FORM-14159 R000*

Periodic Safety Review - Final Document Review Traveler

Bruce Power™

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NK29-SFR-09701-00007	R001	Internal Use Only	Information
Bruce Power Document Title: Safety Factor 7 – Hazard Analysis			
Bruce Power Contract/Purchase Order: 00193829	Bruce Power Project #: 39075		
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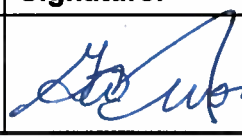
Accepted for use at Bruce Power by:	**Signature:**	**Date**
Name: Gary Newman Title: Chief Engineer & Sr. Vice President, Engineering		14 DEC 2016.

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Division of Kinectrics Inc.

Title: Safety Factor 7 - Hazard Analysis

File: K-421231-00207-R01

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A Report Submitted to Bruce Power

December 13, 2016

Issue	Reason for Issue:				
R00	For use				
	Author: M. Gold	Verifier: G. Buckley	Reviewer: L. Watt G. Archinoff	Approver: L. Watt	Date: Sept 20, 2016
Issue	**Reason for Issue:**				
R01	High-Level / Code-to-Code assessment performed of National Building Code of Canada and National Fire Code of Canada Section 3.6, and Appendices A and C (C.2) updated based on this new assessment.				
	Author: M. Gold	Verifier: R. Gold	Reviewer: L. Watt	Approver: L. Watt	Date: Dec 13, 2016
Issue	**Reason for Issue:**				
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Issue	**Reason for Issue:**				
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Document Classification: Report			Security Classification: Client Proprietary		

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Acronyms and Abbreviations

ASB	Ancillary Services Building
BDBA	Beyond Design Basis Accidents
BP	Bruce Power
CANDU	Canada Deuterium Uranium
CFAM	Corporate Functional Area Manager
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
CSI	CANDU Safety Issue
DBE	Design Basis Earthquake
EA	Environmental Assessment
EMEGs	Emergency Mitigating Equipment Guides
EQ	Environmental Qualification
ERP	Emergency Response Procedure
FASAs	Focus Area Self-Assessment(s)
FP	Fire Protection
HTS	Heat Transport System
IAEA	International Atomic Energy Agency
ISR	Integrated Safety Review
LCH	Licence Conditions Handbook
LTEP	Long Term Energy Plan
MCR	Major Component Replacement
NBCC	National Building Code of Canada
NFCC	National Fire Code of Canada
NFPA	National Fire Protection Association
NPP	Nuclear Power Plant
NRC	National Research Council
NSCA	Nuclear Safety and Control Act
OFI	Opportunities for Improvement
PEVS	Powerhouse Emergency Venting System
PIEs	Postulated Initiating Event(s)

PRA	Probabilistic Risk Assessment
PROL	Power Reactor Operating Licence
PSA	Probabilistic Safety Assessment (synonymous with PRA)
PSR	Periodic Safety Review
QA	Quality Assurance
SAMGs	Severe Accident Management Guidelines
SBR	Safety Basis Report
SCR	Station Condition Record
SFR	Safety Factor Report
SOE	Safe Operating Envelope
SPMPs	System Performance Monitoring Plans
SSCs	Structures, Systems, and Components

1. Objective and Description

Bruce Power (BP), as an essential part of its operating strategy, is planning to continue operation of Bruce B as part of its contribution to the Long Term Energy Plan (LTEP) (http://www.energy.gov.on.ca/en/ltep/). Bruce Power has developed integrated plant life management plans in support of operation to 247,000 Equivalent Full Power Hours in accordance with the Bruce Power Reactor Operating Licence (PROL) [1] and Licence Conditions Handbook (LCH) [2]. A more intensive Asset Management program is under development, which includes a Major Component Replacement (MCR) approach to replacing pressure tubes, feeders and steam generators, so that the units are maintained in a fit for service state over their lifetime. However, due to the unusually long outage and de-fuelled state during pressure tube replacement, there is an opportunity to conduct other work, and some component replacements that could not be done reasonably in a regular maintenance outage will be scheduled concurrently with MCR. In accordance with Licence Condition 15.2 of the PROL [1], Bruce Power is required to inform the Canadian Nuclear Safety Commission (CNSC) of any plan to refurbish a reactor or replace a major component at the nuclear facilities, and Bruce Power shall:

(i) Prepare and conduct a periodic safety review;

(ii) Implement and maintain a return-to-service plan; and

(iii) Provide periodic updates on progress and proposed changes.

The fifteen reports prepared as part of the Periodic Safety Review (PSR), including this Safety Factor Report (SFR), are intended to satisfy Licence Condition 15.2 (i) as a comprehensive evaluation of the design, condition and operation of the nuclear power plant (NPP). In accordance with Regulatory Document REGDOC-2.3.3 [3], a PSR is an effective way to obtain an overall view of actual plant safety and the quality of safety documentation and determine reasonable and practicable improvements to ensure safety until the next PSR.

Bruce Power has well-established PSR requirements and processes for the conduct of a PSR for the purpose of life-cycle management, which are documented in the procedure Periodic Safety Reviews [4]. This procedure, in combination with the Bruce B Periodic Safety Review Basis Document [5], governs the conduct of the PSR and facilitates its regulatory review to ensure that Bruce Power and the CNSC have the same expectations for scope, methodology and outcome of the PSR.

This PSR supersedes the Bruce B portion of the interim PSR that was conducted in support of the ongoing operation of the Bruce A and Bruce B units until 2019 [6]. Per REGDOC-2.3.3 [3], subsequent PSRs will focus on changes in requirements, facility conditions, operating experience and new information rather than repeating activities of previous reviews.

1.1. Objective

The overall objectives of the Bruce B PSR are to conduct a review of Bruce B against modern codes and standards and international safety expectations, and to provide input to a practicable set of improvements to be conducted during the MCR in Units 5 to 8, and during asset

management activities to support ongoing operation of all four units, as well as U0B, that will enhance safety to support long term operation. It will cover a 10-year period, since there is an expectation that a PSR will be performed on approximately a 10-year cycle, given that all units are expected to be operated well into the future.

The specific objective of the review of this Safety Factor is to determine the adequacy of protection of the nuclear power plant against internal and external hazards with account taken of the actual plant design, actual site characteristics, the actual condition of Systems/Structures /Components and their predicted state at the end of the period covered by the PSR, and current analytical methods, safety standards and knowledge.

1.2. Description

The review is conducted in accordance with the Bruce B PSR Basis Document [5], which states that the review tasks are as follows:

1. For each internal or external hazard identified, include the adequacy of the protection, with account taken of the following:
    a. The credible magnitude and associated frequency of occurrence of the hazard;
    b. Current safety standards;
    c. Current understanding of environmental effects;
    d. The capability of the plant to withstand the hazard as claimed in the safety case, based on its current condition and with allowance given to predicted ageing degradation;
    e. The appropriateness of procedures to cover operator actions claimed to prevent or mitigate the hazard.
2. Check list of internal and external hazards for completeness[1].
    a. The following is a representative list of internal hazards that may affect plant safety (additional site specific internal hazards will be included under this Safety Factor if appropriate):
        i. Fire (including measures for prevention, detection and suppression of fire);
        ii. Flooding;
        iii. Pipe whip;
        iv. Missiles and drops of heavy loads;
        v. Steam release;
        vi. Hot gas release;
        vii. Cold gas release;
        viii. Deluge and spray;
        ix. Explosion;
        x. Electromagnetic or radio frequency interference;
        xi. Toxic and/or corrosive liquids and gases;
        xii. Vibration;
        xiii. Subsidence;
        xiv. High humidity;

[1] Lists of internal ad external hazards are taken from Appendix A of Bruce B PSR Basis Document [5]

xv. Structural collapse;
xvi. Loss of internal and external services (cooling water, electricity, etc.);
xvii. High voltage transients; and
xviii. Loss or low capacity of air conditioning (which may lead to high temperatures).

b. The following is a list of representative external hazards that may affect plant safety:

i. Floods, including tsunamis;
ii. High winds, including tornadoes;
iii. Fire;
iv. Meteorological hazards (extreme temperatures, extreme weather conditions, high humidity, drought, snow, buildup of ice);
v. Sun storm;
vi. Toxic and/or corrosive liquids and gases, other contamination in the air intake (for example, industrial contaminants, volcanic ash);
vii. Hydrogeological and hydrological hazards (extreme groundwater levels, seiches[2]);
viii. Seismic hazards;
ix. Volcano hazards;
x. Aircraft crashes, external missiles;
xi. Explosion;
xii. Biological fouling;
xiii. Lightning strike;
xiv. Electromagnetic or radio frequency interference;
xv. Vibration;
xvi. Traffic; and
xvii. Loss of internal and external services (cooling water, electricity, etc).

As required by the PSR Basis Document, preparation of this Safety Factor Report included an assessment of the review tasks to determine if modifications were appropriate. Any changes to the review tasks described in this section are documented and justified in Section 5.

2. Methodology of Review

As discussed in the Bruce B PSR Basis Document [5], the methodology for a PSR should include making use of safety reviews that have already been performed for other reasons. Accordingly, the Bruce B PSR makes use of previous reviews that were conducted for the following purposes:

- Return to service of Bruce Units 3 and 4 (circa 2001) [7];
- Life extension of Bruce Units 1 and 2 (circa 2006) [8] [9] [10];
- Proposed refurbishments of Bruce Units 3 and 4 (circa 2008) [11] [12] [13] [14] [15];
- Safety Basis Report (SBR) and PSR for Bruce Units 1 to 8 (2013) [6]; and
- Bruce A Integrated Safety Review (ISR) to enhance safety and support long term operation (2015) [16] [17].

[2] A seiche is an extreme oscillation in water level.

These reviews covered many, if not all, of the same Safety Factors that are reviewed in the current PSR. A full chronology of Bruce Power safety reviews up to 2013 is provided in Appendix F of [18].

The Bruce B PSR Safety Factor review process comprises the following steps:

1. **Interpret and confirm review tasks:** As a first step in the Safety Factor review, the Safety Factor Report author(s) confirm the review tasks identified in the PSR Basis Document [5] and repeated in Section 1.2 to ensure a common understanding of the intent and scope of each task. In some cases, this may lead to elaboration of the review tasks to ensure that the focus is precise and specific. Any changes to the review tasks are identified in Section 5 of the Safety Factor Report (SFR) and a rationale provided.
2. **Confirm the codes and standards to be considered for assessment:** The Safety Factor Report author(s) validates the list of codes and standards presented in the PSR Basis Document against the defined review tasks to ensure that the assessment of each standard will yield sufficient information to complete the review tasks. Additional codes and standards are added if deemed necessary. If no standard can be found that covers the review task, the assessor may have to identify criteria on which the assessment of the review task will be based. The final list of codes and standards considered for this Safety Factor is provided in Section 3.
3. **Determine the type and scope of assessment to be performed:** This step involves the assessor confirming that the assessment type identified in Appendix C of the Bruce B PSR Basis Document [5] for each of the codes, standards and guidance documents selected for this factor is appropriate based on the guidance provided. The PSR Basis Document provides an initial assignment for the assessment type, selecting one of the following review types:
    - Programmatic Clause-by-Clause Assessments;
    - Plant Clause-by-Clause Assessments;
    - High-Level Programmatic Assessments;
    - High-Level Plant Assessments;
    - Code-to-Code Assessments; or
    - Confirm Validity of Previous Assessment.

    The final assessment types are identified in Section 3, along with the rationale for any changes relative to the assignment types listed in the PSR Basis Document.

4. **Perform gap assessment against codes and standards:** This step comprises the actual assessment of the Bruce Power programs and the Bruce B plant against the identified codes and standards. In general, this involves determining from available design or programmatic documentation whether the plant or program meet the provisions of the specific clause of the standard or of some other criterion, such as a summary of related clauses. Each individual deviation from the provisions of codes and standards is referred to as a Safety Factor "micro-gap". The assessments, performed in Appendix A and Appendix B, include the assessor's arguments conveying reasons why the clause is considered to be met or not met, while citing appropriate references that support this contention.
5. **Assess alignment with the provisions of the review tasks:** The results of the assessment against codes and standards are interpreted in the context of the review tasks of the Safety Factor. To this end, each assessment, whether clause-by-clause, high-level or code-to-code, is assigned to one or more of the review tasks (Section 5). Assessment against the provision of the review task involves formulating a summary assessment of the degree to which the plant or program meets the objective and provisions of the particular review task. This assessment may involve consolidation and interpretation of the various compliance assessments to arrive at a single compliance indicator for the objective of the review task as a whole. The results of this step are documented in Section 5 of each SFR.
6. **Perform program assessments:** The most pertinent self-assessments, audits and regulatory evaluations are assessed, and performance indicators relevant to the Safety Factor identified. The former illustrates that Bruce Power has a comprehensive process of reviewing compliance with Bruce Power processes, identifying gaps, committing to corrective actions, and following up to confirm completion and effectiveness of these actions. The latter demonstrates that there is a metric by which Bruce Power assesses the effectiveness of the programs relevant to the Safety Factor in Section 7. Taken as a whole, these provide a cross section, intended to demonstrate that the processes associated with this Safety Factor are implemented effectively (individual findings notwithstanding). Thus, program effectiveness, if not demonstrated explicitly in the review task assessments in Step 5, can be inferred if Step 5 shows that Bruce Power processes meet the Safety Factor requirements and if this step shows there are ongoing processes to ensure compliance with Bruce Power processes.
7. **Identification of findings:** This step involves the consolidation of the findings of the assessment against codes and standards and the results of executing the review tasks into a number of definitive statements regarding positive and negative findings of the assessment of the Safety Factor. Positive findings or strengths are only identified if there is clear evidence that the Bruce B plant or programs exceed compliance with the provision of codes and standards or review task objectives. Each individual negative finding or deviation is designated as a Safety Factor micro-gap for tracking purposes. Identical or similar micro-gaps are consolidated into comprehensive statements that describe the deviation known as Safety Factor macro-gaps, which are listed in Section 8 of the Safety Factor Reports, as applicable.

3. Applicable Codes and Standards

This section lists the applicable regulatory requirements, codes and standards considered in the review of this Safety Factor. Table C-1 of the Bruce B PSR Basis Document [5] identifies the codes, standards and guides that are relevant to this PSR. Modern revisions of some codes and standards listed in Table C-1 of the PSR Basis Document [5] have been identified in the licence renewal application and supplementary submissions for the current PROL [19] [20] [21]. Codes, standards and guides issued after the freeze date of December 31, 2015 were not considered in the review [5].

3.1. Acts and Regulations

The *Nuclear Safety and Control Act* (NSCA) [22] establishes the Canadian Nuclear Safety Commission and its authority to regulate nuclear activities in Canada. Bruce Power has a process to ensure compliance with the NSCA [22] and its Regulations. Therefore, the NSCA and Regulations were not considered further in this review.

3.2. Power Reactor Operating Licence

The list of codes and standards related to hazard analysis that are referenced in the PROL [1] and LCH [2], and noted in Table C-1 of the Bruce B PSR Basis Document [5], are identified in Table 1. The edition dates referenced in the third column of the table are the modern versions used for comparison.

Table 1: Codes, Standards, and Regulatory Documents Referenced in Bruce A and B PROL and LCH

Document Number	Document Title	Modern Version Used for PSR Comparison	Type of Review
CNSC REGDOC-2.3.3	Periodic Safety Reviews	[3]	NA
CNSC REGDOC-2.4.1	Safety Analysis For Nuclear Power Plants	[23]	PCBC
CSA N286-05 [24]	Management System Requirements for Nuclear Facilities	CSA N286-12 [25]	NA
CSA N286.7-99	Quality Assurance of Analytical, Scientific And Design Computer Programs for Nuclear Power Plants	CSA N286.7-99 (R2012) [26]	NA

Document Number	Document Title	Modern Version Used for PSR Comparison	Type of Review
CSA N290.13-05	Environmental Qualification of Equipment for CANDU Nuclear Power Plants	CSA N290.13-05 (R2010) [27]	NA
CSA N290.15-10	Requirements for the Safe Operating Envelope of Nuclear Power Plants	[28]	NA
CSA N293-12	Fire Protection For Nuclear Power Plants	[29]	CTC/CBC
Assessment type: **NA**: Not Assessed; **CBC**: Clause-by-Clause; **PCBC**: Partial Clause-by-Clause; **CTC**: Code-to-Code; **HL**: High Level; **2SF**: Assessment performed in another SFR; **CV**: Confirm Validity of Previous Assessments			

CNSC REGDOC-2.3.3: This PSR is being conducted in accordance with CNSC REGDOC-2.3.3 per Licence Condition 15.2 (i) [1], and associated compliance verification criteria [2]. Therefore, REGDOC-2.3.3 is not reviewed further in this document.

CNSC REGDOC-2.4.1: Table C-1 of the PSR Basis Document [5] calls for a clause-by-clause assessment against clauses of CNSC REGDOC-2.4.1 with relevance to this Safety Factor. The assessments against clauses relevant to Safety Factor 7 are listed in Table B1 of Appendix B. A fuller clause-by-clause assessment against REGDOC-2.4.1 is performed in Safety Factor 5 – Deterministic Safety Analysis.

CSA N286-12: CSA N286-05 is noted in the PROL (Licence Condition 1.1 [1]). Per the LCH [2], an implementation strategy for the 2012 version is in progress to be submitted to the CNSC by the end of January 2016. CNSC staff have stated that in their view the CSA N286-12 version of CSA N286 "does not represent a fundamental change to the current Bruce Power Management System" and have acknowledged that "the new requirements in CSA N286-12 are already addressed in Bruce Power's program and procedure documentation" [30].

Bruce Power had agreed to perform a gap analysis and to prepare a detailed transition plan, and to subsequently implement the necessary changes in moving from the CSA N286-05 version of the code to the CSA N286-12 version, during the current licensing period [31]. This timeframe will facilitate the implementation of N286 changes to the management system, and enable the gap analysis results from the large number of new or revised Regulatory Documents or Standards committed in the 2015 operating licence renewal. Bruce Power has also proposed that in the interim, CSA N286-05 be retained in the PROL to enable it to plan the transition to CSA N286-12, and committed to develop the transition plan and communicate the plan to the CNSC by January 30, 2016 [32]. Bruce Power further stated CSA N286-12 does not establish any significant or immediate new safety requirements that would merit a more accelerated implementation. The gap analysis and the resulting transition plan were submitted to the CNSC [33]. Per [33], the major milestones of the transition plan to N286-12 are as follows:

- 22 January 2016: Discuss all the regulatory actions and the transition plan at the Corporate Functional Area Manager (CFAM) meeting
- 31 December 2016: Revision of CFAM Program Document(s) [with LCH notification requirements to the CNSC] to comply with CSA N286-12 requirements completed.
- 31 March 2017: Revision of CFAM Program Document(s) [that do not have LCH notification requirements to the CNSC] to comply with CSA N286-12 requirements completed
- 31 December 2017: Confirmation that that all impacted documents in the program suite comply with the requirements of CSA N286-12
- 15 September 2018: Verification via a Focus Area Self Assessment (FASA) that previously identified transition Gaps to meeting the requirements of CSA N286-12 have been addressed and effectively implemented
- 14 December 2018: issue notification to the CNSC regarding state of CSA N286-12 readiness, and, implementation date

This Safety Factor therefore has not performed a code-to-code assessment between CSA N286-05 and CSA N286-12 and will not be performing a clause-by-clause assessment of CSA N286-05, since it is in the current licence and there is a transition plan in effect.

CSA N286.7-99: CSA N286.7-99 [26] was assessed as part of the 2013 interim PSR and has not changed since that assessment. Furthermore, the Bruce Power Nuclear Safety Assessment procedure [34] cited in the Safety Factor 5 component of the 2013 interim PSR as demonstrating compliance with CSA N286.7-99 is unchanged. Therefore, review against these standards was not repeated as part of this Safety Factor.

CSA N290.13-05 (R2010): CSA N290.13 [27] provides Environmental Qualification (EQ) requirements for the design of Canada Deuterium Uranium (CANDU) Nuclear Power Plants (NPPs). A CNSC compliance assessment [35] was conducted in late 2009 regarding sustaining and maintaining environmental qualification of safety systems, with focus on SDS2 and the Powerhouse Emergency Venting System (PEVS). The assessment included review of the procedural guidance on environmental qualification requirements: procedure BP-PROC-00261 [36] and Bruce B Design Guide NK29-DG-03650-003 [37]. It found Bruce Power was compliant with the applicable regulatory requirements, notwithstanding some inconsistencies regarding the EQ status of PEVS which were noted in Action Item 101401. The Bruce Power responses ([38], [39]) to the compliance assessment findings resulted in closure of AI 101401 in [40].

In 2010, CSA N290.13-05 was reaffirmed, with no material change to its clauses, so that assessments done with respect to CSA N290.13-05 are applicable to the reaffirmed 2010 version. An additional 2012 CNSC compliance inspection [41] of environmental qualification practices during the refurbishment of Bruce A Units 1 and 2 concluded that Bruce Power has a strong EQ program in place and has implemented improvements to the EQ program in compliance with CSA N290.13-05. Since that 2012 inspection, neither of the governing documents ([36], [37]) providing guidance in the environmental qualification area has been revised. Therefore, review of CSA N290.13-05 was not repeated for this Safety Factor.

CSA N290.15-10: CSA N290.15 [28] is the first edition of the Canadian Standards Association (CSA) standard for requirements for the safe operating envelope (SOE) of nuclear power plants.

This Standard provides requirements for the definition, implementation, and maintenance of the safe operating envelope at nuclear power plants. In addition, guidance material for existing Canada Deuterium Uranium (CANDU) nuclear power plants is provided in Annex A to support the requirements. NK29-CORR-00531-12770 [35] commits to compliance with CSA N290.15-10 by end of 2015, at which point all Bruce Power governance, processes and procedures affected by SOE requirements will have been modified as part of the implementation of CSA N290.15-10. There is no further discussion on this standard in this Safety Factor Report.

