



Fire protection for facilities that process, handle, or store nuclear substances



Legal Notice for Standards

Canadian Standards Association (operating as “CSA Group”) develops standards through a consensus standards development process approved by the Standards Council of Canada. This process brings together volunteers representing varied viewpoints and interests to achieve consensus and develop a standard. Although CSA Group administers the process and establishes rules to promote fairness in achieving consensus, it does not independently test, evaluate, or verify the content of standards.

Disclaimer and exclusion of liability

This document is provided without any representations, warranties, or conditions of any kind, express or implied, including, without limitation, implied warranties or conditions concerning this document’s fitness for a particular purpose or use, its merchantability, or its non-infringement of any third party’s intellectual property rights. CSA Group does not warrant the accuracy, completeness, or currency of any of the information published in this document. CSA Group makes no representations or warranties regarding this document’s compliance with any applicable statute, rule, or regulation.

IN NO EVENT SHALL CSA GROUP, ITS VOLUNTEERS, MEMBERS, SUBSIDIARIES, OR AFFILIATED COMPANIES, OR THEIR EMPLOYEES, DIRECTORS, OR OFFICERS, BE LIABLE FOR ANY DIRECT, INDIRECT, OR INCIDENTAL DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES, HOWSOEVER CAUSED, INCLUDING BUT NOT LIMITED TO SPECIAL OR CONSEQUENTIAL DAMAGES, LOST REVENUE, BUSINESS INTERRUPTION, LOST OR DAMAGED DATA, OR ANY OTHER COMMERCIAL OR ECONOMIC LOSS, WHETHER BASED IN CONTRACT, TORT (INCLUDING NEGLIGENCE), OR ANY OTHER THEORY OF LIABILITY, ARISING OUT OF OR RESULTING FROM ACCESS TO OR POSSESSION OR USE OF THIS DOCUMENT, EVEN IF CSA GROUP HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES.

In publishing and making this document available, CSA Group is not undertaking to render professional or other services for or on behalf of any person or entity or to perform any duty owed by any person or entity to another person or entity. The information in this document is directed to those who have the appropriate degree of experience to use and apply its contents, and CSA Group accepts no responsibility whatsoever arising in any way from any and all use of or reliance on the information contained in this document.

CSA Group is a private not-for-profit company that publishes voluntary standards and related documents. CSA Group has no power, nor does it undertake, to enforce compliance with the contents of the standards or other documents it publishes.

Intellectual property rights and ownership

As between CSA Group and the users of this document (whether it be in printed or electronic form), CSA Group is the owner, or the authorized licensee, of all works contained herein that are protected by copyright, all trade-marks (except as otherwise noted to the contrary), and all inventions and trade secrets that may be contained in this document, whether or not such inventions and trade secrets are protected by patents and applications for patents. Without limitation, the unauthorized use, modification, copying, or disclosure of this document may violate laws that protect CSA Group’s and/or others’ intellectual property and may give rise to a right in CSA Group and/or others to seek legal redress for such use, modification, copying, or disclosure. To the extent permitted by treaty or by law, CSA Group reserves all intellectual property rights in this document.

Patent rights

Attention is drawn to the possibility that some of the elements of this standard may be the subject of patent rights. CSA Group shall not be held responsible for identifying any or all such patent rights. Users of this standard are expressly advised that determination of the validity of any such patent rights is entirely their own responsibility.

Authorized use of this document

This document is being provided by CSA Group for informational and non-commercial use only. The user of this document is authorized to do only the following:

If this document is in electronic form:

- load this document onto a computer for the sole purpose of reviewing it;
- search and browse this document; and
- print this document if it is in PDF form.

Limited copies of this document in print or paper form may be distributed only to persons who are authorized by CSA Group to have such copies, and only if this Legal Notice appears on each such copy.

In addition, users may not and may not permit others to

- alter this document in any way, or remove this Legal Notice from the attached standard;
- sell this document without authorization from CSA Group; or
- make an electronic copy of this document.

If you do not agree with any of the terms and conditions contained in this Legal Notice, you may not load or use this document or make any copies of the contents hereof, and if you do make such copies, you are required to destroy them immediately. Use of this document constitutes your acceptance of the terms and conditions of this Legal Notice.



