommissioning of nuclear facilities in Canada are subject to the provisions of the *Nuclear Safety and Control Act* and its supporting *Regulations*.

This Standard was prepared by the Subcommittee on Human Factors in Design for Nuclear Power Plants, under the jurisdiction of the Technical Committee on Reactor Control Systems, Safety Systems, and Instrumentation of Nuclear Power Plants and the Strategic Steering Committee on Nuclear Standards, and has been formally approved by the Technical Committee.

Notes:

- 1) Use of the singular does not exclude the plural (and vice versa) when the sense allows.
- 2) Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.
- 3) This Standard was developed by consensus, which is defined by CSA Policy governing standardization — Code of good practice for standardization as “substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity”. It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this Standard.
- 4) To submit a request for interpretation of this Standard, please send the following information to inquiries@csagroup.org and include “Request for interpretation” in the subject line:
 - a) define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;
 - b) provide an explanation of circumstances surrounding the actual field condition; and
 - c) where possible, phrase the request in such a way that a specific “yes” or “no” answer will address the issue.

Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization and are available on the Current Standards Activities page at standardsactivities.csa.ca.

- 5) This Standard is subject to review five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include “Proposal for change” in the subject line:
 - a) Standard designation (number);
 - b) relevant clause, table, and/or figure number;
 - c) wording of the proposed change; and
 - d) rationale for the change.

N290.12-14

Human factors in design for nuclear power plants

0 Introduction

0.1

Human factors (HF) in design applies to nuclear safety, protection of the environment, health and safety of persons, security, productivity, and economics.

0.2

The goal of HF in design is to apply theory, principles, data, and other methods to the design of structures, systems, and components (SSCs) to optimize human and system performance.

0.3

HF in design is an integrated, systematic approach that considers the human as an integral part of the overall system.

0.4

HF in design applies to the entire system design, including human-systems interfaces (HSIs).

Note: *Examples include the design of plant layouts, control rooms, panels, annunciation, communication systems, displays, and field equipment.*

0.5

HF in design extends beyond nuclear systems of nuclear power plants (NPPs).

Note: *Examples include balance of plant, fuel handling, engineered tooling, waste management systems, offsite emergency centre, and emergency equipment.*

0.6

HF in design can influence procedures, training, safety analysis, and staffing considerations.

1 Scope

1.1

This Standard covers HF in design for existing and new NPPs.

Notes

- 1) *This Standard applies to new designs or modifications, large and small, temporary and permanent, to internally and externally engineered solutions, and to commercial off-the-shelf (COTS) products.*
- 2) *This Standard may provide guidance for nuclear facilities other than NPPs, using a graded approach.*

1.2

This Standard covers HF in design activities related to construction, commissioning, operation, maintenance, inspection, testing, and decommissioning.

1.3

This Standard applies to HF in design for the following plant states:

- a) normal operation;
- b) anticipated operational occurrences (AOOs);
- c) design basis accidents (DBAs); and
- d) design extension conditions (DECs) as a subset of beyond design basis accidents (BDBAs).

1.4

In this Standard, “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; “should” is used to express a recommendation, or that which is advised but not required; and “may” is used to express an option or that which is permissible within the limits of the Standard.

Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material.

Notes to tables and figures are considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

2 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below, including all amendments published thereto.

CSA Group

N286-12

Management system requirements for nuclear facilities

CNSC (Canadian Nuclear Safety Commission)

REGDOC-2.4.1:2014

Deterministic Safety Analysis

REGDOC-2.5.2:2014

Design of Reactor Facilities: Nuclear Power Plants

G-276:2003

Human Factors Engineering Program Plans

U.S. NRC (United States Nuclear Regulatory Commission)

NUREG-0711 (2012)

Human Factors Engineering Program Review Model