CSA N293-12: CSA N293-07 [43] defines the Fire Protection (FP) requirements for the design, construction, commissioning, operation, and decommissioning of CANDU NPPs. A recent review of the Bruce Power Fire Protection Program against CSA N293-07 was performed [44] to satisfy a commitment to the CNSC to provide an assessment of the Fire Protection Program at Bruce A/B including the alignment with Fire Protection Codes and Standards [18]. As noted in the review [44], the submission of revised fire protection documentation [45] [46] [47], combined with adherence to a schedule for closure of issues arising from ongoing assessments conducted as part of the transition to N293-07 reports (see [48] as an example), have allowed CNSC staff to conclude that the requirements of CSA N293-07 are met. However, since CSA N293-07 has been superseded by CSA N293-12 [29], a code-to-code review is conducted as part of this Safety Factor, and the results are presented in Appendix C. As well, a clause-by-clause assessment is conducted for those clauses in CSA N293-12 that are new or changed compared to equivalent corresponding CSA N293-07 clauses; the results of this assessment, presented in Appendix B, indicate that Bruce B is compliant with all clauses of CSA N293-12 that differ from, or are new relative to, equivalent CSA N293-07 clauses.

3.3. Regulatory Documents

The Regulatory Documents in Table 2 were considered for application to review tasks of this Safety Factor.

Table 2: Regulatory Documents

Document Number	Document Title	Reference	Type of Review
CNSC R-77 (1987)	Overpressure Protection Requirements for Primary Heat Transport Systems in CANDU Power Reactors fitted with Two Shutdown Systems	[49]	CV
CNSC RD-346 (2008)	Site Evaluation for New Nuclear Power Plants	[50]	CV
CNSC REGDOC-2.5.2 (2014)	Design of Reactor Facilities: Nuclear Power Plants	[51]	PCBC

Document Number	Document Title	Reference	Type of Review
Assessment type: **NA**: Not Assessed; **CBC**: Clause-by-Clause; **PCBC**: Partial Clause-by-Clause; **CTC**: Code-to-Code; **HL**: High Level; **2SF**: Assessment performed in another SFR; **CV**: Confirm Validity of Previous Assessments			

CNSC R-77: CNSC R-77 [49] provides overpressure protection requirements for primary heat transport systems in CANDU power reactors fitted with two shutdown systems, and is relevant to hazard analysis. A clause-by-clause review of R-77 was conducted in Enclosure 3 of [9] as part of the Bruce 1 and 2 ISR. Bruce A was found to be fully compliant with the requirements based on the results in the Safety Report for accidents which lead to pressurization of the heat transport system, i.e., Electrical System failures; Feedwater and Steam Supply System Failures; Loss of Reactivity or Power Control; and Loss of Pressure Control (high). In Reference [52], it is demonstrated that for all safety analysis accidents leading to pressurization of the heat transport system:

- The conclusions derived in Enclosure 3 of [9] regarding compliance of Bruce A safety analysis to R-77 Heat Transport System (HTS) overpressure requirements remain valid for the current (2012) version of the Bruce A Safety Report;
- The Bruce B overpressurization results in the current (2011) version of the Bruce B Safety Report show that Bruce B is also compliant with R-77 HTS overpressure requirements.

Therefore, further review against CNSC R-77 was not repeated for this Safety Factor.

CNSC RD-346: CNSC RD-346 [50] represents the CNSC staff's adoption, or where applicable, adaptation, of the principles set forth by the IAEA in NS-R-3 Site Evaluation for Nuclear Installations [53]. The IAEA guides under NS-R-3 relate to siting, which has been fully addressed as part of the Environmental Assessment conducted for Bruce B in 2004 [54]. The same argument applies to CNSC RD-346. Therefore, CNSC RD-346 is not assessed for this Safety Factor.

CNSC REGDOC-2.5.2: Table C-1 of the PSR Basis Document [5] calls for a clause-by-clause assessment against all clauses of CNSC REGDOC-2.5.2 [51] with relevance to this Safety Factor. The assessments against clauses relevant to Safety Factor 7 are listed in Table B2 of Appendix B. A complete clause-by-clause assessment against REGDOC-2.5.2 is performed in Safety Factor 1 – Plant Design.

3.4. CSA Standards

There are no CSA standards associated with this Safety Factor other than the ones cited in the PROL and discussed in Section 3.2 and Table 1.

3.5. International Standards

The international standard listed in Table 3 is relevant to this Safety Factor and was considered for this review.

Table 3: International Standards

Document Number	Document Title	Reference	Type of Review
IAEA SSG-25	Periodic Safety Review For Nuclear Power Plants	[55]	NA
Assessment type: **NA**: Not Assessed; **CBC**: Clause-by-Clause; **PCBC**: Partial Clause-by-Clause; **CTC**: Code-to-Code; **HL**: High Level; **2SF**: Assessment performed in another SFR; **CV**: Confirm Validity of Previous Assessments			

IAEA SSG-25: IAEA SSG-25 [55] addresses the periodic safety review of nuclear power plants. Per the PSR Basis Document [5], this PSR is being conducted in accordance with REGDOC-2.3.3. As stated in REGDOC-2.3.3 [3], this regulatory document is consistent with IAEA SSG-25. The combination of IAEA SSG-25 and REGDOC-2.3.3, define the review tasks that should be considered for the Safety Factor Reports. However, no assessment is performed specifically on IAEA SSG-25.

3.6. Other Applicable Codes and Standards

Other applicable standards/practices listed in Table 4 were considered for this review.

Table 4: Related Codes and Standards

Document Number	Document Title	Reference	Type of Review
Darlington DG-38-03650-2A	Common Mode Incidents – Overview and Design Requirements	[56]	NA
Darlington DG-38-03650-2B	Common Mode Incidents – Seismic Design	[57]	NA
Darlington DG-38-03650-3	Limiting Consequential Damage of Postulated Pipe Ruptures	[58]	NA
NBCC (2015)	National Building Code of Canada	[59]	CTC/HL

Document Number	Document Title	Reference	Type of Review
NFCC (2015)	National Fire Code of Canada	[60]	CTC/HL
Assessment type: **NA**: Not Assessed; **CBC**: Clause-by-Clause; **PCBC**: Partial Clause-by-Clause; **CTC**: Code-to-Code; **HL**: High Level; **2SF**: Assessment performed in another SFR; **CV**: Confirm Validity of Previous Assessments			

Darlington Design Guides: The Darlington Design Guides provide general and seismic design requirements for Common Mode accidents and on consequential damage for postulated pipe ruptures.

However, Bruce B has its own Design Guides pursuant to these areas ([37], [63], [64]). As well, CNSC REGDOC-2.5.2 [51] provides more detailed guidance in all these areas. Given the clause-by-clause review against CNSC REGDOC-2.5.2 clauses relevant to this Safety Factor that are provided in Table B2 of Appendix B, review against the Darlington Design Guides was not performed for this Safety Factor.

National Building Code of Canada: The National Building Code (NBCC) [59] sets out technical provisions for the design and construction of new buildings. Table C-1 of the PSR Basis Document [5] does not call for this code to be assessed. However, a code-to-code review between the 2015 and 2005 versions is conducted as part of this Safety Factor, and the results are presented in Appendix C (C.2). In establishing the differences between the code versions, the National Research Council (NRC) website site was used [61] [62], rather than the code itself. As well, a high level assessment is conducted on those sections of the NBCC (2015) that are new or changed compared to the corresponding NBCC (2005) sections; the results of this assessment are presented in Appendix A (A.2).

National Fire Code of Canada: The National Fire Code (NFCC) [60] contains technical requirements designed to provide an acceptable level of fire safety. It complements the NBC, and both must be considered when constructing, renovating or maintaining buildings. However, a code-to-code review between the 2015 and 2005 versions is conducted as part of this Safety Factor, and the results are presented in Appendix C (C.2). In establishing the differences between the code versions, the NRC website site was used [61] [62], rather than the code itself. As well, a high level assessment is conducted on those sections of the NFCC (2015) that are new or changed compared to the corresponding NFCC (2005) sections; the results of this assessment are presented in Appendix A (A.3).

4. Overview of Applicable Bruce B Station Programs and Processes

The objective of hazard analysis is to determine the adequacy of protection of the nuclear power plant against internal and external hazards, with account taken of the actual plant design, actual site characteristics, and actual plant condition. As such, hazard analysis has both design verification and safety analysis aspects.

Within the organization of Bruce Power's policies, programs and procedures, hazard analysis is addressed in activities such as deterministic safety analyses, probabilistic safety assessment and criticality safety assessment that are part of Nuclear Safety Assessment [34]. The programmatic guidance for risk evaluation and hazard screening of any hazard are probabilistic safety assessment procedures. The programmatic guidance related to the design verification aspects of hazard analysis are design instructions relating to specific hazards, such as seismic events, fire and environmental qualification. These design instructions fall under the Design Management Function. The Nuclear Safety Assessment Function, together with the Design Management Function, falls under Bruce Power's Plant Design Basis Management Program.

Nuclear safety is addressed at the highest level of the hierarchy in the Management System Manual BP-MSM-1 [65]. BP-MSM-1 includes Bruce Power Policy Statements that have superseded the Policy documents in place at the time of the Bruce 3 and 4 ISR. These find expression in programs such as the Fire Safety Management Plan [66] and the Plant Design Basis Management Program [67]. The Plant Design Basis Management Program is implemented through the following two high-level procedures:

- BP-PROC-00363 on Nuclear Safety Assessment [34]; and
- BP-PROC-00335 on Design Management [68].

The implementation of BP-PROC-00363 [34] on Nuclear Safety Assessment is supported by a variety of divisional and departmental procedures. Although there is no specific procedure addressing hazard analysis, many of the procedures have general applicability and support the hazard analysis process. The implementation of BP-PROC-00335 on Design Management [68] is also supported by a variety of divisional and departmental procedures. A number of these are relevant to hazard analysis, since they address design provisions for specific hazards. The list of Bruce Power policies, programs and procedures that are relevant to hazard analysis is provided in Table 5[3].

Table 5: Key Implementing Documents

Level 0	Level 1	Level 2	Level 3
BP-MSM-1: Management System Manual [65]	BP-PROG-00.02: Environmental Safety Management [69]		
	BP-PROG-08.01: Emergency Management Program [70]	BP-PLAN-00008: Fire Safety Management [66]	

[3] Table 5 lists the key governance documents used to support the assessments of the review tasks for this Safety Factor Report. A full set of current sub-tier documents is provided within each current PROG document. In the list of references, the revision number for the governance documents is the key, unambiguous identifier; the date shown is an indicator of when the document was last updated, and is taken either from PassPort, the header field, or the "Master Created" date in the footer.

Level 0	Level 1	Level 2	Level 3
	BP-PROG-10.01: Plant Design Basis Management [67]	BP-PROC-00261: Environmental Qualification [36]	SEC-EQD-00021: Environmental Qualification Assessments [71]
			SEC-EQD-00031: Preparation of Environmental Qualification Dossiers (EQD) [72]
		BP-PROC-00335: Design Management [68]	DPT-PDE-00017: Bruce Power Seismic Qualification Standard [73]
			BP-PROC-00500: Control of Unsecured Equipment in Seismically Qualified Areas [74]
			DPT-PDE-00027: Fire Hazard Assessment Preparation and Maintenance [75]
			DPT-PDE-00028: Fire Safe Shutdown Analysis Maintenance [76]
			DPT-PDE-00029: Preparation of a Fire Protection Code Compliance Review [77]
			DPT-PDE-00030: Fire Protection Technical Evaluations [78]

Level 0	Level 1	Level 2	Level 3
			DPT-PDE-00031: Third Party Review – Fire Protection [79]
		BP-PROC-00363: Nuclear Safety Assessment [34]	DPT-NSAS-00001: Quality Assurance of Safety Analysis [80]
			DPT-NSAS-00015: Planning and Execution of Nuclear Safety Assessments [81]
			DPT-RS-00002: Risk Assessment of Operational Events [82]
			DPT-RS-00006: Outage and Inage Risk Management [83]
			DPT-RS-00004: Risk Assessment of Proposed Changes to Engineering, Operations, Surveillance and Maintenance [84]
			DPT-RS-00007: Preparation and Maintenance of Probabilistic Risk Assessments [85]

In addition to these procedures, Bruce Power has also issued Probabilistic Risk Assessment (PRA) Methodology Guides for conduct of PRAs for the following internal and external hazards:

- B-REP-03611-00007, Bruce Power PRA Guide, Internal Flood [86];
- B-REP-03611-00008, Bruce Power PRA Guide, Internal Fire [87];
- B-REP-03611-00009, Bruce Power Seismic PRA Guide [88];

- B-REP-03611-00011, Bruce Power PRA Guide, Screening and Disposition of External Hazards [89];
- B-REP-03611-00012, Bruce Power PRA Guide, High Wind Hazard [90];
- B-REP-03611-00013, Bruce Power PRA Guide, External Flooding [91];
- B-03611.2-31JAN2013, Methodology for the Assessment of Seismic Events Leading to Consequential Internal Fire or Internal Flood [92].

5. Results of the Review

The results of the review of this Safety Factor are documented below under headings that correspond to the review tasks listed in Section 1.2 of this document. The review tasks assessed in this section have not changed from those listed in Section 1.2.

5.1. Adequacy of Protection Against External Hazards

This task requires that the following representative list of external hazards that may affect plant safety be reviewed for adequacy of protection:

- Floods, including tsunamis;
- High winds, including tornadoes;
- Fire;
- Meteorological hazards (extreme temperatures, extreme weather conditions, high humidity, drought, snow, buildup of ice);
- Sun storm;
- Toxic and/or corrosive liquids and gases, other contamination in the air intake (for example, industrial contaminants, volcanic ash);
- Hydrogeological and hydrological hazards (extreme groundwater levels, seiches);
- Seismic hazards;
- Volcano hazards;
- Aircraft crashes, external missiles;
- Explosion;
- Biological fouling;
- Lightning strike;
- Electromagnetic or radio frequency interference;
- Vibration;
- Traffic; and
- Loss of internal and external services (cooling water, electricity, etc.).

5.1.1. Completeness of List of External Hazards

Review Task 2 in Section 1.2 requires that the list of hazards be assessed for completeness.

Bruce Power undertook, as part of its disposition of Fukushima Action Items, a re-evaluation of the site-specific magnitudes of each external event to which the plant might be susceptible, using modern calculations and methods; and an evaluation as to whether the current site-specific design protection for each external event so assessed is sufficient (these are designated FAI 2.1.1 and FAI 2.1.2 in [93]). An extensive screening assessment was conducted based on a screening methodology submitted to CNSC staff in [94]. The list of potential external hazards considered is provided in Table 6. This list covers all the external hazards outlined in Section 5.1, as well as several hazards that could be classified as internal hazards.

Table 6: Potential External Hazards

ID	Hazard	ID	Hazard
Airborne and Extra-Terrestrial Hazards			
A01	Extreme air pressure	A13	Salt storm
A02	Extreme rain	A14	Sandstorm
A03	Fog	A15	Snow
A04	Hail	A16	Solar storms
A05	High air pressure	A17	Tornadoes or waterspouts
A06	Hurricane / typhoon	A18	Aircraft impacts
A07	Ice store / sleet / freezing rain	A19	Electromagnetic interference / disturbance
A08	Lightning	A20	Externally generated missiles
A09	Low air temperature	A21	High air pollution
A10	Meteorite	A22	Satellite
A11	Mist	A23	Toxic gas/ chemical release/ radioactive release
A12	Other high winds		
Water-Based Hazards			
W01	Coastal erosion	W12	Other extraordinary waves
W02	Corrosion	W13	River diversion
W03	External flooding	W14	Seiche
W04	Frazil ice	W15	Storm surge
W05	Groundwater	W16	Strong currents
W06	High water temperature	W17	Tsunami
W07	High tide or water level	W18	Underwater landslide

ID	Hazard	ID	Hazard
W08	Ice barriers	W19	Waves
W09	Lake or river-borne material plugging water intakes	W20	Chemical releases into water
		W21	Impurities in water from ship release
W10	Low lake or river level	W22	Ship collisions
W11	Low water temperature	W23	Other ship collisions
Ground-Based Hazards			
G01	Animals	G13	Eddy currents into ground
G02	Avalanche	G14	Excavation work
G03	Biological events	G15	External fire
G04	Drought	G16	Ground contamination
G05	Erosion	G17	Ground vibration
G06	Forest fire	G18	Industrial or military facility accident
G07	Frost	G19	Internal fire spreading from other plant
G08	Ice cover	G20	Internally generated missiles
G09	Land rise	G21	Pipeline accident
G10	Landslide	G22	Release of chemicals from on-site storage
G11	Soil shrink-swell	G23	Transportation accidents
G12	Volcanic activity	G24	Turbine-generated missiles

These hazards were initially subjected to a first-level screening [95], and the hazards which were not eliminated in the first level were then subjected to a second level of screening ([96]). Following this second level of screening, the only hazards requiring assessment are tornadoes, high winds and external flooding. To address these remaining external hazards, Bruce Power has:

- submitted [97] a methodology for analysis of tornadoes, high winds and external flooding;
- submitted [98] the following reports: a High Wind PRA Report (which includes tornado hazard assessment), External Flooding Assessment and revised versions of a Seismic PRA Report and Fire PRA Report.

5.1.2. Credible Magnitude and Associated Frequency of Occurrence of Hazard

Element (a) of Review Task 1 in Section 1.2 requires that hazards be assessed taking account of the credible magnitude and associated frequency of occurrence of the hazard.

The screening assessments [95] and [96] and revised PRAs [98] discussed in Section 5.1.1 include credible magnitude and frequency of occurrence as screening considerations, as discussed below.

Clause 7.13.1 of REGDOC-2.5.2 [51] (See Table B2) requires that seismically qualified SSCs important to safety are qualified to a Design Basis Earthquake (DBE). However, rather than defining a DBE, the clause invokes the CSA N289 series for detailed guidance, including definition of a DBE. In N289.1-08 (R2013) [99], a DBE is defined as having a probability of exceedance of $1x10^{-4}$/a, or such level as determined by the regulatory authority; furthermore, the definition notes that the DBE for some older plants was based on a probability of exceedance of $1x10^{-3}$/a.

While the ground response spectra used in the seismic qualification of Bruce B are based on a probability of exceedance of $1x10^{-3}$/a and are strictly speaking not in compliance with the definition of a DBE in [99], the wording of the DBE definition in the standard, including the note about older plants, implicitly permits this.

Therefore, Bruce B does not comply with the requirement to assess all external hazards using an accepted frequency of occurrence. This is identified as gap SF7-1 in Table 10 against the guidance of N289.1-08 regarding DBE definition.

5.1.3. Current Safety Standards

Element (b) of Review Task 1 in Section 1.2 requires that hazards be assessed against current safety standards. The standards relevant to external hazards are discussed in Section 3 and shown to be current. Bruce B is therefore compliant with the requirement to apply current standards in assessing external hazards.

5.1.4. Current Understanding of Environmental Effects

Element (c) of Review Task 1 in Section 1.2 requires that hazards be assessed based on the current understanding of environmental effects. The screening assessments ([95],[96],[98]) discussed in Section 5.1.1 and Bruce B PRAs take account of environmental effects specific to the Bruce Power geographical location.

Bruce B is therefore compliant with the requirement to account of environmental effects in assessing external hazards.

5.1.5. Capability of Plant to Withstand Hazard

Element (d) of Review Task 1 in Section 1.2 requires that hazard assessments account for the capability of the plant to withstand the hazard as claimed in the safety case, based on its current condition and with allowance given to predicted ageing degradation.

Probabilistic screening assessments of external hazards ([95] and [96]) have allowed removal of most external hazards from concern in terms of plant capability.

The plant capability to withstand remaining external hazards is determined either by additional external hazards PRAs [98] which quantify the increase in Probabilistic Safety Assessment (PSA) measures (Severe Core Damage Frequency or Large Release Frequency), or by such deterministic assessments as a Fire Hazard Assessment [45] and Fire Safe Shutdown Analysis [46]. Regarding deterministic assessments, Safety Factor 5 identified gap SF5-2, which stated that "…Common-mode failure events are not included in Part 3 of the Safety Report."

The effect of ageing on the plant capability to withstand analyzed external hazards is managed by:

- an ageing management program that includes equipment lifecycle management and fitness-for-service evaluations, covered in more detail in Safety Factors 2 and 4;
- a PRA maintenance program to incorporate up-to-date plant-specific component performance data (covered in more detail in Safety Factor 6). This also fulfils the requirement to update the PSA at least every five years, as per [100].

Bruce B is therefore compliant with the requirement to account for ageing effects in assessing external hazards.

5.1.6. Appropriateness of Procedures to Cover Operator Actions Claimed to Prevent or Mitigate Hazard

Element (e) of Review Task 1 in Section 1.2 requires that the appropriateness of procedures to cover operator actions claimed to prevent or mitigate the hazard be assessed.

Bruce Power has Abnormal Incident Manuals, Emergency Operating Procedures and accident management procedures to guide the response to design basis accidents based on event symptoms, regardless of whether the hazard is internal or external in nature.

Severe Accident Management Guidelines (SAMGs) and Emergency Mitigating Equipment Guides (EMEGs) have been developed to guide the response to Beyond Design Basis Accidents (BDBAs) based on the symptoms of the event. The status and plans for the Bruce Power SAMGs and EMEGs developed under Bruce Power's Severe Accident Management Program are described and assessed in Safety Factor 5.

Bruce B is therefore compliant with the requirement to have procedures in place to cover operator actions to prevent or mitigate external hazards.