Standards Update Service

CSA N393:22

September 2022

Title: *Fire protection for facilities that process, handle, or store nuclear substances*

To register for e-mail notification about any updates to this publication

- go to www.csagroup.org/store/
- click on **Product Updates**

The **List ID** that you will need to register for updates to this publication is **24299.0**

If you require assistance, please e-mail techsupport@csagroup.org or call 416-747-2233.

Visit CSA Group's policy on privacy at www.csagroup.org/legal to find out how we protect your personal information.

CSA N393:22
***Fire protection for facilities that
process, handle, or
store nuclear substances***



®A trademark of the Canadian Standards Association, operating as "CSA Group"

*Published in September 2022 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 www.csagroup.org/store/
or call toll-free 1-800-463-6727 or 416-747-4044.*

*ICS 27.120.20
ISBN 978-1-4883-4225-7*

*© 2022 Canadian Standards Association
All rights reserved. No part of this publication may be reproduced in any form whatsoever
without the prior permission of the publisher.*

Contents

Technical Committee on Fire Protection for Facilities that Process, Handle, or Store Nuclear Material 6

Preface 9

1 Scope 11

2 Reference publications 11

3 Definitions and abbreviations 16

3.1 Definitions 16

3.2 Abbreviations 23

4 General requirements 23

4.1 Responsibility 23

4.2 Application of this Standard 23

4.2.1 General principles 24

4.3 Quality management system (QMS) 24

4.3.1 General 24

4.3.2 Personal qualifications 24

4.3.3 Peer review 24

4.4 Alternatives and/or performance-based approaches 24

4.5 Fire protection assessments (FPA) 25

4.5.1 General 25

4.5.2 Existing nuclear facilities 25

4.5.3 New nuclear facilities 25

4.5.4 Document maintenance 26

4.6 Fire protection for modifications to operating nuclear facilities 26

4.6.1 General 26

4.6.2 Third-party review of modifications 26

4.7 Performance-based approaches 26

4.7.1 General 26

4.7.2 Documentation details 26

4.7.3 Minimum documentation requirements 26

4.8 Review of performance-based designs 27

4.8.1 General 27

4.8.2 Third-party review conclusion 27

4.9 Fire response capability 27

5 Fire protection concepts 27

5.1 General 27

5.1.1 Application 27

5.1.2 Good engineering practice 27

5.1.3 Defence-in-depth principle 27

5.1.4 Performance goals, objectives, and criteria 28

5.2 Goals 28

5.3 Safety performance objectives and criteria 28

5.3.1 General 28

5.3.2	Life safety	29
5.3.3	Radioactive material safety	29
5.3.4	Nuclear criticality safety	29
5.3.5	Reactor safety	30
5.3.6	Protection of the environment	30
5.4	Additional considerations	31
5.4.1	Support services	31
5.4.2	Fire hazard control — Layout and separation	31
5.4.3	External fires	31
5.4.4	Other fire hazards	31
5.5	FPP	31
6	FHA	31
6.1	General	31
6.1.1	Objective	31
6.1.2	FHA preparation	31
6.2	Development and maintenance of the FHA	31
6.2.1	General	31
6.2.2	Development	32
6.2.3	Maintenance	32
6.3	Objective of the FHA	32
6.4	Scope of the FHA	32
6.4.1	Areas covered	32
6.4.2	Operational modes	32
6.5	Documentation and assessment	32
6.6	Defence-in-depth principle	33
6.7	Valid assumptions in an FHA	33
6.8	Limitations and uncertainties	33
7	Design requirements for the prevention and mitigation of fires	33
7.1	General	34
7.2	Scope	34
7.3	Fire prevention by design	34
7.3.1	Location with respect to other buildings and within buildings	34
7.3.2	Fire area limitation	34
7.3.3	Fire stopping	34
7.3.4	Combustible material in buildings and interior finishes	34
7.3.5	Design to facilitate control of transient materials	35
7.4	Reducing the spread of fire	35
7.4.1	Storage of combustible materials	35
7.4.2	Flammable liquids and combustible liquids	36
7.4.3	Control of gases	36
7.4.4	Bulk storage of dangerous goods	36
7.4.5	Storage of nuclear substances	36
7.5	Control of combustible materials in electrical equipment and cables	37
7.6	Control of ignition sources	37
7.6.1	Minimizing ignition sources by design	37
7.6.2	Minimizing electrical fires	37
7.6.3	Protection against lightning	37