5.2. Adequacy of Protection Against Internal Hazards

This task requires that the following representative internal hazards that may affect plant safety should be reviewed (additional site specific internal hazards should be included under this Safety Factor if appropriate):

- Fire (including measures for prevention, detection and suppression of fire);
- Flooding;
- Pipe whip;
- Missiles and drops of heavy loads;

- Steam release;
- Hot gas release;
- Cold gas release;
- Deluge and spray;
- Explosion;
- Electromagnetic or radio frequency interference;
- Toxic and/or corrosive liquids and gases;
- Vibration;
- Subsidence;
- High humidity;
- Structural collapse;
- Loss of internal and external services (cooling water, electricity, etc.);
- High voltage transients; and
- Loss or low capacity of air conditioning (which may lead to high temperatures).

5.2.1. Completeness of List of Internal Hazards

Review Task 2 in Section 1.2 requires that the list of hazards be assessed for completeness.

In the 2008 ISR Review of Safety Factor 7 submitted in [14], the list of assessed internal hazards consisted of:

- Fire (prevention, detection and suppression);
- Flooding;
- Pipe whip;
- Missiles;
- Steam release;
- Spray;
- Toxic gas; and
- Explosion.

The current set of internal hazards to be assessed as per the current PSR Basis Document [5], and as listed in Section 5.2, contains 13 additional internal hazards not explicitly considered in [14]:

- Drops of heavy loads;
- Hot gas release;
- Cold gas release;
- Deluge;
- Electromagnetic or radio frequency interference;
- Toxic and/or corrosive liquids and gases;

- Vibration;
- Subsidence;
- High humidity;
- Structural collapse;
- Loss of internal and external services (cooling water, electricity, etc.);
- High voltage transients; and
- Loss or low capacity of air conditioning (which may lead to high temperatures).

As discussed in Section 5.1.1, Bruce Power undertook a re-evaluation of the site-specific magnitudes of each external event to which the plant might be susceptible, using modern calculations and methods; and an evaluation as to whether the current site-specific design protection for each external event so assessed is sufficient. An extensive screening assessment was conducted, and the list of potential external hazards considered is provided in Table 6. Although deemed external hazards, some of the hazards in Table 6 could be considered as internal hazards as noted in Section 5.2, such as:

- electromagnetic or radio frequency interference; and
- toxic and/or corrosive liquids and gases.

This leaves eleven internal hazards which have not yet been explicitly screened for potential relevance:

- Drops of heavy loads;
- Hot gas release;
- Cold gas release;
- Deluge;
- Vibration;
- Subsidence;
- High humidity;
- Structural collapse;
- Loss of internal and external services (cooling water, electricity, etc.);
- High voltage transients; and
- Loss or low capacity of air conditioning (which may lead to high temperatures).

The Bruce A and Bruce PRA models were modified to comply with requirements of Bruce Power Internal Events Level 1 [102] and Level 2 [103] PRA Guides. The as-modified Level 1 and Level 2 models were submitted to CNSC staff as Enclosures 1 to 4 of [101]. While the revised internal event PRAs may not consider every one of the eleven additional internal hazards listed above, the intent to incorporate all imaginable internal hazard PIEs is nonetheless considered largely fulfilled, and the lack of explicit consideration of every internal hazard in SF7 Review Task 2b is deemed an Acceptable Deviation.

5.2.2. Credible Magnitude and Associated Frequency of Occurrence of Hazard

Element (a) of Review Task 1 in Section 1.2 requires that hazards be assessed taking account of the credible magnitude and associated frequency of occurrence of the hazard.

As noted in Section 5.2.1, this was done in the modified Level 1 and Level 2 PRAs for Bruce A and Bruce B (as Enclosures 1 to 4 of [101]).

5.2.3. Current Safety Standards

Element (b) of Review Task 1 in Section 1.2 requires that hazards be assessed against current safety standards. The standards relevant to internal hazards are discussed in Section 3 and shown to be current. Bruce B is therefore compliant with the requirement to apply current standards in assessing internal hazards.

5.2.4. Current Understanding of Environmental Effects

Element (c) of Review Task 1 in Section 1.2 requires that hazards be assessed based on the current understanding of environmental effects. All equipment required to perform a nuclear safety function in the event of a design basis accident must be qualified to the harsh environmental conditions resulting from such an accident, as per the Bruce B Environmental Qualification Design Guide [37].

Bruce B is therefore compliant with the requirement to account for ageing effects in assessing internal hazards.

5.2.5. Capability of Plant to Withstand Hazard

Element (d) of Review Task 1 in Section 1.2 requires that hazard assessments account for the capability of the plant to withstand the hazard as claimed in the safety case, based on its current condition and with allowance given to predicted ageing degradation.

The plant capability to withstand internal flood is assessed in the Bruce B Internal Flood PRA (summary report submitted in [101]).

The plant's protection against internal fire is assessed in the Bruce B Fire Hazard Assessment [45] and Fire Safe Shutdown Analysis [46].

The issue of assessing effects of pipe whip and jet impingement are reflected in CANDU Safety Issue (CSI) IH6 "Need for systematic assessment of high energy line break effects", originally designated as a Category 3 issue (measures are in place to maintain safety margins, but the adequacy of these measured needs to be confirmed) for all licensees (Section 7.8 of [104]). Bruce Power requested a reclassification of Issue IH6 from Category 3 to lower Category 2 (appropriate measures are in place to maintain safety margins) for both Bruce A and Bruce B, with the Bruce B request based on an assessment that considered the dynamic effects of pipe whip of large HTS piping, and their potential consequences on nuclear safety. The assessment confirmed that the capability to control, cool and contain would not be significantly impaired by

the postulated breaks in containment [105]. CNSC staff agreed to reclassify IH6 as a Category 2 issue for Bruce A and B, provided that probabilistic fracture mechanics calculations be performed to demonstrate that the probability of double-ended guillotine breaks in large diameter high energy piping is acceptably low [106]. Bruce A and B Action Item 1207-3509 was opened to track progress on this issue, and Bruce Power is working with the CANDU Industry in performing the requested probabilistic fracture mechanics calculations.

Loss of internal and external services are considered in the PSA, either as initiating events (loss of switchyard, loss of bulk electricity supply, loss of low pressure service water), or as failure of the support systems (loss of service water, loss of instrument air).

Some of the internal hazards listed in Section 5.2.1 have been assessed as part of the hazard screening and assessment process ([95], [96]) e.g., electromagnetic or radio frequency interference, toxic and/or corrosive liquids and gases, or as part of the PSA itself (steam release, loss of internal and external services).

As noted previously, the focus of Hazard Analysis is to determine the adequacy of protection of the nuclear power plant against hazards, with account taken of the actual plant design, actual site characteristics, and actual plant condition. Therefore, starting from an understanding of the adequacy of the existing design to withstand internal hazards, the effect of ageing on the plant capability to withstand internal hazards is managed by:

- an ageing management program that includes equipment lifecycle management and fitness-for-service evaluations, covered in more detail in Safety Factor 2 and 4;
- a PRA maintenance program to incorporate up-to-date plant-specific component performance data (covered in more detail in Safety Factor 6).

Bruce B is therefore compliant with the requirement to account for ageing effects in assessing internal hazards.

5.2.6. Appropriateness of Procedures to Cover Operator Actions Claimed to Prevent or Mitigate Hazard

Element (e) of Review Task 1 in Section 1.2 requires that the appropriateness of procedures to cover operator actions claimed to prevent or mitigate the hazard be assessed.

Bruce Power has Abnormal Incident Manuals, Emergency Operating Procedures and accident management procedures to guide the response to design basis accidents based on event symptoms, regardless of whether the hazard is internal or external in nature.

SAMGs and EMEGs have been developed to guide the response to BDBAs based on the symptoms of the event. The status and plans for the Bruce Power SAMGs and EMEGs developed under Bruce Power's Severe Accident Management Program is described and assessed in Safety Factor 5.

Bruce B is therefore compliant with the requirement to have procedures in place to cover operator actions to prevent or mitigate internal hazards.

6. Interfaces with Other Safety Factors

There is some degree of interrelationship among most of the 15 Safety Factors that comprise the Bruce B PSR. The following identifies specific aspects of this Safety Factor that are addressed in, or where more detail is provided in, another Safety Factor Report.

- "Safety Factor 1: Plant Design" in Section 5.2, addresses design provisions for internal and external hazards. A clause-by-clause assessment of REGDOC-2.5.2 is performed in Safety Factor 1.
- "Safety Factor 2: Actual Conditions of SSCs" in Section 5.1, addresses the condition and degradation of Structures, Systems and Components (SSCs) important to safety as knowledge of the condition and degradation of SSCs is important when determining what upgrades and improvements are necessary for defense against external hazards.
- "Safety Factor 4: Ageing" in Section 5.9, reviews the existing Bruce Power programmatic guidance which describes how fitness for service monitoring and safety analysis activities are coordinated to ensure that safety margins are adequate and ageing management issues are addressed.
- "Safety Factor 5: Deterministic Safety Analysis" in Section 5.7 describes and assesses the status and plans for Bruce Power SAMGs. A clause-by-clause assessment of CNSC REGDOC-2.4.1 is performed in Safety Factor 5.
- "Safety Factor 6: Probabilistic Safety Analysis" through its assessment against the requirements of CNSC REGDOC-2.4.2 in Appendix B.1, addresses the frequency of occurrence for postulated events and the way that initiating events are identified and the use of PSA to assess the adequacy of the plant for events that are covered by the scope of hazard analysis.

7. Program Assessments and Adequacy of Implementation

Section 7 supplements the assessments of the review tasks in Section 1.2, by providing information on four broad methods used to identify the effectiveness with which programs are implemented, as follows:

- Self-Assessments;
- Internal and External Audits and Reviews;
- Regulatory Evaluations; and
- Performance Indicators.

For the first three methods, the most pertinent self-assessments, audits and regulatory evaluations are assessed. Bruce Power has a comprehensive process of reviewing compliance with Bruce Power processes, identifying gaps, committing to corrective actions, and following up to confirm completion and effectiveness of these actions. While there have been instances of

non-compliance with Bruce Power processes, Bruce Power's commitment to continuous improvement is intended to correct any deficiencies.

For the fourth method, the performance indicators relevant to this Safety Factor are provided. These are intended to demonstrate that there is a metric by which Bruce Power assesses the effectiveness of the programs relevant to this Safety Factor.

Taken as a whole, these methods demonstrate that the processes associated with this Safety Factor are implemented effectively (individual findings notwithstanding). Thus, program effectiveness can be inferred if Bruce Power processes meet the Safety Factor requirements and if there are ongoing processes to ensure compliance with Bruce Power processes. This is the intent of Section 7.

7.1. Self-Assessments

Generally, self-assessments are used by functional areas to assess the adequacy and effective implementation of their programs. The results of each assessment are compared with business needs, the Bruce Power management system, industry standards of excellence and regulatory/statutory or other legal requirements. Where gaps are identified, corrective actions are identified and implemented.

The self-assessments:

- Identify internal strengths and best practices;
- Identify performance and/or programmatic gap(s) as compared to targets, governance standards and "best in class";
- Identify gaps in knowledge/skills of staff;
- Identify the extent of adherence to established processes and whether the desired level quality is being achieved;
- Identify adverse conditions and Opportunities for Improvements (OFI); and
- Identify the specific improvement corrective actions to close the performance/programmatic gap.

Since there are no procedures devoted exclusively to hazard analysis, no self-assessment addressing hazard analysis exclusively was performed. However, a number of self-assessments that interface with hazard analysis, either through management of hazardous materials or operations, through the relevant fire and EQ programs, or through deterministic or probabilistic safety analysis, have been conducted. The relevant FASAs that have been conducted since 2008 are listed in Table 7 as evidence of ongoing program effectiveness.

Table 7: Self Assessments Relevant to Safety Factor 7 Conducted since 2008

Assessment Number	Title
SA-NSAS-2008-03	Review of NSAS Support to Units 1 and 2 Restart Project
SA-PDE-2008-01	EQ Program Requirements
SA-BPMS-2009-02	Program Owner Awareness of N286.05
SA-ENV-2009-03	Zebra Mussel Management Program
SA-MPR-2009-03	Lifting, Rigging and Material Handling
SA-NSAS-2009-04	Support for Bruce Units 1 and 2 Restart and Units 3 and 4 Refurbishment
SA-PDE-2009-03	EQ Barrier Project – Baseline Complete and Sustained
SA-PE-2009-05	WANO AFI SOER 99-1 Rec 3 Loss of Grid
SA-RS-2009-01	Special Project Implementation: SAMG project
SA-CHM-2010-05	Zebra Mussel control Critical review of the current status
SA-COM-2010-02	EQ Program Sustainability
SA-OCP-2010-02	Conduct of Infrequently Performed Tests or Evolutions
SA-PDE-2010-01	Seismic Qualification Procedure Adherence for Bruce A Engineering Changes
SA-SAC-2010-01	Commissioning Readiness FASA for BP-PROG-12.02 & BP-PROG-00.02
SA-SAC-2010-08	Commissioning Readiness FASA for BP-PROG-00.04, 10.01, 10.02 & 10.03
SA-SAC-2010-20	Commissioning Readiness FASA for BP-PROG-00.03
SA-COM-2011-04	Technical Effectiveness of Component & System Condition Monitoring Activities on EQ Applications
SA-COM-2011-12	Restart EQ Procurement – Requirements Identification and Traceability
SA-CSP-2011-05	Bruce A Chemical Cabinets
SA-HP-2011-01	Screening and Evaluating External OPEX
SA-COM-2012-02	EQ Program - Procedure Compliance and Effectiveness
SA-ENV-2012-01	Review of new CSA Standards
SA-COM-2013-07	EQ Program - Procedure Compliance and Effectiveness
SA-SSO-2013-02	Center of Site Scaffolding Processes
SA-EPS-2013-01	Effectiveness of Fire Pre-Define Work
SA-PI-2013-08	External OPEX applicability responses (ongoing)
SA-PI-2013-02	OPEX - Utilization of significant Internal OPEX (ongoing)
SA-MPR-2013-05	Rigging Lifting and Material Handling (ongoing)
SA-COM-2014-07	EQ Program Health
SA-EPS-2014-02	Fire Evacuation & Assembly Protocols
SA-EPS-2014-06	Assess Awareness and Safety Culture re Extreme Events
SA-COM-2015-02	EQ Program Assessment

The following self-assessments were reviewed:

- SA-PDE-2010-01 [107] assessed the application of the BP Seismic Qualification Standard DPT-PDE-00017 and associated procedures to engineering changes at Bruce A. It was found that engineering changes were implemented in such a way as to ensure that seismic qualification of SSCs as identified in the Bruce A Seismic Margin Assessment was preserved.
- SA-COM-2013-07 [108]: Assessment of System Performance Monitoring Plans (SPMPs) and system walkdowns established generally good procedural guidance and proper inclusion of EQ in the procedure DPT-PE-00008 on SPMP.
- SA-COM-2014-07 [109]: Review of maintenance procedures indicated compliance to EQ sustainability requirements. Specific areas for improvement in individual maintenance procedures were identified.
- SA-COM-2015-02 [110]: Review of six years of EQ-related work orders indicated almost no deviation from the requirement that environmental qualification status of equipment be sustained.
- SA-EPS-2013-01 [111]: Review of quality of pre-defines performed by emergency response maintainers, specifically Combustible Free Zone inspections, Hot Work inspections, and scheduled monthly inspections. The only adverse observation is that some pre-defines are not automatically scheduled.
- SA-EPS-2014-06 [112]: Assessment of safety culture around extreme events. Employee familiarity with the events at Fukushima and with subsequent post-Fukushima actions taken by Bruce Power was investigated through interviews. A high degree of awareness of both was found.

7.2. Internal and External Audits and Reviews

The objective of the audit process as stated in BP-PROG-15.01 [113] is threefold:

- To assess the Management System and to determine if it is adequately established, implemented, and controlled;
- To confirm the effectiveness of the Management System in achieving the expected results and that risks are identified and managed; and
- To identify substandard conditions and enhancement opportunities.

The objective is achieved by providing a prescribed method for evaluating established requirements against plant documentation, field conditions and work practices. The process describes the activities associated with audit planning, conducting, reporting, and closing-out. The results of the independent assessments are documented and reported to the level of management having sufficient breadth of responsibility for resolving any identified problems (as stated in Section 5.14.2 of [24]).

Since the Bruce 3 and 4 ISR was completed, a number of Bruce Power audits of significant relevance to this Safety Factor have been conducted. They are listed in Table 8 as evidence of ongoing program effectiveness.

Table 8: Audits Relevant to Safety Factor 7 Conducted since 2008

Audit Number	Title
AU-2008-00004	Fire Protection - Bruce A
AU-2008-00005	Fire Protection - Bruce B
AU-2008-00006	Centre of Site Fire Protection
AU-2008-00023	ERT Fire Response Capability Audit
AU-2008-00025	Emergency Response Plan
AU-2008-00029	Units 1&2 Restart Environmental Qualification Program
AU-2008-00032	OPEX Program
AU-2008-00046	Unit 1 & 2 Quality Program Audit
AU-2009-00001	EMS Program and Compliance
AU-2009-00002	Bruce B Conduct of Operations
AU-2009-00004	PB Design, Documentation and Records Audit
AU-2009-00007	Bruce A Fire Protection Program
AU-2009-00008	Bruce B Fire Protection Program
AU-2009-00019	Units 1 & 2 Restart EQ Program Audit
AU-2009-00039	Conduct of Operations Follow Up July 2009
AU-2009-00041	ERT Fire Drill Capability
AU-2009-00049	Emergency Measures Schedule Compliance
AU-2010-00003	Hazard Waste Management Audit
AU-2010-00005	EMS Program/Compliance Audit
AU-2010-00029	Reporting of S-99 Emergency and Fire Events
AU-2010-00031	N286-05 Implementation
AU-2010-00040	Fire Protection Program
AU-2011-00002	EMS and Environmental Compliance
AU-2011-00006	Nuclear Emergency Plan
AU-2011-00016	Environmental Qualification
AU-2013-00004	Emergency Measures
AU-2013-00007	Bruce Power Management System
AU-2013-00016	Fire Protection Program
AU-2014-00003	Environmental Safety Management
AU-2014-00005	Nuclear Emergency Response Plan
AU-2014-00021	Fire Protection Program Audit Bruce Power 2014
AU-2015-00001	Environmental Safety Management
AU-2015-00008	Seasonal Readiness

Audit Number	Title
AU-2015-00019	Conduct of Lifting Activities
AU-2015-00020	Fire Protection Program

The following internal audits were reviewed:

- AU-2011-00016 [114] had as its objectives an assessment of the completeness, implementation and compliance to BP-PROC-00261 (Environmental Qualification) [36] and its effectiveness, and a verification of EQ process integration within the Bruce Power Management System. It was noted that currently, the EQ sustainability is heavily dependent upon the knowledge and capabilities of the EQ Engineering Section Staff and the adequate integration of the EQ Process within the company's institutionalized programs and processes. Three adverse conditions were noted, culminating in three level 3C Station Condition Records (SCRs).
- AU-2010-00040 [115] was an annual Fire Protection and prevention system audit. It found 10 non-conformances with minor risk, 8 non-conformances with major risk and 2 non-conformances with high risk.
- AU-2013-00016 [116] was an annual Fire Protection Program audit. The audit concluded that the fire protection program satisfactorily meets the requirements of CSA N293-07 [43] and the plant License Conditions. The drill's format and results were found to be acceptable and satisfied the performance criteria prescribed in N293-07. The Plant Condition Inspection found that the facilities were generally compliant with the operational requirements of the N293-07 Standard and the NFCC. The audit resulted in 4 findings culminating in 4 SCRs.
- AU-2014-00021 [117] was an annual Fire Protection Program audit, with the objectives of evaluating the FP Program compliance with CSA 293-07, attending a fire drill to assess Emergency Response Procedure (ERP) performance level to CSA N293-07 Clause 8.3.4.2(h), and attending an annual plant condition inspection. Overall, the audit resulted in 2 findings culminating in SCRs.
- AU-2015-00020 [118] was an annual Fire Protection Program audit, with the objectives of evaluating the FP Program compliance with CSA 293-07, attending a fire drill and attending an annual plant condition inspection. Overall, the audit resulted in 2 findings culminating in SCRs.

7.3. Regulatory Evaluations and Reviews

After a licence is issued, the CNSC stringently evaluates compliance by the licensee on a regular basis. In addition to having a team of onsite inspectors, CNSC staff with specific technical expertise regularly visit plants to verify that licensees are meeting the regulatory requirements and licence conditions. Compliance activities include inspections and other oversight functions that verify a licensee's activities are properly conducted, including planned Type I inspections (detailed audits), Type II inspections (routine inspections), assessments of information submitted by the licensee to demonstrate compliance, and other unplanned inspections in response to special circumstances or events.

Type I inspections are systematic, planned and documented processes to determine whether a licensee program, process or practice complies with regulatory requirements. Type II inspections are planned and documented activities to verify the results of licensee processes and not the processes themselves. They are typically routine inspections of specified equipment, facility material systems or of discrete records, products or outputs from licensee processes.

The CNSC carefully reviews any items of non-compliance and follows up to ensure all items are quickly corrected.

The CNSC inspections relevant to Safety Factor 7 that have been conducted in the last five years are listed in Table 9.

Table 9: CNSC Compliance Inspections Related to Safety Factor 7

Inspection Report Title	Reference
Corporate Emergency Exercise	[119]
Emergency Power Supply System	[120]
Bruce A Unit 1 Walkdown of IIP Post-LOCA Mitigation Modifications	[121]
Transportation Emergency Response Plan	[122]
Environmental Qualification of Bruce A Units 1 and 2	[41]
Reactive Inspection Relating to Initial Lessons Learned from Japanese Nuclear Event	[123]
Fire Protection Inspection of Very Early Warning Air Aspirating Smoke Detection Systems	[124]
Bruce A Environmental Qualification Program Inspection Report	[125]
Units 5-8 Fire Protection Walkdown	[126]
Bruce Power Industrial Fire Brigade	[127]
Ancillary Services Building (ASB) Monthly Fire Protection Walkdown	[128]
Pumphouse and Water Treatment Plant Monthly Fire Protection Walkdown	[129]
Emergency Preparedness and Radiation Protection	[130]
Compliance with Bruce Power Nuclear Emergency Plan	[131]
Fire Protection Walkdown - Bruce A All Units	[132]
EPS Fire Drill – Bruce A and Bruce B	[133]
Bruce B Sustaining Environmental Qualification	[35]
Bruce Power Fall 2013 Emergency Exercise	[134]
Fire Protection Walkdown Units 5-8	[135]
Fukushima Action Item Field Verification	[136]
Bruce Power Fall 2014 Fire Drill	[137]
Fire Protection Bruce A and B	[138]
Fire Drill Bruce A and B	[139]
Fukushima Verifications	[140]

The two inspections documented in [138] and [139] are of particular relevance to fire protection:

A recent CNSC inspection of the Bruce Power Fire Protection programme, with focus on compliance with CSA N293-07, concluded [138] that Bruce Power's Fire Protection Program is in compliance with the licence requirements and licensee staff are following approved company procedures. However, some procedural improvements are required for Combustible Free Zones and Transient Material Permits.

The CNSC conducted an inspection of the fire drill component of the Fire Response program by observing a fire drill at Bruce A and B. The inspection report [139] concludes that CNSC staff are satisfied that Bruce Power demonstrated a response to a Standby Generator fire scenario which met the expectations of CSA N293-07 and of National Fire Protection Association NFPA) guidelines NFPA 600-05 and NFPA 1081-07. However, there were minor non-compliances with licensee procedures where CNSC staff requested further corrective actions.

7.4. Performance Indicators

Performance indicators are defined as data that are sensitive to and/or signal changes in the performance of systems, components, or programs.

There are no specific performance indicators associated with hazard analysis or any of the relevant programs and procedures.

8. Summary and Conclusions

The overall objectives of the Bruce B PSR are to conduct a review of Bruce B against modern codes and standards and international safety expectations, and to provide input to a practicable set of improvements to be conducted during the MCR in Units 5 to 8, as well as U0B, and during asset management activities to support ongoing operation of all four units, that will enhance safety to support long term operation. The specific objective of the review of this Safety Factor is to determine the adequacy of protection of the nuclear power plant against internal and external hazards with account taken of the actual plant design, actual site characteristics, the actual condition of SSCs and their predicted state at the end of the period covered by the PSR, and current analytical methods, safety standards and knowledge. This specific objective has been met by the completion of the review tasks specific to hazard analysis.

No specific strengths were identified specific to hazard analysis.

Table 10 summarizes the key issue arising from the Periodic Safety Review of Safety Factor 7.

Table 10: Key Issues

Issue Number	Gap Description	Source(s)
SF7-1	Definition of DBE for purposes of seismic qualification of SSCs important to safety is not consistent with the 2013 version of the CSA standard.	Section 5.1.2 Micro-gaps against guidance clause: REGDOC-2.5.2 Clause 7.13.1

Based on this review, it is concluded that Bruce B complies with the requirements of the most recent codes and standards related to Hazard Analysis, with the exception of the issue noted in Table 10.

9. References

[1] NK21-CORR-00531-12136/NK29-CORR-00531-12546/E-DOC 4723908 , Nuclear Power Reactor Operating Licence, Bruce Nuclear Generating Stations A and B, PROL 18.00/2020, Canadian Nuclear Safety Commission, May 27, 2015.

[2] NK21-CORR-00531-12135/NK29-CORR-00531-12545/E-DOC 4659316, Licence Conditions Handbook, LCH-BNGS-R000, Bruce Nuclear Generating Station A and Bruce Nuclear Generating Station B Nuclear Reactor Operating Licence, PROL 18.00/2020 (Effective: June 1, 2015), Canadian Nuclear Safety Commission, May 27, 2015.

[3] CNSC REGDOC-2.3.3, Operating Performance: Periodic Safety Reviews, CNSC, April 2015.

[4] BP-PROC-01024-R000, Periodic Safety Reviews, Bruce Power, November 7, 2015.

[5] NK29-CORR-00531-12932, Bruce B Periodic Safety Review Basis Document, Bruce Power Letter, F. Saunders to K. Lafrenière, January 25, 2016.

[6] NK21-CORR-00531-11005/NK29-CORR-00531-11397, Submission of Safety Basis Report, Bruce Power Letter, F. Saunders to R. Lojk, December 30, 2013.

[7] NK21-CORR-00531-00514, Bruce A: CNSC Approval to Restart Units 3 and 4 and Application to Amend PROL 15.01/2003, Bruce Power Letter, F. Saunders to J.H.M. Douglas, November 16, 2001.

[8] NK21-CORR-00531-04636, Bruce A Units 1 and 2 Return to Service: Systematic Review of Safety – Basis, Bruce Power Letter, F. Saunders to D.A. Desjardins, December 22, 2006.

[9] NK21-CORR-00531-04059, Bruce A Refurbishment for Life Extension – Systematic Review of Safety: Plant Design, Bruce Power Letter, F. Saunders to P. Webster, March 30, 2006.

[10] NK21-CORR-00531-04339, Bruce A Units 1 and 2 Return to Service – Systematic Review of Safety, Bruce Power Letter, F. Saunders to P. Webster, July 31, 2006.

[11] NK21-CORR-00531-05749, Bruce A Refurbishment for Life Extension and Continued Operation of Units 3 and 4 – Integrated Safety Review Basis, Bruce Power Letter, F. Saunders to P. Elder, February 29, 2008.

[12] NK21-CORR-00531-05976, Bruce A Units 3 and 4 Refurbishment for Life Extension and Continued Operations: ISR Safety Factor Reports, Bruce Power Letter, F. Saunders to P. Elder, June 2, 2008.

[13] NK21-CORR-00531-06596, Bruce A Units 3 and 4 Refurbishment for Life Extension and Continued Operation: ISR Safety Factor Reports 1, 2, 3 and 4, Bruce Power Letter, F. Saunders to K. Lafrenière, December 18, 2008.

[14] NK21-CORR-00531-06076, Bruce A Units 3 and 4 Refurbishment for Life Extension and Continued Operation: ISR Safety Factor Reports 5, 6, and 7, Bruce Power Letter, F. Saunders to P. Elder, July 22, 2008.

[15] NK21-REP-03600-00025-R001, Bruce NGS A Units 3 and 4 Global Assessment Report and Integrated Implementation Plan, May 29, 2009.

[16] NK21-CORR-00531-11617, Integrated Safety Review for Bruce A, Bruce Power Letter, F. Saunders to K. Lafrenière, including enclosure K-421231-00010-R00, Candesco Report, October 27, 2014.

[17] NK21-CORR-00531-12269, Bruce A Integrated Safety Review – Safety Factor Reports, Bruce Power Letter, F. Saunders to K. Lafrenière, August 27, 2015.

[18] NK21-CORR-00531-10576/NK29-CORR-00531-10975, Application Requirements for Renewal of Power Reactor Operating Licences for Bruce Nuclear Generating Stations A and B, Bruce Power Letter, F. Saunders to R. Lojk, July 17, 2013.

[19] NK29-CORR-00531-11252, Application for the Renewal of the Power Reactor Operating Licence for Bruce Nuclear Generating Station B, Letter, F. Saunders to M. Leblanc, October 31, 2013.

[20] NK21-CORR-00531-11711/NK29-CORR-00531-12101, Bruce A and Bruce B Licence Renewal – Supplemental Update, F. Saunders to M. Leblanc, November 27, 2014.

[21] NK21-CORR-00531-11715/NK29-CORR-00531-12105, Bruce Power: Requests and Supplemental Information for Licence Renewal, F. Saunders to M. Leblanc, November 28, 2014.

[22] Nuclear Safety and Control Act, 1997, c. 9, N-28.3, Assented to March 20, 1997.

[23] CNSC REGDOC-2.4.1, Deterministic Safety Analysis, CNSC, May 2014.

[24] CAN/CSA N286-05, Management System Requirements for Nuclear Power Plants, CSA, February 2005, (Update No.2, 2010), R2010.

[25] CAN/CSA N286-12, Management System Requirements for Nuclear Facilities, CSA, June 2012.

[26] CAN/CSA N286.7-99, Quality Assurance of Analytical, Scientific and Design Computer Programs for Nuclear Power Plants, CSA, March 1999, R2012.

[27] CSA N290.13-05, Environmental Qualification of Equipment for CANDU Nuclear Power Plants, CSA, February 2005, R2010.

[28] CAN/CSA N290.15-10, Requirements for the Safe Operating Envelope of Nuclear Power Plants, CSA, August 2010.

[29] CSA N293-12, Fire Protection for Nuclear Power Plants, CSA, October 2012.

[30] NK21-CORR-00531-11494, Response to Bruce Power Letter, Response to Bruce Power letter, CSA N286-12 “Management system requirements for nuclear facilities”, Action Item 1307-4697, CNSC Letter, K. Lafrenière to F. Saunders, July 24, 2014.

[31] NK21-CORR-00531-11189/NK29-CORR-00531-11593, Action Item 1307-4697: CSA N286-12 - Management System Requirements for Nuclear Facilities, Bruce Power Letter, F. Saunders to K. Lafrenière, May 16, 2014.

[32] NK21-CORR-00531-11563/NK29-CORR-00531-11946, CSA N286-12 - Management System Requirements for Nuclear Facilities, Action Item 1307-4697, Bruce Power Letter, F. Saunders to K. Lafrenière, September 9, 2014.

[33] NK21-CORR-00531-12570/NK29-CORR-00531-12996, Action Item 1307-4697: CSA N286-12 - Management Systems Requirements for Nuclear Facilities, Bruce Power Letter, F. Saunders to K. Lafrenière, January 29, 2016.

[34] BP-PROC-00363-R003, Nuclear Safety Assessment, Bruce Power, January 24, 2013.

[35] NK29-CORR-00531-08745, Bruce B Sustaining Environmental Qualification - CNSC Compliance Inspection Report BRPD-2010-B-002, CNSC Letter, K. Lafrenière to F. Saunders, March 30, 2010.

[36] BP-PROC-00261-R005, Environmental Qualification, Bruce Power, November 7, 2012.

[37] NK29-DG-03650-003-R007, Environmental Qualification of Safety-Related Equipment, June 2012.

[38] NK29-CORR-00531-08811, Action Item 101401: CNSC Type II Compliance Inspection Report BRPD-2010-B-002, Bruce Power Letter, F. Saunders to K. Lafrenière, June 15, 2010.

[39] NK29-CORR-00531-08910, Action Item 101401: CNSC Type II Compliance Inspection Report BRPD-2010-B-002, Bruce Power Letter, F. Saunders to K. Lafrenière, August 9, 2010.

[40] NK29-CORR-00531-09294, Action Item 101401: Bruce B Sustaining Environmental Qualification - CNSC Compliance Inspection Report BRPD-2010-B-002, CNSC Letter, K. Lafrenière to F. Saunders, March 1, 2011.

[41] NK21-CORR-00531-10094, Bruce A CNSC Compliance Inspection Report BRPD-R-2012-038, Environmental Qualification of Bruce A Units 1 and 2, December 12, 2012.

[42] NK21-CORR-00531-12337/NK29-CORR-00531-12770, Bruce A and Bruce B CSA N290.15 Compliance Update, Bruce Power Letter, F. Saunders to K. Lafrenière, September 30, 2015.

[43] CSA N293-07, Fire Protection for CANDU Nuclear Power Plants, CSA, January 2008.

[44] B-REP-00701-29NOV2013-059-R000, Assessment of Fire Protection at Bruce Power, Bruce Power, November 29, 2013.

[45] NK29-REP-71400-00004-R004, Bruce NGS B Fire Hazards Assessment, Bruce Power, January 2013.

[46] NK29-REP-71400-00003-R003, Bruce NGS B Fire Safe Shutdown Analysis, Bruce Power, December 2012.

[47] NK29-REP-71400-00002-R003, Bruce NGS B Fire Protection Code Compliance Review, Bruce Power, December 2012.

[48] NK21-CORR-00531-11574/NK29-CORR-00531-11955, Action Item 1207-3890: CSA N293 Transition Summary Report, Bruce Power Letter, F. Saunders to K. Lafrenière, October 3, 2014.

[49] CNSC R-77, Overpressure Protection Requirements for Primary Heat Transport Systems in CANDU Power Reactors Fitted with Two Shutdown Systems, CNSC, October 1987.

[50] CNSC RD-346, Site Evaluation for New Nuclear Power Plants, CNSC, November 2008.

[51] CNSC REGDOC-2.5.2, Design of Reactor Facilities: Nuclear Power Plants, CNSC, May 2014.

[52] B-REP-09701-16MAY2016, Bruce NGS A and Bruce NGS B Compliance to Overpressure Protection Requirements of CNSC Regulatory Document R-77, May 16, 2016.

[53] IAEA NS-R-3, Site Evaluation for Nuclear Installations, IAEA Safety Requirements, November 2003.

[54] NK29-REP-07730-00001-R001, New Fuel Project for Bruce B: Environmental Assessment Study Report, October 22, 2004.

[55] IAEA SSG-25, Periodic Safety Review of Nuclear Power Plants, IAEA, March 2013.

[56] Darlington-DG-38-03650-2A, Common Mode Incidents – Overview and Design Requirements.

[57] Darlington-DG-38-03650-2B, Common Mode Incidents – Seismic Design.

[58] Darlington-DG-38-03650-3-R005, Limiting Consequential Damage of Postulated Pipe Ruptures, March 1985.

[59] National Building Code of Canada, Government of Canada, 2015.

[60] National Fire Code of Canada, Government of Canada, 2015.

[61] Significant Technical Changes in the 2010 National Model Construction Codes, NRC Website, https://www.nrc-cnrc.gc.ca/ci-ic/article/v15n4-2.

[62] Codes Canada 2015: Significant Technical Changes, NRC Website, http://www.nrc-cnrc.gc.ca/eng/solutions/advisory/codes_centre/technical_changes_2015.html.

[63] NK29-DG-03650-002-R007, Seismic Qualification of Safety-Related Systems, June 2012.

[64] NK29-DG-03650-006-R004, Containment Provisions for Extensions of the Containment Envelope, December 2005.

[65] BP-MSM-1-R012, Management System Manual, Bruce Power, June 2014.

[66] BP-PLAN-00008-R004, Fire Safety Management, Bruce Power, September 14, 2015.

[67] BP-PROG-10.01-R009, Plant Design Basis Management, Bruce Power, December 4, 2014.

[68] BP-PROC-00335-R007, Design Management, Bruce Power, July 30, 2015.

[69] BP-PROG-00.02-R009, Environmental Safety Management, Bruce Power, October 22, 2014.

[70] BP-PROG-08.01-R008, Emergency Management Program, Bruce Power, November 3, 2015.

[71] SEC-EQD-00021-R003, Environmental Qualification Assessments, Bruce Power, December 6, 2012.

[72] SEC-EQD-00031-R002, Preparation of Environmental Qualification Dossiers, Bruce Power, June 27, 2011.

[73] DPT-PDE-00017-R005, Bruce Power Seismic Qualification Standard, Bruce Power, July 4, 2012.

[74] BP-PROC-00500-R001, Control of Unsecured Equipment in Seismically Qualified Areas, Bruce Power, December 10, 2008.

[75] DPT-PDE-00027-R003, Fire Hazard Assessment Preparation and Maintenance, Bruce Power, October 29, 2013.

[76] DPT-PDE-00028-R004, Fire Safe Shutdown Analysis Maintenance, Bruce Power, October 28, 2013.

[77] DPT-PDE-00029-R003, Fire Protection Code Compliance Review Maintenance, Bruce Power, November 20, 2013.

[78] DPT-PDE-00030-R003, Fire Protection Technical Evaluations Preparation Review and Acceptance, Bruce Power, December 10, 2013.

[79] DPT-PDE-00031-R005, Third Party Review – Fire Protection, Bruce Power, August 22, 2013.

[80] DPT-NSAS-00001-R006, Quality Assurance of Nuclear Safety Analysis, Bruce Power, August 20, 2014.

[81] DPT-NSAS-00015-R004, Planning and Execution of Nuclear Safety Assessments, Bruce Power, October 16, 2013.

[82] DPT-RS-00002-R000, Risk Assessment of Operational Events, Bruce Power, January 31, 2007.

[83] DPT-RS-00006-R001, Outage and Inage Risk Management, Bruce Power, January 28, 2011.

[84] DPT-RS-00004-R001, Risk Assessment of Proposed Changes to Engineering, Operations, Surveillance and Maintenance, Bruce Power, October 4, 2011.

[85] DPT-RS-00007-R001, Preparation and Maintenance of Probabilistic Risk Assessments, Bruce Power, February 15, 2007.

[86] B-REP-03611-00007 R002, Bruce Power Probabilistic Risk Assessment (PRA) Guide – Internal Flood, Bruce Power [see Enclosure 1 of NK21-CORR-00531-10067/NK29-CORR-00531-10486, Internal Fire and Internal Flood Probabilistic Risk Assessment (PRA) Guides, Bruce Power Letter F. Saunders to R. Lojk, January 2, 2013].

[87] B-REP-03611-00008 R001, Bruce Power Probabilistic Risk Assessment (PRA) Guide – Internal Fire, Bruce Power [see Enclosure 2 of NK21-CORR-00531-10067/NK29-CORR-00531-10486, Internal Fire and Internal Flood Probabilistic Risk Assessment (PRA) Guides, Bruce Power Letter F. Saunders to R. Lojk, January 2, 2013].

[88] B-REP-03611-00009-R001, Bruce Power Seismic PRA Guide, Bruce Power, October 2012 [see Enclosure 1 of NK21-CORR-00531-09763/NK29-CORR-00531-10249, Bruce Power Level 1 Seismic Probabilistic Risk Assessment (PRA) Guide, Bruce Power Letter, F. Saunders to R. Lojk, November 1, 2012].

[89] B-REP-03611-00011-R001, Bruce Power PRA Guide, Screening and Disposition of External Hazards, Bruce Power, February 2014.

[90] B-REP-03611-00012-R000, Bruce Power PRA Guide, High Wind Hazard, Bruce Power, November 2012.

[91] B-REP-03611-00013-R000, Bruce Power PRA Guide, External Flooding, Bruce Power, April 2014, [see Enclosure 1 of NK21-CORR-00531-11599/NK29-CORR-00531-11983, August 25, 2014].

[92] B-03611.2-31JAN2013, Methodology for the Assessment of Seismic Events Leading to Consequential Internal Fire or Internal Flood, Enclosure 1 of NK21-CORR-00531-10192/ NK29-CORR-00531-10597, February 11, 2013.

[93] NK21-CORR-00531-09676/NK29-CORR-00531-10193, Bruce Power Progress Report No. 1 on CNSC Action Plan – Fukushima Action Items, Bruce Power Letter, F. Saunders to R. Lojk, July 16, 2012.

[94] NK21-CORR-00531-09253/NK29-CORR-00531-09881, Submission of Revised Bruce Power Probabilistic Risk Assessment Guide – Screening and Disposition of External Events, Bruce Power Letter, F. Saunders to R. Lojk, March 9, 2012.

[95] NK21-CORR-00531-09809/NK29-CORR-00531-10287, Bruce A and B External Hazard Assessment, Bruce Power Letter, F. Saunders to R. Lojk, September 28, 2012.

[96] NK21-CORR-00531-10848/NK29-CORR-00531-11226, Bruce A and B External Hazard Assessment, Bruce Power Letter, F. Saunders to R. Lojk, December 12, 2013.

[97] NK21-CORR-00531-09969/NK29-CORR-00531-10409, Methodology for Tornados, High Winds and External Flooding, Bruce Power Letter, F. Saunders to R. Lojk, November 27, 2012.

[98] NK21-CORR-00531-11324/NK29-CORR-00531-11729, Submission of S-294 Probabilistic Risk Assessment Final Reports, Bruce Power Letter, F. Saunders to K. Lafrenière, July 31, 2014.

[99] CSA N289.1-08 (R2013), General Requirements for Seismic Design and Qualification of CANDU Nuclear Power Plants, CSA, 2008, Reaffirmed 2013.

[100] CNSC REGDOC-2.4.2, Probabilistic Safety Assessment (PSA) for Nuclear Power Plants, CNSC, May 2014.

[101] NK21-CORR-00531-10958/NK29-CORR-00531-11342, Submission of S-294 Probabilistic Risk Assessment Deliverables, Bruce Power Letter, F. Saunders to R. Lojk, December 24, 2013.

[102] B-REP-03611-00005-R001, Level 1 At-Power Internal Events Probabilistic Risk Assessment (PRA) Guide, June 2011.

[103] B-REP-03611-00010-R001, Level 2 At-Power Internal Events Probabilistic Risk Assessment (PRA) Guide, October 2012.

[104] N-REP-03611-0381169, Application of the CNSC Risk-Informed Decision Making Process to Category 3 CANDU Safety Issues, Canadian Nuclear Safety Commission Report, August 2009.

[105] NK21-CORR-00531-09435/NK29-CORR-00531-10019, CANDU Category III Safety Issues: Request for Reclassification of AA3, PF 20, SS5 and IH6, Bruce Power Letter, F. Saunders to G. Rzentkowski, June 25, 2012.

[106] NK21-CORR-00531-09822/NK29-CORR-00531-10295, Reclassification of Category 3 CANDU Safety Issue IH6: "Need for systematic assessment of high energy line break effects" to Category 2, New Action Item 1207-3509, CNSC Letter, R. Lojk to F. Saunders, August 29, 2012.

[107] SA-PDE-2010-01, Seismic Qualification Procedure Effectiveness & Adherence, Bruce Power Plant Design Engineering Department FASA Report, June 29, 2010.

[108] SA-COM-2013-07, EQ Program – Procedure Compliance and Effectiveness, Bruce Power Plant Procurement and EQ Engineering Department FASA Report, November 11, 2013.