7.6.4	Protection against external fires	37
7.7	Fire protection of structures	37
7.8	Life safety — Means of egress	38
7.9	Control of firefighting water	38
7.10	Control of combustible materials in HVAC equipment	38
7.11	Smoke control	39
8	Design and installation requirements for fire protection systems	39
8.1	General	39
8.1.1	Scope	39
8.1.2	Qualification	39
8.1.3	Design, installation, and verification	39
8.2	Fire alarm systems	40
8.2.1	General	40
8.2.2	Fire endurance of electrical conductors	40
8.3	Fire suppression	40
8.4	Water supply for fire protection	41
8.5	Fire hydrants	42
8.6	Manual firefighting	43
8.6.1	General	43
8.6.2	Access	43
8.6.3	Portable extinguishers	43
8.6.4	Standpipes	43
9	Special hazards within nuclear facilities	43
9.1	General	43
9.2	Hazardous substances	43
9.2.1	General	43
9.2.2	Combustible metals	43
9.2.3	Control of gases	43
9.3	Radioactive material	44
9.4	Hazardous processes	44
9.5	Hot cells, caves, glove boxes and hoods	44
9.6	Underground facilities	45
9.7	Protection of safety-related systems and equipment	45
9.8	Reactors	45
9.8.1	General	45
9.8.2	FSSA	45
9.8.3	Redundant systems	46
9.8.4	Separation of redundant fire safe shutdown systems	46
9.8.5	Spatial separation	46
9.8.6	Control room complex/maintaining operation during a fire	47
9.8.7	Credited manual actions	47
9.8.8	Emergency lighting	48
9.8.9	Control of combustibles	48
9.8.10	Layout of cable trays	48
9.8.11	Fire separations	48
9.8.12	Egress from containment structures	48
9.8.13	Fire alarm system	49

9.8.14	Communications	50
9.8.15	Emergency power supply	50
9.8.16	Water supply for fire protection	50
9.8.17	Seismic qualification	52
10	Fire protection program (FPP)	52
10.1	General	52
10.2	Role authority and responsibility	53
10.3	Fire protection for nuclear facility modification	53
10.4	Fire protection and fire brigade training	53
10.4.1	Training needs analysis	53
10.4.2	Training needs analysis requirements	53
10.4.3	Fire safety awareness training for facility personnel	54
10.4.4	Training for fire brigade personnel	54
10.4.5	Requalification interval	55
10.5	Housekeeping	55
10.6	Minimization and management of combustibles	55
10.6.1	General	55
10.6.2	Transient materials	55
10.6.3	Combustible waste	55
10.6.4	Combustible contents	56
10.6.5	Structures, systems, and components (SSCs)	56
10.6.6	Fire protection for the handling, use, and storage of radioactive materials	56
10.6.7	Handling and storage of dangerous goods	56
10.7	Ignition source control	57
10.7.1	Control of hot work	57
10.7.2	Control of smoking	57
10.7.3	Extension cords	57
10.8	Fire protection of safety-related systems	57
10.9	Fire safety during work activities	58
10.10	Reporting and follow-up of fire incidents	58
10.11	Inspection, testing, maintenance, and operation of fire protection equipment	59
10.12	Impairments to fire protection systems	59
10.12.1	Planned impairment	59
10.12.2	Unplanned impairment	59
10.12.3	Compensatory measures	59
10.12.4	Impairment procedure	59
10.13	Inspections	60
10.14	Annual facility condition inspection	60
10.15	Fire protection program (FPP) audit	60
10.16	Fire response capability	61
10.17	QMS	61
11	Fire response capability	62
11.1	General	62
11.2	FRNA	62
11.2.1	Requirements of FRNA	62
11.2.2	Maintenance of FRNA	62
11.3	Pre-fire planning	62