[109] SA-COM-2014-07, EQ Program - Sustainability, Bruce Power Plant Procurement and EQ Engineering Department FASA Report, December 11, 2014.

[110] SA-COM-2015-02, EQ Program Assessment, Bruce Power Plant Procurement and EQ Engineering Department FASA Report, September 1, 2015.

[111] SA-EPS-2013-01, Effectiveness of Fire Pre-Define Work, Bruce Emergency Services Department FASA Report, August 15, 2013.

[112] SA-EPS-2014-06, Assess Aware and Safety Culture re Extreme Events, Bruce Emergency Services Department FASA Report, March 31, 2014.

[113] BP-PROG-15.01-R004, Nuclear Oversight Management, Bruce Power, December 18, 2013.

[114] AU-2011-00016, EQ Process Audit, Bruce Power, August 2011.

[115] AU-2010-00040, Annual Fire Protection Audit, Bruce Power, November 2010.

[116] AU-2013-00016, Third Party Fire Protection Program Audit, January 2014.

[117] AU-2014-00021, Third Party Fire Protection Program Audit, December 2014.

[118] AU-2015-00020, Third Party Fire Protection Program Audit, December 2015.

[119] NK21-CORR-00531-08814/NK29-CORR-00531-09535, Action Item 100719: Bruce A/B CNSC Compliance Inspection Report BRPD-2010-AB-009, Bruce Power Corporate Emergency Exercise, CNSC Letter, K. Lafrenière to F. Saunders, July 12, 2011.

[120] NK29-CORR-00531-09995, Bruce B CNSC Compliance Inspection Report BRPD-B-2012-021 Emergency Power Supply System Inspection, CNSC Letter, R. Lojk to F. Saunders, March 30, 2012.

[121] NK21-CORR-00531-09659, BRPD-R-2012-024: Bruce A Unit 1 Walkdown of IIP Post-LOCA Mitigation Modifications, CNSC Letter, R. Lojk to F. Saunders, June 28, 2012.

[122] NK21-CORR-00531-08366/NK29-CORR-00531-09152/NK37-CORR-00531-01653, Transportation Emergency Response Plan CNSC Compliance Inspection Report EMPD-BP-2010-T18441, CNSC Letter, K. Lafrenière to F. Saunders, December 10, 2010.

[123] NK21-CORR-00531-08610/NK29-CORR-00531-09356, Action Items 110716, 110717 and 111402: Reactive Inspection Relating to Initial Lessons Learned from Japanese Nuclear Event, CNSC Letter, K. Lafrenière to F. Saunders, March 29, 2011.

[124] NK21-CORR-00531-08299/NK29-CORR-00531-09114, Bruce A and B CNSC Compliance Inspection Report BRPD-2010-AB-011 Bruce Power Fire Protection Inspection of Very Early Warning Air Aspirating Smoke Detection Systems, CNSC Letter, K. Lafrenière to F. Saunders, November 16, 2010.

[125] NK21-CORR-00531-06188, Inspection of the Bruce A Environmental Qualification Program, Report No. SED-BA-2005-T3452-06, Revision 1, CNSC Letter, P. Elder to F. Saunders, June 20, 2008.

[126] NK29-CORR-00531-08810, Bruce B CNSC Compliance Inspection Report BRPD-2010-B-031 Units 5-8 Fire Protection Walkdown, CNSC Letter, K. Lafrenière to F. Saunders, May 11, 2010.

[127] NK21-CORR-00531-07314/NK29-CORR-00531-08381, Bruce Power Industrial Fire Brigade Type II Inspection, CNSC Letter, K. Lafrenière to F. Saunders, August 14, 2009.

[128] NK21-CORR-00531-07244, Bruce A CNSC Compliance Inspection Report BRPD-2009-A-042 Bruce A – Ancillary Services Building (ASB) Monthly Fire Protection Walk Down, CNSC Letter, K. Lafrenière to F. Saunders, July 16, 2009.

[129] NK21-CORR-00531-07245, Bruce A CNSC Compliance Inspection Report BRPD-2009-A-041 Bruce A, Unit 1, 2, 3, 4 Pumphouse and Water Treatment Plant Monthly Fire Protection Walkdown, CNSC Letter, K. Lafrenière to F. Saunders, July 16, 2009.

[130] NK29-CORR-00531-07937, Type II Inspection – IDB-2008-B-040 Bruce B – Emergency Preparedness and Radiation Protection Walk Down Inspection, CNSC Letter, K. Lafrenière to F. Saunders, January 12, 2009.

[131] NK21-CORR-00531-06157/NK29-CORR-00531-07504, Type I Inspection Notification – Compliance with Bruce Power Nuclear Emergency Plan, CNSC Letter, P. Elder to F. Saunders, June 5, 2008.

[132] NK21-CORR-00531-10158, CNSC Type II Compliance Inspection Report: Fire Protection Walkdown Bruce A All Units, Report # BRPD-A-2012-021, CNSC Letter, R. Lojk to F. Saunders, January 10, 2013.

[133] NK21-CORR-00531-10589/NK29-CORR-00531-10984, Action Item 1307-4158: EPS Fire Drill Bruce A and B, BRPD-AB-2013-007, CNSC Letter, R. Lojk to F. Saunders, June 11, 2013.

[134] NK29-CORR-00531-11477, CNSC Type II Compliance Inspection Report BRPD-AB-2013-019: Bruce Power Fall 2013 Emergency Exercise, CNSC Letter, R. Lojk to F. Saunders, January 29, 2014.

[135] NK29-CORR-00531-11412, CNSC Type II Compliance Inspection Report: BRPD-B-2013-009 – Fire Protection Walkdown Units 5-8, CNSC Letter, R. Lojk to F. Saunders, December 20, 2013.

[136] NK21-CORR-00531-11381/NK29-CORR-00531-11784, CNSC Type II Compliance Inspection Report BRPD-AB-2014-005: Fukushima Action Item Field Verification, CNSC Letter, K. Lafrenière to F. Saunders, June 3, 2014.

[137] NK21-CORR-00531-11804/NK29-CORR-00531-12192, Action Item 2014-07-5701: CNSC Type II Compliance Inspection Report BRPD-AB-2014-017, Bruce Power Fall 2014 Fire Drill, CNSC Letter, K. Lafrenière to F. Saunders, December 18, 2014.

[138] NK21-CORR-00531-11848/NK29-CORR-00531-12243, CNSC Type II Compliance Inspection Report: BRPD-AB-2014-019 Fire Protection Bruce A and B, CNSC Letter, K. Lafrenière to F. Saunders, January 13, 2015.

[139] NK21-CORR-00531-12213/NK29-CORR-00531-12641, Action Item 2015-07-6751: CNSC Type II Compliance Inspection Report: BRPD-AB-2015-002 Fire Drill Bruce A and B, CNSC Letter, K. Lafrenière to F. Saunders, July 14, 2015.

[140] NK21-CORR-00531-12278/NK29-CORR-00531-12707, Action Item 2015-07-6855: CNSC Type II Compliance Inspection Report: BRPD-AB-2015-004 Fukushima Verifications, CNSC Letter, K. Lafrenière to F. Saunders, August 10, 2015.

[141] Comparison of Snow Loads 2005 and 2010 in Kincardine, http://foretruss.com/includes/2005GSL.pdf.

Appendix A – High-Level Assessments Against Relevant Codes and Standards

A.1. National Building and Fire Codes of Canada – Introduction

Sections A.2 and A.3, respectively, present the high level assessment of those sections of the 2015 versions of the NBCC and NFCC that are new or changed compared to the corresponding 2005 versions. These sections are established based on the code-to-code assessments provided in Appendix C (Section C.2), with sections not relevant to Bruce Power excluded.

It is important to note that Bruce Power has made significant improvements in overall fire protection, and has committed to continuing to do so. In [48], a seven year plan to implement the prioritized Fire Protection Capital Projects for N293-07 improvements was presented. Most of these initiatives are now part of the Bruce Power Integrated Implementation Plan. Table A1, which is excerpted from the 2016 Bruce A and B Global Assessment Report and Integrated Implementation Plan, provides clear evidence of Bruce Power's commitment to improvement in fire protection. In view of this, no new gaps were identified in Sections A.2 and A.3.

Table A1: List of CNSC Commitments Related to Fire Protection Included in Integrated Implementation Plan

Racer #	Project	Title
511	38744	Bruce B Main Control Panel PL18A Upgrade
357	32100	BA ASB Fire Protection Upgrades
322	37465	BB U0 Fuel Storage Area Sprinkler Upgrades
520	38745	Bruce B Fireworks Terminal Replacement
488	38730	Unit 1 and 2 Fire Upgrades (Restart)
521	38743	Bruce B Firewater Pipe Replacement
227	31723	BA Standby Generator Building Fire Protection Upgrade
2111		Bruce B Fire Detection Upgrade
2110		Bruce B VESDA Upgrade
2117		Bruce B Fire Barriers (Cable Wrap) upgrades
2116		Air Foam System Replacement
238	31711	BB Standby Generator Building Fire Protection Upgrade
1008		Bruce A Fire Barriers Upgrades
239	31712	BB EPG / EWPS Building Fire Protection Upgrade
2511		Unit 1 and 2 Fire Upgrades (Restart) - DCP 3270
2107		Bruce A VESDA Upgrade MCR/CER
2508		Unit 8 Fire Upgrades - DCP 3328

A.2. National Building Code of Canada

A.2.1. Incremental Assessment of Changes from 2005 to 2010 Editions

Part 3: Fire Protection, Occupant Safety and Accessibility

Section	Section Change	Assessment
Fire Alarm Systems and Smoke Alarms (also Part 9)	New requirements and clarifications were introduced for smoke alarm placement, commissioning of life safety and fire safety systems, and when fire alarm components must be installed.	Superseded by more specific technical requirements for design and installation requirements for fire alarms in CSA N293-12 Section 7.2. There, “fire detectors” include both heat detectors and smoke detectors. Furthermore, as shown in Table A1, Bruce Power is upgrading the Bruce B Fire Detection (Racer 2111).
Penetrations Through Fire Separations (also Part 9)	Definitions for “fire stops” and “fire blocks” have been added, as were several changes addressing penetrations through fire separations. Requirements involving attics that do not have sprinklers were clarified.	Superseded by requirements for fire separations and penetrations through fire separations in CSA N293-12 Section 6.5. Bruce units do not have attics.
Exit Signs and Markings (also Part 9)	Requirements addressing green pictograms conforming to ISO standards and photoluminescent exit signs were introduced.	Superseded by requirements for egress route signage in CSA N293-12 Section 6.6.1.
Stairs, Ramps, Handrails and Guards (also Part 9)	A set of 31 changes address inconsistencies between Part 3 and Part 9 regarding the respective requirements for stairs, ramps, handrails and guards. Many clarifications were also added.	CSA N293-12 Section 6.6.1.1 states “Interior aisles, corridors, stairs, walkways, catwalks, and platforms used for egress shall meet NBCC requirements for width, height, treads, risers, guards, handrails, and headroom”

Part 4: Structural Design

Section	Section Change	Assessment
Wind Loads	Buildings with very long periods of vibration, one of the most important factors determining how a structure will respond to external forces, must now be designed by experimental methods; dynamic calculations are no longer acceptable.	Superseded by REGDOC-2.5.2 [51] Section 7.4.2 requirement that "All natural and human-induced external hazards that may be linked with significant radiological risk shall be identified. External hazards which the plant is designed to withstand shall be selected, and classified as DBAs or DECs. Various interactions between the plant and the environment, such as population in the surrounding area, meteorology, hydrology, geology and seismology shall be identified during the site evaluation and environmental assessment processes. These interactions shall be taken into account in determining the design basis for the NPP. Applicable natural external hazards shall include such hazards as earthquakes, droughts, floods, high winds, tornadoes, tsunami, and extreme meteorological conditions."
Earthquake Design	Revisions were made to requirements related to site properties, irregularities, steel structures, static and dynamic procedures, and diaphragms.	Superseded by seismic design requirements in CSA N289.1-08 (R2013) [99], CSA N289.2-10 (R2015), CSA N289.3-10 (R2015) and CSA N289.4-12.

Part 5: Environmental Separation

Section	Section Change	Assessment
Structural Loads	Seismic effects will now be taken into account only for post-disaster buildings (i.e. buildings essential to the continued provision of services in the event of a disaster).	Superseded by seismic design requirements in CSA N289.1-08 (R2013) [99], CSA N289.2-10 (R2015), CSA N289.3-10 (R2015) and CSA N289.4-12.
Windows, Doors and Skylights (also Part 9)	A new, harmonized North American standard for windows, doors and skylights is now referenced in the NBC. This resulted in a substantial reorganization of Sections 9.6 and 9.7.	CSA N293-12 requirements regarding windows and door as fire barriers, and regarding windows, doors and skylights as access and egress routes, supersede these reorganized NBCC sections.
Sealant Standards (also Part 9)	Outdated standards for sealants were replaced with current ASTM standards that address relevant product categories and contain equivalent or similar performance criteria.	Superseded by requirements regarding sealants in CSA N287 standards for concrete containment structures, specifically N287.1-14, N287.2-08, N287.3-14, N287.4-09, N287.5-11, N287.6-11, N287.7-08.

Part 6: Heating, Ventilation and Air-conditioning

Section	Section Change	Assessment
Ventilation	New requirements relating to acceptable building air ventilation have been added. They specify maximum levels of particulate matter, ground-level ozone and carbon monoxide in air for building ventilation purposes.	Superseded by CNSC REGDOC-2.5.2 (Clause 7.10), which states: “The safety support systems shall ensure that the fundamental safety functions are available in operational states, DBAs and DECs. Safety support systems provide services such as electrical power, compressed air, water, and air conditioning and ventilation to systems important to safety.”

Part 9: Housing and Small Buildings

Section	Section Change	Assessment
Lateral Loads	A probabilistic-based approach for exposure to wind and seismic forces using environmental load data was added, as were prescriptive requirements for high-load areas. The concept of braced wall panels was introduced. Requirements for fastening and framing based on local wind and seismic conditions have also been added.	Superseded by: • Seismic design requirements in CSA N289.1-08 (R2013) [99], CSA N289.2-10 (R2015), CSA N289.3-10 (R2015) and CSA N289.4-12; • Requirements for consideration of external hazards in REGDOC-2.5.2 [51] Section 7.4.2; • Requirements for probabilistic treatment of external hazards in REGDOC-2.4.2 [100] Section 4.8.
Low Permeance Materials in the Building Envelope	A simplified approach to requiring the correct position and properties for low air and vapour permeance materials in building envelopes was introduced.	These changes are superseded by the changes in the 2015 edition, which actually ease the requirements, hence would not lead to gaps.
Table A-9.10.3.1.A and Table A-9.10.3.1.B	Two footnotes were added to clarify requirements for adhesives employed in finger-joined studs and prefabricated I-joists used in assemblies requiring a fire-resistance rating in buildings.	As shown in Table A1, Bruce Power has a significant number of capital projects to upgrade all aspects of fire protection, which also includes fire resistance.

A.2.2. Incremental Assessment of Changes from 2010 to 2015 Editions

Part 4: Structural Design

Section	Section Change	Assessment
Appendix C: Ground snow load	Changes to the ground snow load values for different areas of Canada. About 84% of the locations listed in Table C-2 of Appendix C of the NBC remain unchanged.	The snow load S_s has remained unchanged at 2.6 kPa in Kincardine and 2.8 kPa in Port Elgin [141].
Appendix C: Seismic Model (also Part 9)	A major overhaul of the seismic model for Canada has resulted in changes relating to seismicity. These changes are based on improved ground motion data from large earthquakes in the last decade, as well as an improved understanding of the relationship between earthquake occurrence and the geological structure of the earth's crust. The new seismic model for Canada incorporates these advancements and is the first major update in 20 years. It provides better risk coverage against seismic events. The proposed changes fall into three categories: location-specific changes as listed in Table C-2 of Appendix C of the NBC; site-specific changes such as revised foundation factors and equations; and structure-specific changes such as revised higher mode factors. These changes are interrelated. Consequently, design seismic loads will change in some areas, and a different trigger zone may apply. Some jurisdictions may end up falling under a different zone after the trigger value is calculated. This may result in either an increase or a decrease in the requirements. The seismicity changes also impact Part 9 buildings and housing, as the prescriptive solutions in Part 9 use the spectral hazard values as triggers for construction requirements. For example, an increase in the spectral hazard for short period buildings may trigger more stringent construction requirements for elements such as braced wall bands, roof sheathing nailing, masonry and ICF wall construction, and the attachment of HVAC equipment.	Superseded by seismic design requirements in CSA N289.1-08 (R2013) [99], CSA N289.2-10 (R2015), CSA N289.3-10 (R2015) and CSA N289.4-12.

Part 9: Housing and Small Buildings

Section	Section Change	Assessment
Low permeance materials	Currently, a material's water vapour permeance triggers the requirement to insulate assemblies on the exterior. Based on the results of an NRC modeling project that examined the risk potential for moisture condensation within various wall assembly configurations and key climate areas, the change allows installation of more products on the exterior without the need for additional insulation.	These changes, as described, would ease the requirements with respect to insulation, hence would not lead to gaps.

A.3. National Fire Code of Canada

A.3.1. Incremental Assessment of Changes from 2005 to 2010 Editions

Section	Section Change	Assessment
Leak Detection and Monitoring	Changes dealing with leak detection and monitoring, as well as handling of certain dangerous goods, have been introduced. Existing requirements relating to the detection and monitoring of storage tanks, sumps, and piping systems containing flammable and combustible liquids were revised and new ones added.	As indicated in the Code Compliance Review [47], this is not applicable. This design requirement does not retroactively apply to existing facilities.
Storage of Flammable and Combustible Liquids in Buildings	Limits to quantities of flammable and combustible liquids stored within buildings have been updated. New passive and active fire protective measures have been added.	Superseded by requirements for storage of flammable and combustible liquids in CSA N293-12 Section 6.5.1, and requirements for control of flammable and combustible liquids in CSA N293-12 Section 6.8.5. As well, N293-12 Section 5.7.1.3 states: “The use of transient combustible materials shall be minimized and controlled so they do not pose a fire hazard beyond the capabilities of existing fire protection measures. Where a fire hazard exceeds these capabilities, temporary or permanent fire protection measures that are commensurate with the fire hazard shall be provided.” In addition, Section 6.8.2.2 states “During the operation of the plant, transient materials shall be controlled so that they do not pose a hazard beyond the capabilities of existing fire protection measures.” Furthermore, CSA N293-12 Section 5.8.4 states: “Fire safety plans shall be developed and implemented in accordance with the requirements of the NFCC and shall address the life cycle of the plant.” The assessment of CSA N293-12 is provided in Appendix B (B.3).

A.3.2. Incremental Assessment of Changes from 2010 to 2015 Editions

Section	Section Change	Assessment
Dangerous Goods Classification	The NFC now harmonizes the dangerous goods classification system with the Globally Harmonized System (GHS) of classification, and introduces the Workplace Hazardous Materials Information System (WHMIS) into the NFC’s dangerous goods section. The new harmonized system of classification in the NFC categorizes dangerous goods by types of hazards, harmonizing communications, labelling and safety data sheets. This substantial change improves	The GHS classification of dangerous goods is superseded by the process in place for management of Occupational Health and Safety Hazards as per BP-PROC-00596-R006, Occupational Health and Safety Hazards and Risk Assessment Registry and Applicable Legal Requirements Identification.

Section	Section Change	Assessment
	the availability of information on physical hazards, compatibility and toxicity from chemicals in order to enhance the protection of human health, fire safety and the environment during the handling, transport and use of these chemicals. These new requirements set the precedence of dangerous goods classes and provide a description of the GHS classification system. Placards conforming to Transport of Dangerous Goods (TDG) regulations can once again be be [sic] used to identify the hazards associated with the product classified under WHMIS.	BP-PLAN-00005-R005 Radioactive Material Transportation Emergency Response Plan provides guidance regarding adherence to TDG regulations.
Fire Protection: Storage Limit of Flammable and Combustible Liquid in Self-Service Storage Buildings	The maximum quantities are defined for flammable and combustible liquids permitted to be stored in self-service storage buildings.	BP-PROC-00158-R004, Removal of Packaging Material Prior to Entering Bruce A Protected Area, Bruce B Protected Area, COS Zone 2, Zone 3 and the Unzoned Areas, provides a procedure for limiting the accumulation of combustible materials.
Storage Tanks: Storage Tank Repair and Refurbishment	References to withdrawn certification programs (ULC-S601(A), ULC-S603(A), ULC-S615(A), ULC-S630(A)) are removed and references to new standards are added for reusing and refurbishing storage tanks.	This is superseded by CSA N285, General Requirements For Pressure-Retaining Systems And Components In CANDU Nuclear Power Plants.
Hot Works: Location of Operations	Guidance for the use of high and low tech inspection methods is provided, along with alternatives to the final inspection four hours following hot works. The protection of bitumen kettles during roofing applications is further refined.	This provides guidance on an aspect in which Bruce Power is in compliance.
Dangerous Goods: Laboratories – Placard Use in Laboratories	The requirement is clarified for placards that identify the presence of dangerous goods in laboratories.	A visual inspection of placards had been performed as part of the Code Compliance Review [47], and determined that Bruce Power was in compliance. The change is only a clarification of the 2005 clause, and thus Bruce Power is still in compliance.
Dangerous Goods: Laboratories – Interlocking of the Enclosure Exhaust Ventilation System with the Fire Alarm System	The enclosure exhaust ventilation system must not be interlocked with fire detection, fire alarm or makeup air system.	As indicated in the Code Compliance Review [47], this is not applicable. This design requirement does not retroactively apply to existing facilities.
Dangerous Goods: Laboratories – Dangerous Goods Maximum Quantities	The quantities of all dangerous goods stored in a laboratory are limited, including the quantities 'in use' during normal operations.	As indicated in the Code Compliance Review [47], the Bruce Power Spill Plan Database and visual inspection, the quantity of dangerous goods kept in the Bruce B chemical laboratories meets the maximum allowable quantities of this section.

Section	Section Change	Assessment
Dangerous Goods: Laboratories – Containers in Laboratories	Containers used for the storage of or processing of flammable or combustible liquids in a laboratory should conform to Subsection 4.2.3. requirements, Containers and Portable Tanks, of Division B of the NFC.	As indicated in the Code Compliance Review [47], BP-PROC-00189-R011 Control of Transient Material requires that containers and portable tanks for flammable or combustible liquids shall be built in conformance with Transportation of Dangerous Goods Regulations (TDGR), Canadian Standards Association (CSA) B376-M, “Portable Containers for Gasoline and Other Petroleum Fuels”, or Underwriters Laboratories of Canada (ULC) ULC/ORDC30, “Safety Containers.”

Appendix B – Clause-By-Clause Assessments Against Relevant Codes and Standards

This appendix presents the clause-by-clause assessments that are performed for this Safety Factor. The PSR Basis Document provides the following compliance categories and definitions for clause-by-clause assessments:

- Compliant (C) – compliance has been demonstrated with the applicable clause;
- Indirect Compliance (IC) – Compliance has been demonstrated with the intent of the applicable clause;
- Acceptable Deviation (AD) – Compliance with the applicable clause cannot be demonstrated; however, a technical assessment has determined that the deviation is acceptable. For this case a detailed discussion and explanation shall be included in the PSR documentation;
- Gap – system design and/or operational improvements may be necessary;
- Guidance: A potential programmatic, engineering, analytical or effectiveness gap found against non-mandatory guidance;
- Relevant but not Assessed (RNA) – the particular clause provides requirements that are less strenuous than clauses of another standard that has already been assessed. The definition also includes the guidance portion of clauses in which a gap has already been identified against the requirement;
- Not Relevant (NR) – The topic addressed in the specific clause is not relevant to the safety factor under consideration but may well be assessed under a different Safety Factor; and
- Not Applicable (NA) – The text is not a clause that provides requirements or guidance. Also used if the clause does not apply to the specific facility.

B.1. CNSC REGDOC-2.4.1, Deterministic Safety Analysis

In support of the review tasks listed in Section 5 relevant clauses of CNSC REGDOC-2.4.1 have been assessed in Table B1. A more detailed assessment is performed in “Safety Factor 5 – Deterministic Safety Analysis”.

Table B1: CNSC REGDOC-2.4.1, Deterministic Safety Analysis

Article No.	Clause Requirement	Assessment	Compliance Category
4.2.1	The licensee shall use a systematic process to identify events, event sequences, and event combinations (“events” hereafter in this document) that can potentially challenge the safety or control functions of the NPP. The licensee shall also identify events that may lead to fission product releases, including those related to spent fuel pools (also called irradiated fuel bays) and fuel-handling systems. This process shall be based on regulatory requirements and guidance, past licensing precedents, operational experience, engineering judgment, results of deterministic and probabilistic assessments, and any other systematic reviews of the design. The identification of events will include at-power and shutdown states. The deterministic analysis should also be performed for other states where the reactor is expected to operate for extended periods of time and that are not covered by the at-power and shutdown analysis. Common-cause events affecting multiple reactor units on a site shall be considered. The list of identified events shall be reviewed for completeness during the design and analysis process and modified as necessary. In addition to events that could challenge the safety or control functions of the NPP, safety analysis shall be performed for normal operation.	The only element of this clause that is relevant to Hazard Analysis is paragraph 3 of the guidance: "The set of events to be considered in safety analysis is identified using a systematic process and by taking into account: * reviews of the plant design using such methods as hazard and operability analysis, failure mode and effects analysis, and master logic diagrams" Bruce Power undertook, as part of its disposition of Fukushima Action Items, a re-evaluation of the site-specific magnitudes of each external event to which the plant might be susceptible, using modern calculations and methods; and an evaluation as to whether the current site specific design protection for each external event so assessed is sufficient (these are designated Fukushima Action Items FAI 2.1.1 and FAI 2.1.2). An extensive screening assessment was conducted for external hazards and submitted to CNSC staff in NK21-CORR-00531-09809/NK29-CORR-00531-10287. The Bruce A and Bruce B PRA models were	AD

Article No.	Clause Requirement	Assessment	Compliance Category
	Guidance The safety analysis is performed for a set of events that could lead to challenges related to the NPP's safety or control functions. These include events caused by SSC failures or human error, as well as human-induced or natural common-cause events. The events considered in safety analysis could be single PIEs, sequences of several consequential events, or combinations of independent events. The set of events to be considered in safety analysis is identified using a systematic process and by taking into account: • reviews of the plant design using such methods as hazard and operability analysis, failure mode and effects analysis, and master logic diagrams • lists of events developed for safety analysis of other NPPs, as applicable • analysis of operating experience data for similar plants • any events prescribed for inclusion in safety analysis by regulatory requirements (e.g., REGDOC-2.5.2, Design of Reactor Facilities: Nuclear Power Plants) • equipment failures, human errors and common-cause events identified iteratively with PSA • a cut-off frequency for common-cause events that is consistent across all events The list of identified events should be iteratively reviewed for accuracy and completeness as the plant design and safety analyses proceed. Reviews should also be periodically conducted throughout the NPP lifecycle, to account for new information and requirements. This regulatory document requires that, when identifying	modified to comply with requirements of Bruce Power Internal Events Level 1 and Level 2 PRA Guides (B-REP-03611-00005 R01 and B-REP-03611-00010 R01, respectively). The as-modified Level 1 and Level 2 models were submitted to CNSC staff as Enclosures 1 to 4 of NK21-CORR-00531-10958/NK29-CORR-00531-11342. While the revised internal event PRAs may not consider every internal hazard listed under SF7 Review Task 2b in Section A.2 of the PSR Basis Document, the intent to incorporate all imaginable internal hazard PIEs is nonetheless considered largely fulfilled, and the lack of explicit consideration of every internal hazard in SF7 Review Task 2b is deemed an Acceptable Deviation.	

Article No.	Clause Requirement	Assessment	Compliance Category
	events, all permissible plant operating modes be considered. All operating modes used for extended periods of time should be analyzed. Modes that occur transiently or briefly can be addressed without a specific analysis, as long as it can be shown that existing safety analyses bound the behaviour and consequences of those states. NPP operating modes include, but are not limited to: • initial approach to reactor criticality • reactor start-up from shutdown through criticality to power • steady-state power operation, including both full and low power • changes in the reactor power level, including load follow modes (if employed) • reactor shutting down from power operation • shutdown in a hot standby mode • shutdown in a cold shutdown mode • shutdown in a refuelling mode or maintenance mode that opens major closures in the reactor coolant pressure boundary • shutdown in other modes or plant configurations with unique temperature, pressure or coolant inventory conditions • operation of limited duration, with some systems important to safety being unavailable For events identified by the systematic process used for this purpose, a full range of configurations and operating modes of equipment should be considered in the deterministic safety analysis. Special plant configurations may occur during major plant modifications such as plant refurbishment, lay-up, or		

Article No.	Clause Requirement	Assessment	Compliance Category
	decommissioning. These configurations should be considered, and potential events should be identified and included in the deterministic safety analysis.		
4.2.2.4	Common-cause events are multiple component failures that can be initiated by internal and external events (these events could be human-induced or naturally occurring). Internal common-cause events include fires, floods of internal origin, explosions, and equipment failures (such as turbine breakup) that may generate missiles. External, naturally occurring events (triggers for plant equipment failures) that are considered in deterministic safety analysis include: • earthquakes • external fires • floods/tsunamis occurring outside the site • biological hazards (for instance, mussels or seaweed affecting cooling water flow and/or temperature) • extreme weather conditions (temperature, precipitation, high winds, tornadoes etc.) External initiating events may cause internal and/or external events. For example, an earthquake could lead to plant equipment failures, loss of offsite power, flood, tsunami or fire. External events may cause accidents in one or more of the units where there are multiple units at a site. Human-induced external events that are considered in deterministic safety analysis include: • aircraft or missile impacts • explosions at nearby industrial facilities or transportation systems	All hazards that could potentially serve as the initiator of common-cause events were subjected to a first level of screening in order to eliminate ones which are inapplicable to Bruce B or with too low a frequency. The first level screening report was submitted to CNSC staff in NK21-CORR-00531-09809/NK29-CORR-00531-10287. The remaining hazards were submitted to a second level screening (submitted in NK21-CORR-00531-10848/NK29-CORR-00531-11226) which eliminated from consideration for further assessment all but the following events: *Fire *Earthquake; *Tornado; *External flooding and extreme waves. The detailed hazard analysis of protection against fire is generated as per DPT-PDE-00027, DPT-PDE-00028 and DPT-PDE-00029, and is documented in NK29-REP-71400-00004, NK29-REP-71400-00003 and NK29-REP-71400-00002. The safety-related systems in Bruce B requiring seismic qualification against earthquakes are defined in Design Guide NK29-DG-03650-002. The seismic qualification is carried out as per DPT-PDE-00017. Bruce Power has identified in NK21-CORR-	C

Article No.	Clause Requirement	Assessment	Compliance Category
	• release of toxic or corrosive chemicals from nearby industrial facilities or transportation systems • electromagnetic interference	00531-09969/NK29-CORR-00531-10409 its plans for assessment of tornados and external flooding.	
4.2.2.5	Combinations of events (which may occur either simultaneously or sequentially while restoring the plant to a stable state) should be considered. Types of combinations include: • multiple independent failures in equipment important to safety • failure of a process system and system important to safety • multiple process system failures • equipment failures and operator errors • common-cause events and operator errors Examples of event combinations include: • loss of coolant with subsequent loss of station electrical power, including station blackout • loss of coolant with loss of containment cooling • small loss-of-coolant accidents (LOCAs) with failure of primary or secondary depressurization • main steam line break with failure of the operator to initiate a backup cooling system	The one aspect of this clause applicable to Hazard Analysis is that of common-cause events and operator errors. Deterministic assessments of hazards such as the Bruce NGS B Fire Safe Shutdown Analysis (NK29-REP-71400-00003) do not consider the initiating hazard in combination with operator events. However, the role of the operator is considered in the probabilistic assessment of hazards.	IC
4.4.1	The analysis shall provide the appropriate level of confidence in demonstrating conformity with the acceptance criteria. To achieve the appropriate level of confidence, the safety analysis shall: 1. be performed by qualified analysts in accordance with an approved QA process 2. apply a systematic analysis method 3. use verified data 4. use justified assumptions 5. use verified and validated models and computer codes	Hazard Analysis is considered part of Nuclear Safety Assessment work, and hence governed by the requirements of Bruce Power Departmental Procedure Quality Assurance of Nuclear Safety Assessment, DPT-NSAS-00001.	RNA

Article No.	Clause Requirement	Assessment	Compliance Category
	6. build in a degree of conservatism 7. be subjected to a review process Guidance Section 4.4 mainly addresses analysis methods and assumptions for the deterministic safety analysis of AOOs and DBAs for Level 3 defence in depth. Similar analysis methods and assumptions can be applied for Levels 2 and 4 defence in depth (with appropriate levels of conservatism). Certain conservative rules, such as the single-failure criterion, are not applied in Level 2 and Level 4 analyses. The safety analyst has the option of selecting safety analysis methods and assumptions, as long as the regulatory requirements and expectations are satisfied. The selection of the safety analysis methods and assumptions should be such that the appropriate level of confidence can be achieved in the analysis results.		
4.4.4.2	The analysis should take into account consequential failures that may occur as a result of an initiating event. Any failures that occur as a consequence of the initiating event are part of that event and are not considered to be a single failure for the purpose of safety analysis. For example, equipment that is not qualified for specific accident conditions should be assumed to fail unless its normal operation leads to more conservative results.	As per NK29-DG-03650-003, safety-related equipment credited to operate during accident conditions must be environmentally qualified for those conditions.	C

B.2. CNSC REGDOC-2.5.2, Design of Reactor Facilities: Nuclear Power Plants

In support of the review tasks listed in Section 5 relevant clauses of CNSC REGDOC-2.5.2 have been assessed in Table B2. A more detailed assessment is performed in "Safety Factor 1 – Plant Design".

Table B2: CNSC REGDOC-2.5.2, Design of Reactor Facilities: Nuclear Power Plants

Article No.	Clause Requirement	Assessment	Compliance Category
4.2.3	To demonstrate achievement of the safety objectives, a comprehensive hazard analysis, a deterministic safety analysis, and a probabilistic safety assessment shall be carried out. These analyses shall identify all sources of exposure, in order to evaluate potential radiation doses to workers at the plant and to the public, and to evaluate potential effects on the environment. The safety analyses shall examine plant performance for: 1. normal operation 2. AOOs 3. DBAs 4. BDBAs, including DECs (DECs could include severe accident conditions) Based on these analyses, the capability of the design to withstand PIEs and accidents shall be confirmed, the effectiveness of the items important to safety demonstrated, and requirements for emergency response established. The results of the safety analyses shall be fed back into the design. The safety analyses are discussed in further detail in section 9.0.	The comprehensiveness of the Hazard Analysis is covered in detail in the assessment against Clause 4.2.1 of REGDOC 2.4.1.	RNA
5.7	Design documentation shall include information to demonstrate the adequacy of the design and shall be used	The degree to which the design documentation demonstrates adequacy of the design, including	RNA

Article No.	Clause Requirement	Assessment	Compliance Category
	for procurement, construction, commissioning and safe operation, including maintenance, aging management, modification and eventual decommissioning of the NPP. The design documentation shall include: 1. design description 2. design requirements 3. classification of SSCs 4. description of plant states 5. security system design, including a description of physical security barriers and cyber security programs 6. operational limits and conditions 7. identification and categorization of initiating events 8. acceptance criteria and derived acceptance criteria 9. deterministic safety analysis 10. probabilistic safety assessment (PSA) 11. hazard analysis Guidance A suite of design documentation should be developed, following the establishment of an overall baseline, listing all key design documents. Design documents should be contained in a logical and manageable framework. For additional guidance on derived acceptance criteria, refer to CNSC regulatory document REGDOC-2.4.1, Deterministic Safety Analysis. Additional information Additional information may be found in: •CNSC, RD/GD-369, Licence Application Guide: Licence to Construct a Nuclear Power Plant, Ottawa, Canada, 2011. •CNSC, REGDOC-2.4.1, Deterministic Safety Analysis, Ottawa, Canada, 2014.	against hazards, is assessed more fully in SFR1.	
6.5	The design shall include adequate provision for an appropriate exclusion zone. The appropriateness of the	The one clause portion relevant to SFR7 is paragraph 3 under "Security Requirements":	RNA

Article No.	Clause Requirement	Assessment	Compliance Category
	exclusion zone shall be based on several factors, including: 1. evacuation needs 2. land usage needs 3. security requirements 4. environmental factors Guidance The exclusion zone for NPPs in Canada has been typically defined as 914 metres from the reactor building. Rather than prescribe a particular size for the exclusion zone, this regulatory document specifies factors that must be considered in establishing an appropriate size, including evacuation needs, land usage needs, security requirements and environmental factors. Evacuation needs The design should take into account emergency response requirements based on the size of the exclusion zone and the facilities and infrastructures that are within the zone. The exclusion zone boundary should be defined with consideration for the capabilities of onsite and offsite emergency response. Environmental factors which can affect the response times should be taken into consideration. The design also considers projected changes over time in land use and population density, which could adversely affect response times, or the ability to shelter or evacuate persons from both the site itself and associated emergency planning regions. Evacuation needs are generally based on existing provincial nuclear emergency response plans. Land usage needs The design should ensure that the exclusion zone is large enough to accommodate the site for the nuclear plant	"In establishing the radius of the exclusion zone boundary, the design should take into account: • facility robustness against natural and human induced external hazards (including malevolent acts)" This clause is assessed in detail under SFR1.	

Article No.	Clause Requirement	Assessment	Compliance Category
	(accounting for the full number of units postulated to be built at the site, whether or not they would be built immediately). The design activities should seek to optimize land usage by the plant as part of determining the exclusion zone. Security requirements The design should provide security requirements based on the size of the exclusion zone, the facilities and infrastructures that are within the zone, and the design of the facility. Generally, a larger exclusion zone would require more security capabilities, in order to avoid a longer response time. Physical characteristics of the site itself (which include geographical characteristics, such as proximity to elevated land) also play a role in determining these requirements. The design authority may decide to mitigate these risks while maintaining a smaller exclusion zone, by choosing highly robust facility designs, applying engineered security measures to the site, and having a well-designed security program. These engineered measures should be described. In establishing the radius of the exclusion zone boundary, the design should take into account: •the site selection and threat assessment report •facility robustness against natural and human induced external hazards (including malevolent acts) •the capability of the onsite security program, along with any offsite security resources that will supplement the onsite security program In each of the above parameters, the design should take into account projected changes over time in land use and population density, which could adversely affect that parameter. The design should be such that the exclusion zone, as established at the design stage, will be sustainable		

Article No.	Clause Requirement	Assessment	Compliance Category
	for the full lifecycle of the facility. The acceptability of the information to be provided in support of the above is discussed in section 7.22 of this document. Environmental factors Environmental factors which may have an impact on the size of the exclusion zone include local meteorological conditions which could affect the radiological dose received by members of the public. The design authority may use generic site data using conservative assumptions regarding meteorological conditions in the absence of a specific site. The Radiation Protection Regulations establish an effective dose limit of 1 mSv per year for members of the public. This limit implies that a hypothetical member of the public who lives at the exclusion zone boundary for 1 year (since no permanent dwelling is permitted within the exclusion zone) would not accumulate a dose of more than 1 mSv from normal operation of the NPP. Additional information may be found in: •CNSC, RD-346, Site Evaluation for New Nuclear Power Plants, Ottawa, Canada, 2008.		
7.4	The design for the NPP shall apply a systematic approach to identifying a comprehensive set of postulated initiating events, such that all foreseeable events with the potential for serious consequences or with a significant frequency of occurrence are anticipated and considered. Postulated initiating events can lead to AOOs, DBAs or BDBAs, and include credible failures or malfunctions of SSCs, as well as operator errors, common-cause internal hazards, and external hazards. For a site with multiple units, the design shall take due	The comprehensiveness of the Hazard Analysis is covered in detail in the assessment against clause 9.3	RNA

Article No.	Clause Requirement	Assessment	Compliance Category
	account of the potential for specific hazards simultaneously impacting several units on the site. Guidance The postulated initiating events (PIEs) are identified using engineering judgment and deterministic and probabilistic assessment. A justification of the extent of usage of deterministic safety analyses and probabilistic safety analyses should be provided, in order to show that all foreseeable events have been considered. Sufficient information should be provided regarding the methods used to identify PIEs, their scope and classification. In cases where the identification methods have made use of analytical tools (e.g., master logic diagrams, hazard and operability analysis, failure modes and effect analysis), detailed information is expected to be presented. A systematic approach to event classification should consider all internal and external events, all normal operating configurations, various plant and site conditions, and failure in other plant systems (e.g., storage for irradiated fuel, and tanks for radioactive substances). The design should take into account failure of equipment that is not part of the NPP, if the failure has a significant impact on nuclear safety. CNSC REGDOC-2.4.1, Deterministic Safety Analysis and REGDOC-2.4.2, Probabilistic Safety Assessments, provide the requirements and guidance for establishing the scope of PIEs, and for classifying the PIEs in accordance with their anticipated frequencies, and other factors, as appropriate. For further information on the safety analysis for the identified PIEs, refer to section 9.0 of this document.		