11.4	External response agreement	63
11.5	Performance criteria	63
11.6	Reliance on an off-site response for manual firefighting	63
11.7	Reliance on an on-site fire brigade	64
11.7.1	On-site fire brigade	64
11.7.2	Site duties	64
11.7.3	Personnel	64
11.7.4	Overall site control	65
11.7.5	Medical and job-related physical fitness requirements	65
11.7.6	Response coordination — Incident management	65
11.7.7	Communication	65
11.7.8	Equipment	66
11.8	Fire response drills	66
11.8.1	Fire response drills frequency	66
11.8.2	Fire response drill reviewer	66
11.8.3	Third party evaluation of fire response capability	66
11.8.4	Documentation	66
12	Fire protection requirements for decommissioning	67
12.1	General	67
12.2	Application	67
12.2.1	General	67
12.2.2	Preparation for decommissioning	67
12.2.3	Execution of decommissioning	67
12.2.4	Demolition activities	67
12.3	Fire protection program (FPP)	67
12.4	Fire hazard assessments (FHA)	67
12.5	Fire protection systems	68
12.5.1	General	68
12.5.2	Fire alarm systems	68
12.5.3	Fire protection water supply	68
12.5.4	Fire hydrants	68
12.5.5	Automatic and manual water-based fire suppression systems	68
12.5.6	Standpipes and hose systems	68
12.5.7	Special extinguishing systems	68
12.5.8	Portable extinguishers	68
12.5.9	Fire separation	68
12.5.10	Fire exits	68
12.6	Fire resolutions	69

Annex A (informative) — Commentary on Clauses in CSA N393 70

Annex B (informative) — Guidelines for the preparation of an FHA 82

Technical Committee on Fire Protection for Facilities that Process, Handle, or Store Nuclear Material

I. Bolliger	Jensen Hughes, Ottawa, Ontario, Canada <i>Category: Professional Services</i>	<i>Chair</i>
S. Kurien	Bruce Power L.P., Tiverton, Ontario, Canada <i>Category: Owner/Operator/Producer</i>	<i>Vice Chair</i>
V. Bostan	Ontario Power Generation Inc., Pickering, Ontario, Canada	<i>Non-voting</i>
A. Bounagui	Canadian Nuclear Safety Commission, Ottawa, Ontario, Canada <i>Category: Government and/or Regulatory Authority</i>	
G. Cherkas	Westinghouse Electric Canada, Ottawa, Ontario, Canada <i>Category: Professional Services</i>	
R. Cronk	PLC Fire Safety Solutions, Mississauga, Ontario, Canada	<i>Non-voting</i>
M. Crowe	Canadian Nuclear Laboratories, Chalk River, Ontario, Canada <i>Category: Owner/Operator/Producer</i>	
J. Current	Office of the Fire Marshal and Emergency Management, Toronto, Ontario, Canada <i>Category: Government and/or Regulatory Authority</i>	
M. Edrington	WANO, Atlanta, Georgia, USA <i>Category: General Interest</i>	
L. Esposito	JENSEN HUGHES, Ottawa, Ontario, Canada	<i>Non-voting</i>

I. Goma	National Research Council of Canada, Ottawa, Ontario, Canada <i>Category: Government and/or Regulatory Authority</i>	
C. Griffin	Énergie NB Power, Maces Bay, New Brunswick, Canada <i>Category: Owner/Operator/Producer</i>	
S. P. Lee	Retired Professional, Orangeville, Ontario, Canada <i>Category: General Interest</i>	
J. Mahoney	Nordion Inc., Ottawa, Ontario, Canada <i>Category: Owner/Operator/Producer</i>	
C. D. McCulloch	Global Safety Corporation, Tiverton, Ontario, Canada <i>Category: General Interest</i>	
A. McLean	Bruce Power L.P, Tiverton, Ontario, Canada	<i>Non-voting</i>
S. T. Moulding	Saskatchewan Ministry of Environment, Saskatoon, Saskatchewan, Canada <i>Category: Government and/or Regulatory Authority</i>	
T. Nitheanandan	Canadian Nuclear Safety Commission, Ottawa, Ontario, Canada	<i>Non-voting</i>
G. Qamheiah	PLC Fire Safety Solutions, Mississauga, Ontario, Canada <i>Category: Professional Services</i>	
M. Rawlingson	Retired Professional, Bowmanville, Ontario, Canada <i>Category: General Interest</i>	
T. Rouse	Cameco Corporation, Port Hope, Ontario, Canada <i>Category: Owner/Operator/Producer</i>	
S. Shaikh	Nuclear Waste Management Organization, Toronto, Ontario, Canada	<i>Non-voting</i>

M. Sherwood	Cameco Corporation, Saskatoon, Saskatchewan, Canada <i>Category: Owner/Operator/Producer</i>	
T. Shiblaq	Hatch Ltd., Mississauga, Ontario, Canada <i>Category: Professional Services</i>	
L. Sims	Arencon Inc., Mississauga, Ontario, Canada	<i>Non-voting</i>
B. Sivamyinthan	Ontario Power Generation Inc., Pickering, Ontario, Canada	<i>Non-voting</i>
C. Sutherland	Canadian Nuclear Laboratories, Chalk River, Ontario, Canada	<i>Non-voting</i>
J. J. TeBogt	Marsh Canada Limited, Toronto, Ontario, Canada <i>Category: General Interest</i>	
R. Tennant	Canadian Nuclear Safety Commission, Ottawa, Ontario, Canada	<i>Non-voting</i>
D. W. Timmons	INPO, Atlanta, Georgia, USA	<i>Non-voting</i>
D. Trylinski	Engineering Planning and Management Inc., Deep River, Ontario, Canada	<i>Non-voting</i>
D. Wallace	Canadian Nuclear Safety Commission, Ottawa, Ontario, Canada	<i>Non-voting</i>
C. Zou	CSA Group, Toronto, Ontario, Canada	<i>Project Manager</i>

Preface

This is the second edition of CSA N393, *Fire protection for facilities that process, handle, or store nuclear substances*. It supersedes the previous edition published in 2013.

The major changes to this edition include the following:

- a) updated the list of reference publications to include any newly added references and to update the referenced editions;
- b) updated the list of definitions to add clarification and to align with other CSA Standards and REGDOC-3.6;
- c) revised Clause [5](#) to improve clarity for objectives and criteria;
- d) revised Clause [10.4](#) to improve clarity of training requirements;
- e) reordered and updated Clause [11](#) to improve clarity of the requirements; and
- f) revised Clause [12](#) to remove duplicate requirements and update terminologies to align with CSA N294.

Users of this Standard are reminded that the site selection, design, manufacture, construction, installation, commissioning, operation, and decommissioning of nuclear facilities in Canada are subject to the *Nuclear Safety and Control Act* and Regulations. Authorities having jurisdiction may impose requirements additional to those specified in this Standard. In Canada, this Standard will come into force on the date specified by the nuclear facility licence or licence condition handbook. For nuclear facilities licensed prior to the publication of this Standard, the design and construction requirements of this Standard will not be retroactively applied to existing structures, systems, and components, but the operational requirements (e.g., general requirements, concepts, programs, operations, analyses, emergency response) of this Standard will apply. Fire protection concepts and performance levels are detailed in Clause [5](#), and more detailed requirements for achieving these concepts and performance are provided in Clauses [6](#) to [12](#). In addition, where noted, explanatory material has been added in Annex [A](#) to clarify the content.

The CSA N-Series Standards provide an interlinked set of requirements for the management of nuclear facilities and activities. CSA N286 provides overall direction for management in developing and implementing sound management practices and controls, while the other CSA Group 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 was prepared by the Technical Committee on Fire Protection for Facilities that Process, Handle, or Store Nuclear Material, under the jurisdiction of 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:
- define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;
 - provide an explanation of circumstances surrounding the actual field condition; and
 - 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 within five years from the date of publication. 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:
- Standard designation (number);
 - relevant clause, table, and/or figure number;
 - wording of the proposed change; and
 - rationale for the change.

CSA N393:22

Fire protection for facilities that process, handle, or store nuclear substances

1 Scope

1.1

This Standard provides the minimum fire protection requirements for the design, construction, commissioning, operation, and decommissioning of facilities which process, handle, or store nuclear substances, including structures, systems and components, and other hazardous substances that directly relate to the nuclear substances being regulated.

1.2

This Standard applies to all nuclear facilities where it is referenced as a licence condition or included in the licence condition handbook.

1.3

This Standard does not cover fire protection for nuclear power plants, which is covered by CSA N293.

Note: See Annex [A](#) for further clarification on what facilities are covered under this Standard.

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.

Note: In cases where the editions listed below are amended, replaced by new editions, or superseded by another standard during the life of this referencing Standard, the users of this Standard may investigate the possibility of applying those amendments, new editions, or superseding standards (refer to Clause [4.4](#) regarding alternatives and performance-based approaches).