Article No.	Clause Requirement	Assessment	Compliance Category
	Additional information Additional information may be found in: •CNSC, REGDOC-2.4.1, Deterministic Safety Analysis, Ottawa, Canada, 2014.		
7.4.1	SSCs important to safety shall be designed and located in a manner that minimizes the probability and effects of hazards (e.g., fires and explosions) caused by external or internal events. The plant design shall take into account the potential for internal hazards, such as flooding, missile generation, pipe whip, jet impact, fire, smoke, and combustion by-products, or release of fluid from failed systems or from other installations on the site. Appropriate preventive and mitigation measures shall be provided to ensure that nuclear safety is not compromised. Internal events which the plant is designed to withstand shall be identified, and AOOs, DBAs and DECs shall be determined from these events. The possible interaction of external and internal events shall be considered, such as external events initiating internal fires or floods, or that may lead to the generation of missiles. Guidance The design should take into account specific loads and environmental conditions (temperature, pressure, humidity, radiation) imposed on structures or components by internal hazards. The following potential initiators of flooding should be considered: •leaks and breaks in pressure-retaining components •flooding by water from neighbouring buildings •spurious actuation of the fire-fighting system	The comprehensiveness of protection against internal hazards is covered in detail in SFR1, and in the SFR7 assessment against clause 9.3.	RNA

Article No.	Clause Requirement	Assessment	Compliance Category
	•overfilling of tanks •failures of isolating devices The design considers internal missiles which can be generated by failure of rotating components (such as turbines), or by failure of pressurized components. For those potential missiles considered to be credible, the following actions should be taken: •a realistic assessment is made of the postulated missile size and energy, and its potential trajectories •potentially impacted components associated with systems required to achieve and maintain a safe shutdown state are identified •a loss of these potentially impacted components is evaluated to determine if sufficient redundancy remains to achieve and maintain a safe shutdown state The civil design takes into account loads generated by internal hazards in the environmental loading category consistent with section 7.15.		
7.4.2	All natural and human-induced external hazards that may be linked with significant radiological risk shall be identified. External hazards which the plant is designed to withstand shall be selected, and classified as DBAs or DECs. Various interactions between the plant and the environment, such as population in the surrounding area, meteorology, hydrology, geology and seismology shall be identified during the site evaluation and environmental assessment processes. These interactions shall be taken into account in determining the design basis for the NPP. Applicable natural external hazards shall include such hazards as earthquakes, droughts, floods, high winds, tornadoes, tsunami, and extreme meteorological conditions. Human induced external hazards shall include those that	The comprehensiveness of protection against external hazards is covered in detail in SFR1, and in the SFR7 assessment against clause 9.3.	RNA

Article No.	Clause Requirement	Assessment	Compliance Category
	are identified in the site evaluation, such as potential aircraft crashes, ship collisions, and terrorist activities. Guidance The design should take into account all site characteristics that may affect the safety of the plant, and should identify the following: •site-specific hazard evaluation for external hazards (of human or natural origin) •design assumptions or values, in terms of recurrence probability of external hazards •definition of the design basis for external hazards •collection of site reference data for the plant design (geotechnical, seismological, hydrological, hydrogeological and meteorological) •evaluation of the impact of the site-related issues to be considered in the application, concerning emergency preparedness and accident management •arrangements for the monitoring of site-related parameters throughout the life of the plant Natural external hazards other than earthquakes may be categorized as: •hazards that have potential to damage SSCs important to safety •hazards that are evaluated and screened out Natural external hazards considered in the design process should include: •earthquakes •extreme meteorological conditions of temperature, snow, freezing rain, hail, frost, subsurface freezing and drought •floods due to tides, tsunamis, seiches, storm surges, precipitation, waterspouts, dam forming and dam failures, snow melt, land slides into water bodies, channel changes		

Article No.	Clause Requirement	Assessment	Compliance Category
	and work in the channel •cyclones (e.g., hurricanes, tornadoes) and straight winds •abrasive dust and sand storms •lightning •volcanoes (site is sufficiently remote from volcanoes) •biological phenomena •collision of floating debris (e.g., ice, logs) with accessible safety-related structures, such as water intakes and ultimate heat sink components •geomagnetic storm (solar flare and electromagnetic pulses) •combinations of extreme weather conditions that could reasonably be assumed to occur at the same time Natural external hazards that are evaluated and screened out may be based on the following criteria: •a phenomenon that occurs slowly or with adequate warning with respect to the time required to take appropriate protective action •a phenomenon which in itself has no significant impact on the operation of an NPP and its design basis •an individual phenomenon which has an extremely low probability of occurrence •the NPP is located sufficiently distant from or above the postulated phenomenon (e.g., fire, flooding) •a phenomenon that is already included or enveloped by design in another phenomenon (e.g., storm-surge and seiche included in flooding or accidental small aircraft crash enveloped by tornado loads) Human induced hazards considered in the design process should include: •aircraft crashes (general aviation) •explosions (deflagrations and detonations) with or without fire, with or without secondary missiles, originating from offsite and onsite sources (but external to safety-related		

Article No.	Clause Requirement	Assessment	Compliance Category
	buildings), such as hazardous or pressurized materials in storage, transformers, pressure vessels, or high- energy rotating equipment •release of hazardous gases (asphyxiant, toxic) from offsite and onsite storage •release of corrosive gases and liquids from offsite and onsite storage •release of radioactive material from offsite sources •fire generated from offsite sources (mainly for its potential for generating smoke and toxic gases) •collision of ships or floating debris with accessible safety-related structures, such as water intakes and ultimate heat sink components •collision of vehicles at the site with SSCs •electromagnetic interference from off the site (e.g., from communication centres and portable phone antennas) and on the site (e.g., from the activation of high voltage electrical switchgear and from unshielded cables) •any combination of the above, as a result of a common initiating hazard (such as an explosion with fire and release of hazardous gases and smoke) Malevolent acts including aircraft crashes are considered separately, in section 7.22. For civil design, human induced hazards which are classified as DBAs are taken into account as loads in the abnormal or extreme environmental load category, consistent with section 7.15. Less frequent human induced hazards are considered part of DECs. Additional information Additional information may be found in: •American Nuclear Society (ANS), 2.3, Estimating Tornado, Hurricane, and Extreme Straight		

Article No.	Clause Requirement	Assessment	Compliance Category
	Line Wind Characteristics at Nuclear Facility Sites, La Grange Park, Illinois, 2011. •CNSC, RD-346, Site Evaluation for New Nuclear Power Plants, Ottawa, Canada, 2008. •IAEA, NS-G-3.1, External Human Induced Events in Site Evaluation for Nuclear Power Plants, Vienna, 2002. •National Research Council (NRC), National Building Code of Canada, Ottawa, Canada, 2010.		
7.4.3	Combinations of randomly occurring individual events that could credibly lead to AOOs, DBAs, or DECs shall be considered in the design. Such combinations shall be identified early in the design phase, and shall be confirmed using a systematic approach. Events that may result from other events, such as a flood following an earthquake, shall be considered to be part of the original PIE. Guidance Where the results of engineering judgment, deterministic safety assessments and probabilistic safety assessments indicate potential combinations of events, such combinations of events should be considered to be AOOs, DBAs or DECs, depending on their likelihood of occurrence.	The comprehensiveness of protection in the design against event combinations is covered in detail in SF1.	RNA
7.12.1	Suitable incorporation of operational procedures, redundant SSCs, physical barriers, spatial separation, fire protection systems, and design for fail-safe operation shall achieve the following general objectives: 1. prevent the initiation of fires 2. limit the propagation and effects of fires that do occur by: a. quickly detecting and suppressing fires to limit damage b. confining the spread of fires and fire by-products that	Guidance for documenting protection against fire hazard is provided in DPT-PDE-00027, DPT-PDE-00028 and DPT-PDE-00029. The Bruce B design achieves all objectives detailed in this clause, as documented in NK29-REP-71400-00004, NK29-REP-71400-00003 and NK29-REP-71400-00002.	C

Article No.	Clause Requirement	Assessment	Compliance Category
	have not been extinguished 3. prevent loss of redundancy in safety and safety support systems 4. provide assurance of safe shutdown 5. ensure that monitoring of safety-critical parameters remains available 6. prevent exposure, uncontrolled release, or unacceptable dispersion of hazardous substances, nuclear material, or radioactive material, due to fires 7. prevent the detrimental effects of event mitigation efforts, both inside and outside of containment 8. ensure structural sufficiency and stability in the event of fire Buildings or structures shall be constructed using non-combustible or fire retardant and heat resistant material. Fire is considered an internal hazard. The essential safety functions shall be available during a fire. Fire suppression systems shall be designed and located such that rupture, or spurious or inadvertent operation, will not significantly impair the capability of SSCs important to safety. Guidance Effective fire protection is achieved by: •fire protection features such as programs and procedures, fire prevention, fire detection, fire warning, emergency communication, fire by-product management, fire suppression and fire containment, non-combustible construction, seismic and environmental qualification of fire protection equipment •the use of physical barriers to segregate redundant SSCs important to safety The design should address protection from fire by		

Article No.	Clause Requirement	Assessment	Compliance Category
	demonstrating that a defence in depth approach has been implemented. Supporting documents are expected to include a comprehensive design report, code compliance review, a fire hazard assessment, fire safe shutdown analysis, and a fire protection program. An independent third-party review of the design assessing compliance against the applicable fire codes and standards used in the design for protection from fires and explosions should be performed. The review should provide a definitive statement that the design conforms to the identified codes and standards, meets good engineering practices, and achieves fire protection objectives. The design should comply with the requirements of the following codes and standards: •CSA Group, N293, Fire protection for nuclear power plants, Toronto, Canada. •NRC, National Building Code of Canada, Ottawa, Canada, 2010. •NRC, National Fire Code of Canada, Ottawa, Canada, 2010. Although CSA N293 is considered acceptable to provide technology-neutral design criteria, it does not fully address some fire safety aspects, such as: •operator-initiated manual actions •associated fire safe shutdown circuit analysis •multiple spurious operations Guidance on the above fire safety aspects is provided in: •U.S. NRC, NUREG-1852, Demonstrating the Feasibility and Reliability of Operator Manual Actions in Response to Fire, 2007. •Nuclear Energy Institute, NEI 00-01, Guidance for Post-Fire Safe Shutdown Circuit Analysis, Washington, D.C., 2005.		

Article No.	Clause Requirement	Assessment	Compliance Category
	Additional information may be found in: •IAEA, NS-G-2.1, Fire Safety in Operation of Nuclear Power Plants, Vienna, 2000. •IAEA, Safety Report Series No. 8, Preparation of Fire Hazard Analysis for Nuclear Power Plants, Vienna, 1998. •IAEA, NS-G-1.7, Protection Against Internal Fires and Explosions in the Design of Nuclear Power Plants, Vienna, 2004. •National Fire Protection Association (NFPA), Fire Protection Handbook, Quincy, Massachusetts, 2008. •NFPA, 805, Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants, Quincy, Massachusetts, 2010. •NFPA, 804, Standard for Fire Protection for Advanced Light Water Reactor Electric Generating Plants, Quincy, Massachusetts, 2010. •NEI, 00-01, Guidance for Post-Fire Safe Shutdown Circuit Analysis, Washington, D.C., 2005. •NEI, 04-02, rev. 1, Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program under 10 CFR 50.48(c), Washington, D.C., 2005. •Society of Fire Protection Engineers (SFPE), SFPE Handbook of Fire Protection Engineering, Bethesda, Maryland, 2008. •U.S. NRC, NUREG/CR-6850, EPRI 1011989, Fire Probabilistic Risk Assessment Methods Enhancements, Washington, D.C., 2010. •U.S. NRC, NUREG-0800, section 9.5.1.1, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR edition - Fire Protection Program, Washington, D.C., 2009. •U.S. NRC, Regulatory Guide 1.189, Fire Protection for		

Article No.	Clause Requirement	Assessment	Compliance Category
	Operating Nuclear Power Plants, Washington, D.C., 2009. •U.S. NRC, NUREG-1852, Demonstrating the Feasibility and Reliability of Operator Manual Actions in Response to Fire, Washington, D.C., 2007.		
7.12.2	The design shall provide protection to workers and the public from event sequences initiated by fire or explosion in accordance with established radiological, toxicological, and human factors criteria so that the following objectives are achieved: 1. Persons not intimate with the initial event (including the public, occupants, and emergency responders) are protected from injury and loss of life. 2. Persons intimate with the initial event have a low probability of injury or death. To demonstrate that the above life safety objectives have been achieved, the design shall provide: 1. effective and reliable means of fire detection in all areas 2. effective and reliable means of emergency notification, including the nature of the emergency and protective actions to be taken 3. multiple and separate safe egress routes from any area 4. easily accessible exits 5. effective and reliable identification and illumination of egress routes and exits 6. sufficient exiting capacity for the number of workers (taking into account the emergency movement of crowds) 7. protection of workers from fires and fire by-products (i.e., combustion products, smoke, heat etc.) during egress and in the areas of refuge 8. protection of workers performing plant control and mitigation functions during or following a fire 9. adequate supporting infrastructure (lighting, access etc.)	Guidance for documenting protection against fire hazard is provided in DPT-PDE-00027, DPT-PDE-00028 and DPT-PDE-00029. The Bruce B design achieves all objectives detailed in this clause, as documented in NK29-REP-71400-00004, NK29-REP-71400-00003 and NK29-REP-71400-00002.	C

Article No.	Clause Requirement	Assessment	Compliance Category
	for workers to perform emergency response, plant control, and mitigation activities during or following a fire 10. sufficient structural integrity and stability of buildings and structures to ensure the safety of workers and emergency responders during and after a fire 11. protection of workers from the release or dispersion of hazardous substances, radioactive material, or nuclear material as a result of fire Guidance The National Building Code of Canada (NBCC) and the National Fire Code of Canada (NFCC) are objective-based national model codes. The provisions of the NBCC and NFCC are considered the minimum acceptable measures for meeting the objectives of safety, health, structural protection, and fire protection of buildings. As such, additional fire protection measures may be required to meet the regulatory requirements detailed in this regulatory document. Additional fire safety provisions are usually assessed and documented in the code compliance and fire hazard assessment, as required by CSA N293, Fire protection for nuclear power plants.		
7.13.1	The design authority shall ensure that seismically qualified SSCs important to safety are qualified to a design-basis earthquake (DBE), and ensure that they are categorized accordingly. This shall apply to: 1. SSCs whose failure could directly or indirectly cause an accident leading to core damage 2. SSCs restricting the release of radioactive material to the environment 3. SSCs that assure the subcriticality of stored nuclear material 4. SSCs such as radioactive waste tanks containing	Assessed in more detail in SFR1. The safety-related systems in Bruce B requiring seismic qualification against earthquakes are defined in Design Guide NK29-DG-03650-002. The seismic qualification is carried out as per DPT-PDE-00017. This clause invokes the CSA N289 series for detailed guidance, including definition of a Design Basis Earthquake (DBE). In CSA N289.1-08 (R2013), a DBE is defined as having a probability of exceedance of 1E-4/a, or such level as determined	Gap

Article No.	Clause Requirement	Assessment	Compliance Category
	radioactive material that, if released, would exceed regulatory dose limits The design of these SSCs shall also meet the DBE criteria to maintain all essential attributes, such as pressure boundary integrity, leak-tightness, operability, and proper position in the event of a DBE. The design shall ensure that no substantive damage to these SSCs will be caused by the failure of any other SSC under DBE conditions. Seismic fragility levels shall be evaluated for SSCs important to safety by analysis or, where possible, by testing. A beyond-design-basis earthquake (BDBE) shall be identified that meets the requirements for identification of DECs as described in section 7.3.4. SSCs credited to function during and after a BDBE shall be demonstrated to be capable of performing their intended function under the expected conditions. Such demonstration shall provide high confidence of low probability of failure (HCLPF) under BDBE conditions for these SSCs. This demonstration need not be seismic qualification by testing. Guidance The seismic design of an NPP should account for: • technical safety objectives and corresponding load categories • seismic input motion • seismic classification • structural layout criteria • seismic analysis and design of structural systems, subsystems and equipment • seismic testing and instrumentation	by the regulatory authority; furthermore, the definition notes that the DBE for some older plants was based on a probability of exceedance of 1E-3/a. While the ground response spectra used in the seismic qualification of Bruce B are based on a probability of exceedance of 1E-3/a, the wording of the DBE definition in the standard, including the note about older plants, implicitly permits this. This is considered a Gap against the guidance of CSA N289.1-08 regarding DBE definition.	

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	Design and beyond design load categories are defined to demonstrate structural performance in operational states, DBAs and DECs. In addition, beyond design load categories are considered for structural performance in DECs. Earthquake load is not part of the normal load category corresponding to normal operation. Site design earthquake load, according to the CSA N289 series on seismic design and qualification, is defined under the severe load category corresponding to AOO. A DBE is defined as a part of the abnormal or extreme load category corresponding to DBA. BDBE load should be considered under DECs. Seismic input motion, derived from the DBE, should be based on seismicity and geologic conditions at the site and expressed in such a manner that it can be applied for the qualification of SSCs. The DBE is defined by multiplying the mean site specific uniform hazard spectrum with a probability of occurrence of 10^{-4}/yr by a design factor, defined in the standard ASCE 43-05, Seismic Design Criteria for Structures, Systems and Components in Nuclear Facilities. The probability of occurrence of the defined DBE is therefore equivalent to the probability of DBAs. A minimum seismic input motion, consistent with national or international standards, should be considered in the design phase for the DBE. The minimum seismic input motion should take into account frequencies of interest for SSCs. Structural layout criteria, including structural separation, should follow best engineering practices and lessons learned from past earthquakes. Modelling of soil-structure interaction (SSI) should be based on geotechnical investigation and taking into account the random nature of soil material properties and inherent uncertainties incorporated in soil constitutive models used in		

Article No.	Clause Requirement	Assessment	Compliance Category
	the analysis. To account for uncertainties in soil properties a range with at least three values (upper limit, best estimate and lower limit) should be taken into account in the analysis according to CSA N289.3, Design procedures for seismic qualification of nuclear power plants, clause 5.2.3. The analysis of SSI should take into account all effects due to kinematic interaction (effect of applied seismic ground motion on massless structure) and inertial interaction (inertial forces developed in the structure due to the seismic ground motion). The detail and sophistication of soil-structure models should be in accordance with the purposes of the analyses. The frequency range of interest determines aspects of the structure model and the SSI model parameters. The frequency range of interest should be based on the combination of the frequency range of the earthquake input, the soil properties, the frequency range of building response (including response of subsystems modelled in the main building or structure model), and the frequency range of the response parameter of interest. Refined finite element meshes and increased analytical rigor are required to transmit higher frequencies through the analytical models. Damping ratios for structural systems and sub-systems should be taken into account according to recognized standards such as ASCE 43-05 and CSA N289.3. For generating the in-structure response spectra to be used as input to the structure mounted systems and components, Response Level 1 damping of the structure is more appropriate unless the structure response generally exceeds demand over capacity factor given in ASCE 43-05. The seismic design of structural systems should be categorized according to seismic design category (SDC) 1		

Article No.	Clause Requirement	Assessment	Compliance Category
	to 5 as per ASCE 43-05. SDC 1 and 2 structural systems should be in accordance with the National Building Code of Canada, Division B, Part 4. According to the Code, SDC 1 should be as normal and SDC 2 as post-disaster. All structures important to safety are classified as SDC 5. However, the designer may still classify some structures as SDC 3, 4 and 5 provided that they include proper justification. Guidance on SDC 3, 4 and 5 (if SDC 3 and 4 are used) structural systems are provided as follows: • for concrete containment, the design should be based on the American Society of Civil Engineers, ASCE 43-05 (SDC 5, limit state D) and CSA N287.3, Design Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants • for steel containment, the design should be based on ASCE 43-05 (SDC 5), 2010 ASME Boiler and Pressure Vessel Code, Section III: Rules for Construction of Nuclear Power Plant Components, Division 1, Subsection NE: Class MC Components and U.S. NRC Regulatory Guide 1.57, Design Limits and Loading Combinations for Metal Primary Reactor Containment System Components • for concrete and steel safety related structures the design should be based on ASCE 43-05 (SDC 5, limit state D) and CSA N291, Requirements for Safety-Related Structures for CANDU Nuclear Power Plants For all safety design categories in an NPP, ductility requirements should be in accordance with CSA-A23.3, Design of Concrete Structures for concrete structures and CSA S16, Design of Steel Structures for steel structures assuming that the structures are ductile or type D. These ductility requirements should provide margins for the BDBE.		

Article No.	Clause Requirement	Assessment	Compliance Category
	Sub-system analysis should follow the guidance presented for structural systems with the following criteria specific to sub-system supports: • in-structure response spectra • in-structure time response histories The methods of defining in-structure response spectra or in-structure time-histories as well as application of this seismic input to sub-systems and components should be in accordance with ASCE 04, Seismic Analysis for Safety-Related Nuclear Structures. Multiple support seismic input of sub-systems and components should take into account their inertial and kinematic components. The analysis should follow ASCE 04 or CSA N289.3, Design procedures for seismic qualification of nuclear power plants. Determination of the number of earthquake cycles for sub-system analysis should be in accordance with U.S. NRC NUREG-0800, Standard Review Plan, section 3.7.3, Seismic Subsystem Analysis as well as seismic analysis of above-ground tanks. Seismic design of sub-systems and components should be in accordance with ASCE 43-05 section 8.2.3 which follows ASME Code. For equipment qualified by testing, multi-axis, multi-frequency testing is acceptable for the DBE in accordance with the requirement of IEEE 344-2004 – IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations and that the testing response spectrum should be at least a factor of 1.4 times the required response spectrum throughout the frequency range. Any deviation from this		

Article No.	Clause Requirement	Assessment	Compliance Category
	should be conservatively justified on a case-by-case basis. Any evaluation for BDBE should utilize the methodology in the Electrical Power Research Institute, (EPRI) TR-103959, Methodology for Developing Seismic Fragilities to determine if a HCLPF goal is met. Seismic instrumentation design should follow CSA-N289.5, Seismic Instrumentation Requirements for Nuclear Power Plants and Nuclear Facilities which itemizes the requirements for single and multiple unit site seismic instrumentation. Beyond-design-basis margin should be such that seismically induced SSC failure probabilities do not contribute to the total core damage frequency and small and large release frequency to the extent that they do not meet the safety goals. To support meeting the safety goals, the acceptance criterion for BDBE should demonstrate that the plant HCLPF is at least 1.67 times the DBE. Assessment and validation of margins for beyond-design-basis earthquakes should be considered, including the metric HCLPF. The seismic isolation of SSCs is an acceptable design approach to limit seismic demand. Seismic isolation devices should be designed, manufactured and installed to withstand a seismic action defined by a DBE without any failure, preserving its mechanical resistance and full load bearing capacity during and after the earthquake. Moreover, the devices and the whole structural system should be designed to withstand a BDBE up to 2 times the spectral accelerations of the DBE without major damage and preserving its function. It includes the provisions to accommodate the structural displacements up to 2 times the		

Article No.	Clause Requirement	Assessment	Compliance Category
	displacements under DBE conditions. Additional information Additional information may be found in: • American National Standards Institute (ANSI)/American Nuclear Society (ANS) Standard 2.26, Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design, La Grange Park, Illinois, reaffirmed 2010. • American Society of Civil Engineers (ASCE), 04-98, Seismic Analysis of Safety-Related Nuclear Structures, Reston, Virginia, 2000. • ASCE/Structural Engineering Institute, 43-05, Seismic Design Criteria for Structures, Systems and Components in Nuclear Facilities, Reston, Virginia, 2005. • American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code Section III, Division 1-Subsection NE, Rules for Construction of Nuclear Facility Components, New York, 2010. • CSA Group, N287 series on requirements for concrete containment structures for CANDU nuclear power plants. • CSA Group, N289 series on seismic design and qualification of nuclear power plants. • CSA Group, A23.3, Design of Concrete Structures, Toronto, Canada. • CSA Group, S16, Design of Steel Structures, Toronto, Canada. • CSA Group, N291, Requirements for Safety-Related Structures for CANDU Nuclear Power Plants, Toronto, Canada. • Electric Power Research Institute, TR-103959, Methodology for Developing Seismic Fragilities, Palo Alto, California, 1994.		

Article No.	Clause Requirement	Assessment	Compliance Category
	• European Standard, EN-15129, Anti-seismic Devices, European Committee for Standardization: Brussels, 2009. • European Standard, EN-1337-3, Structural Bearings – Elastomeric Bearings, European Committee for Standardization: Brussels, 2000. • European Standard, EN 1337-1, Structural Bearings – General Design Rules, European Committee for Standardization: Brussels, 2000. • IEEE, 344, IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations, Piscataway, New Jersey, 2004. • NRC, National Building Code of Canada, Ottawa, Canada, 2010. • U.S. NRC, Regulatory Guide 1.57, Design Limits and Loading Combinations for Metal Primary Reactor Containment System Components, Washington, D.C., 2007. • U.S. NRC, Regulatory Guide 1.91, Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants, Washington, D.C., 1978. • U.S. NRC, NUREG-0800, section 3.7.3, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR edition- Seismic Subsystem Analysis, Washington, D.C., 2007.		
7.15.1	The NPP design shall specify the required performance for the safety functions of the civil structures in operational states, DBAs and DECs. Civil structures important to safety shall be designed and located so as to minimize the probabilities and effects of internal hazards such as fire, explosion, smoke, flooding, missile generation, pipe whip, jet impact, or release of fluid due to pipe breaks. External hazards such as earthquakes, floods, high winds,	Assessed under SFR1.	RNA

Article No.	Clause Requirement	Assessment	Compliance Category
	tornadoes, tsunamis, and extreme meteorological conditions shall be considered in the design of civil structures. Settlement analysis and evaluation of soil capacity shall include consideration of the effects of fluctuating ground water on the foundations, and identification and evaluation of potential liquefiable soil strata and slope failure. Civil structures important to safety shall be designed to meet the serviceability, strength, and stability requirements for all possible load combinations under the categories of normal operation, AOO, DBA and DEC conditions, including external hazards. The serviceability considerations shall include, without being limited to, deflection, vibration, permanent deformation, cracking, and settlement. The design specifications shall also define all loads and load combinations, with due consideration given to the probability of concurrence and loading time history. Environmental effects shall be considered in the design of civil structures and the selection of construction materials. The choice of construction material shall be commensurate with the designed service life and potential life extension of the plant. The plant safety assessment shall include structural analyses for all civil structures important to safety. Guidance The design authority should provide the design principles, design basis requirements and criteria, and applicable codes and standards, design and analysis procedures, the assumed boundary conditions and the computer codes used in the analysis and design. All internal and external hazard loads are specified in section 7.4. Earthquake design input loads and impacts of		

Article No.	Clause Requirement	Assessment	Compliance Category
	malevolent acts, including large aircraft crash can be found in sections 7.13 and 7.22, respectively. Load categories corresponding to the plant states are defined in this section so as to demonstrate structural performances as follows: •normal condition loads which are expected during the assumed design life of the NPP •AOO loads (or severe environmental loads) •DBA loads (or abnormal or extreme environmental loads) •DEC loads (or beyond-design loads) The design should identify all DEC loads considered in the structure design and provide the assessment methodology and acceptance criteria. The structural design should withstand, accommodate or avoid foundation settlement (total and differential), according to its performance requirements. The structural design should consider the impact of aging on the structure and its material. The design should include sufficient safety margins for the buildings and structures that are important to safety. The physical and material description of each civil structure and its base slab should include: •the type of structure, and its structural and functional characteristics •the geometry of the structures, including sketches showing plan views at various elevations and sections (at least two orthogonal directions) •the relationship between adjacent structures, including any separation or structural ties •the type of base slab and its arrangement with the methods of transferring horizontal shears (such as those seismically induced) to the foundation media		

Article No.	Clause Requirement	Assessment	Compliance Category
	Containment structure The design should specify the safety requirements for the containment building or system, including, for example, its structural strength, leak tightness, and resistance to steady-state and transient loads (such as those arising from pressure, temperature, radiation, and mechanical impact) that could be caused by postulated internal and external hazards. In addition, the design should specify the safety requirements and design features for the containment internal structures, (such as the reactor vault structure, the shielding doors, the airlocks, and the access control and facilities). The design of the containment structure should include: •base slab and sub-base •containment wall and dome design •containment wall openings and penetrations •pre-stressing system •containment liner and its attachment method The design pressure of the containment building should be determined by increasing by at least 10% the peak pressure that would be generated by the DBA (refer to clause 4.49 of IAEA NS-G-1.10, Design of Reactor Containment Systems for Nuclear Power Plants). Ultimate internal pressure capacity should be provided for the containment building structures including containment penetrations. If the containment building foundation is a common mat slab which is not separated from the other buildings foundation, the impact should be evaluated. Concrete containment structures should be designed and constructed in accordance with the CSA N287 series, as applicable:		

Article No.	Clause Requirement	Assessment	Compliance Category
	•N287.1, General Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants, for general requirements in documentation of design specification and design reports •N287.2, Material Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants, for material •N287.3, Design Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants for design •N287.4, Construction, Fabrication and Installation Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants, and N287.5, Examination and Testing Requirements for Concrete Containment Structures for Nuclear Power Plants, for containment construction and inspection •N287.6, Pre-operational proof and leakage rate testing requirements for concrete containment structures for nuclear power plants, for pressure test before operation Steel containment structures should be designed according to the ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NE, Class MC Components or equivalent standard. Stability of the containment vessel and appurtenances should be evaluated using ASME Code Case N-284-1, Metal Containment Shell Buckling Design Methods, Section III, Division 1, Class MC. For other requirements on the design of containment structures, refer to section 8.6.2 of this regulatory document. Safety-related structures The safety-related structures other than the containment should be designed and constructed in accordance with CSA N291, Requirements for safety-related structures for CANDU nuclear power plants. The design of other safety-related structures should include:		

Article No.	Clause Requirement	Assessment	Compliance Category
	•internal structures of reactor building •service (auxiliary) building •fuel storage building •control building •diesel generator building •containment shield building, if applicable •other safety-related structures defined by the design •turbine building (for boiling water reactor) Additional information Additional information may be found in: •American Concrete Institute (ACI), 349-06, Code Requirements for Nuclear Safety-Related Concrete Structures & Commentary, Farmington Hills, Michigan, 2007. •ASME, Boiler and Pressure Vessel Code (BPVC) Section III, Division 2, Section 3, Code for Concrete Containments, New York, 2010. •IAEA, NS-G-1.10, Design of Reactor Containment Systems for Nuclear Power Plants, Vienna, 2004. •U.S. NRC, NUREG/CR-6486, Assessment of Modular Construction for Safety-Related Structures at Advanced Nuclear Power Plants, Washington, D.C., 1997. •U.S. NRC, Regulatory Guide 1.76, Design Basis Tornado and Tornado Missiles for Nuclear Power Plants, Washington, D.C., 2007. •U.S. NRC, Regulatory Guide 1.91, Evaluations of Explosions Postulated to occur on Transportation Routes near Nuclear Power Plants, Washington, D.C., 1978. •U.S. NRC, NUREG-0800, Section 3.8.1, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition - Concrete Containment, Washington, D.C., 2007.		

Article No.	Clause Requirement	Assessment	Compliance Category
9.3	Hazard analysis shall collect and evaluate information about the NPP to identify the associated hazards and determine those that are significant and must be addressed. A hazard analysis shall demonstrate the ability of the design to effectively respond to credible common-cause events. As discussed in section 9.1, the first step of the hazard analysis is to identify PIEs. For each common-cause PIE, the hazard analysis shall identify: 1. applicable acceptance criteria (i.e., the success path criteria) 2. the hazardous materials in the plant and at the plant site 3. all qualified mitigating SSCs credited during and following the event all non-qualified safety or safety support systems are assumed to fail, except in cases where their continued operation would result in more severe consequences 4. operator actions and operating procedures for the event 5. plant or operating procedure parameters for which the event is limiting The hazard analysis shall confirm that: 1. the plant design incorporates sufficient diversity and separation to cope with credible common-cause events 2. credited SSCs are qualified to survive and function during and following credible common- cause events, as applicable 3. the following criteria are met: a. the plant can be brought to a safe shutdown state b. the integrity of the fuel in the reactor core can be maintained c. the integrity of the reactor coolant pressure boundary and containment can be maintained d. safety-critical parameters can be monitored by the	Paragraph 1: For some specific hazards (fire, seismic, pipe whip, steam protection for EQ), deterministic assessments were performed. PSAs were also performed per CNSC S-294 requirements for fire and seismic because it is recognized that these were high risk contributors. For the remaining hazards, per the S-294 requirements, a list of internal and external events was developed and preliminary screening was performed using defined criteria, such as low frequency of occurrence to remove the majority of hazards/hazard combinations from further consideration. After two levels of screening (NK21-CORR-00531-09809/NK29-CORR-00531-10287, NK21-CORR-00531-10848/NK29-CORR-00531-11226), the remaining events had bounding analysis performed to demonstrate the low risk, or performed a PSA in the case of four remaining external hazards: fire, earthquake, tornado and external flooding. Rather than demonstrate the deterministic control/cool/contain/monitor function, it was demonstrated that the risk (consequence) of the hazard and failure of mitigating systems was acceptable. As part of Fukushima follow-up, the PSA work was expanded to looked at 'review level conditions' for some of the major external hazards to again ensure risk was acceptable. The status of assessment of the four external hazards is as follows: 1) Fire: The detailed hazard analysis of protection against fire is documented in NK29-REP-71400-00004,	C

Article No.	Clause Requirement	Assessment	Compliance Category
	operator The hazard analysis report shall include the findings of the analysis and the basis for those findings. This report shall also: 1. include a general description of the physical characteristics of the plant that outlines the prevention and protection systems to be provided 2. include the list of safe shutdown equipment 3. define and describe the characteristics associated with hazards for all areas that contain hazardous materials 4. describe the performance criteria for detection systems, alarm systems, and mitigation systems, including requirements such as seismic or environmental qualification 5. describe the control and operating room areas and the protection systems provided for these areas, including additional facilities for maintenance and operating personnel 6. describe the operator actions and operating procedures of importance to the given analysis 7. identify the plant parameters for which the event is limiting 8. explain the inspection, testing, and maintenance parameters needed to protect system integrity 9. define the emergency planning and coordination requirements for effective mitigation, including any necessary measures to compensate for the failure or inoperability of any active or passive protection system or feature Guidance The objective of the hazard analysis is to determine the adequacy of protection of the NPP against internal and external hazards, while taking into account the plant design and site characteristics. To ensure the availability of	NK29-REP-71400-00003 and NK29-REP-71400-00002. As well, Bruce Power has submitted in NK21-CORR-00531-11324/NK29-CORR-00531-11729 a Fire Probabilistic Risk Assessment (PRA) report. 2) Earthquake: The safety-related systems in Bruce B requiring seismic qualification against earthquakes are defined in Design Guide NK29-DG-03650-002. The seismic qualification is carried out as per DPT-PDE-00017. As well, Bruce Power has submitted in NK21-CORR-00531-11324/NK29-CORR-00531-11729 a Seismic PRA report. 3) Tornado and 4) External Flooding: Bruce Power has submitted in NK21-CORR-00531-09969/NK29-CORR-00531-10409 a methodology for analysis of tornadoes, high winds and external flooding, and has submitted in NK21-CORR-00531-11324/NK29-CORR-00531-11729 a High Wind PRA Report (which includes tornado hazard assessment) and an External Flooding Assessment. Paragraph 2: 1. For fire hazards assessments, the fire protection goals are, as per CSA N293-12: (a) to minimize the risk of radiological releases to the public that are a result of fire; (b) to protect plant occupants from death or injury due to fire; (c) to minimize economic loss resulting from fire damage to structures, equipment, and inventories;	

Article No.	Clause Requirement	Assessment	Compliance Category
	required safety functions and operator actions, all the SSCs important to safety (including the main control room, secondary control room and emergency support facilities) should be adequately protected against relevant internal and external hazards. The hazard analysis should establish a list of relevant internal and external hazards that may affect plant safety. For the relevant hazards, the review should demonstrate, by using deterministic and probabilistic techniques, that the probability or consequences of the hazard are sufficiently low so that no specific protective measures are necessary, or that the preventive and mitigating measures against the hazard are adequate. All internal and external hazards are considered as part of PIEs. The hazards that make an insignificant contribution to plant risk can be screened out from the detailed analysis; however, the rationale for this screening should be provided. The remaining PIEs constitute the scope of the hazard analysis. The design should specify design-basis hazards, establishing clear criteria. The design-basis hazards should be analyzed using the deterministic safety analysis rules and criteria provided in section 9.4. Such analysis should also demonstrate the adequacy of the complementary design features in mitigating radiological consequences of design extension conditions. The hazard analysis should demonstrate that the design incorporates sufficient safety margins. Additional information Additional information may be found in: •CNSC, RD-346, Site Evaluation for New Nuclear Power Plants, Ottawa, Canada, 2008. •CNSC, RD/GD-369, Licence Application Guide: Licence to	and (d) to minimize the impact of radioactive and hazardous materials on the environment as a result of fire. For common-mode hazards other than fires, the assessment acceptance criteria are to maintain the four basic nuclear safety functions: (a) to safely shutdown the reactor and maintain it in a safe shutdown condition; (b) to remove residual and decay heat from the reactor after shutdown; (c) to limit release of radioactive material and ensure that dose to public is within prescribed limits; (d) to be able to monitor safety-critical parameters. The Bruce B Fire Hazard Assessment NK29-REP-71400-00004 demonstrates that both sets of acceptance criteria are met. 2. Bruce Power's Environmental Safety Management program (BP-PROG-00.02) requires that all hazardous materials in the plant and on the site be identified so that its impact on the environment can be assessed. Thus, all of the hazardous material can be identified as required by this clause for any future hazards analyses. 3. Section 8.0 of NK29-DG-03650-002 defines the level of seismic qualification of all safety-related system components to ensure that the hazard acceptance criteria are met. Appendices A and B of NK29-DG-03650-003 define the environmental qualification requirements for	

Article No.	Clause Requirement	Assessment	Compliance Category
	Construct a Nuclear Power Plant, Ottawa, Canada, 2011. •CSA Group, N293, Fire protection for nuclear power plants, Toronto, Canada, 2012. •CSA Group, N289.4, Testing procedures for seismic qualification of nuclear power plants, Toronto, Canada. •IAEA, NS-G-3.3, Evaluation of Seismic Hazards for Nuclear Power Plants, Vienna, 2002. •IAEA, NS-G-1.5, External Events Excluding Earthquakes in the Design of Nuclear Power Plants, Vienna, 2003. •IAEA, NS-G-3.1, External Human Induced Events in Site Evaluation for Nuclear Power Plants, Vienna, 2002. •IAEA, NS-G-3.5, Flood Hazard for Nuclear Power Plants on Coastal and River Sites, Vienna, 2003. •IAEA, NS-G-3.4, Meteorological Events in Site Evaluation for Nuclear Power Plants, Vienna, 2003. •IAEA, SSG-18, Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations, Vienna, 2011. •IAEA, NS-G-1.7, Protection Against Internal Fires and Explosions in the Design of Nuclear Power Plants, Vienna, 2004. •IAEA, NS-G-1.11, Protection Against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants, Vienna, 2004. •IAEA, NS-G-1.6, Seismic Design and Qualification for Nuclear Power Plants, Vienna, 2003. •IAEA, SSG-9, Seismic Hazards in Site Evaluation for Nuclear Installations, 2 Vienna, 2010.	safety-related systems when subjected to the harsh environment of the most limiting Design Basis Accident (DBA). 4. Section 1.3 of Bruce B Safety Report Part 3 (NK29-SR-01320-00002) summarizes operator credits for various initiating events. Emergency Operating Procedures and the Abnormal Incidents Manual NK29-AIM-03600.1 address DBAs regardless of the hazard initiating the DBA. For fires, the majority of the actions are via automated systems. However, the Fire Safe Shutdown Assessment (FSSA) (NK29-REP-71400-00003) identifies fire zones where manual actions could be credited, and identifies procedures needed to be updated to incorporate these operator actions. 5. Section 1.5 of Bruce B Safety Report Part 3 (NK29-SR-01320-00002) provides details of limiting parameters of all initiating events regardless of the hazard causing the accident. Paragraph 3: 1 As per Bruce B Location and Separation Requirements for Safety Related Systems NK29-DG-29-03650-005, the Bruce B design incorporates diversity, redundancy and separation requirements, such as incorporation of a two-group philosophy applied to each of the basic safety functions (control, cool, contain, monitor) following common-mode effects. 2. Only Structures, Systems, and Components (SSCs) qualified to withstand conditions during and	

Article No.	Clause Requirement	Assessment	Compliance Category
		after credible initiating events are credited. 3. The requirements to control, cool, contain and monitor the reactor are part of the success path of hazard analysis. Regarding the monitoring of safety-critical parameters, Bruce Power has constructed a Secondary Control Area (SCA) in each of the four reactor buildings and an additional common SCA in the Emergency Water and Power Supply Building. The purpose of these SCAs is to provide an alternate location for control and monitoring of the reactors should the MCR become unavailable. Thus, these parameters can be monitored following a fire The SCA has been designed to be seismically qualified and available for monitoring of safety-critical parameters. Paragraph 4: There is no single Hazard Analysis Report which collects all the noted information in the elements of this paragraph. Instead, the information is listed in documents already cited in the assessment of the preceding paragraphs: NK29-SR-01320-00001, NK29-SR-01320-00002, BP-PROG-00.02, NK29-REP-71400-00003, NK29-REP-71400-00002, BP-PLAN-00001, NK29-AIM-03600.1. Based on the above discussion with respect to each paragraph of the clause, Bruce B is compliant with the entire clause.	

B.3. Incremental Clause-by-Clause Assessment of CSA N293-12, Fire Protection for Nuclear Power Plants

In support of the review tasks listed in Section 5, a code-to-code comparison has been performed for CSA N293-12 to the previous version assessed (CSA N293-07) in Table C1. An incremental verification of these new requirements has been performed in Table B3.

Table B3: Incremental Clause-by-Clause Assessment of CSA N293-12, Fire Protection for Nuclear Power Plants

Article No.	Clause Requirement	Assessment	Compliance Category
5.2*	The fire protection goals for plants are (a) to minimize the risk of radiological releases to the public that are a result of fire; (b) to protect plant occupants from death or injury due to fire; (c) to minimize economic loss resulting from fire damage to structures, equipment, and inventories; and (d) to minimize the impact of radioactive and hazardous materials on the environment as a result of fire.	The four goals are reflected in the Purpose section of the Bruce Power Fire Safety Management procedure (BP-PLAN-00008)	C
5.6.1	The fire protection assessments shall be prepared for every plant in accordance with the requirements in Clause 11 and shall include at least the following: (a) code compliance review; (b) fire hazard assessment; and (c) fire safe shutdown analysis.	Bruce B has a Fire Safety Assessment (FSA), consisting of a Code Compliance Review (CCR), Fire Hazard Assessment (FHA) and Fire Safe Shutdown Analysis (FSSA). The most recent versions NK29-REP-71400-00004, NK29-REP-71400-00003 and NK29-REP-71400-00002 were submitted to the CNSC in NK29-CORR-00531-10591. The CNSC response in NK21-CORR-00531-10758/NK29-CORR-00531-11139 noted that based on review of all Fire Protection material submitted, the revised FSSA, FHA and CCR for Bruce B were deemed acceptable to meet the requirements of CSA N293 and the Bruce Power Reactor Operating Licence (PROL) and associated	C

Article No.	Clause Requirement	Assessment	Compliance Category
		Licence Conditions Handbook.	
5.6.2	The fire protection assessments shall be updated as necessary to reflect plant modifications, significant changes in fire hazards, and operating experience.	This is done as required. As demonstration of this, the Bruce B FHA NK29-REP-71400-00004, FSSA NK29-REP-71400-00003 and CCR NK29-REP-71400-00002 comprising the Fire Protection Assessment are currently at R04, R03 and R03 respectively.	C
7.4.1	All fire protection systems shall be seismically designed to satisfy the requirements of NFPA 13 and NBCC, except for fire protection systems specified in Clauses 7.4.2 and 7.4.3. The design and installation of fire protection systems specified in Clause 7.4.2 and 7.4.3 shall comply with CSA N289.3. The following seismic categories shall be used to identify the extent to which SSCs are required to remain operational after an earthquake: (a) Seismic Category A - SSCs that must retain their pressure boundary integrity, structural integrity, or passive function (i.e., equipment that does not have an active mechanical function but might have an electrical or load-bearing function) during and following an earthquake. (b) Seismic Category B - SSCs that must retain their pressure boundary integrity, structural integrity, or active function and in addition must remain operable during and following an earthquake. Category B includes equipment that is not part of the pressure boundary but must operate during and following an earthquake.	As per Section 2.7 of Bruce B Design Manual NK29-DM-71410-001, the following fire protection system SSCs are seismically qualified to DBE Category A: * Fire protection system piping in the Emergency Water and Power Supply (EWPS) Building *Class 1 Standpipe piping installed in essential egress stairwells in the Reactor Auxiliary Bay *Any sections of fire protection system piping adjacent to ECI piping in the Reactor Auxiliary Bay In addition, as per Section 8.0 of Bruce B Design Guide NK29-DG-03650-002 Seismic Qualification of Safety-Related Systems, all portable fire protection systems are to be qualified to DBE Category C (SSCs that must retain their pressure boundary integrity, structural integrity, or active function and in addition must remain operable following an earthquake). Seismic Category C differs from Category B only in that the SSCs must operate following the earthquake, but not necessarily during the earthquake. The clause focuses on the extent to which SSCs remain operational after an earthquake, so portable fire protection system components qualified to Category C, hence operable following the earthquake, fulfil the clause intent.	C

Article No.	Clause Requirement	Assessment	Compliance Category
11.1*	Clause 11 specifies requirements for the preparation of fire protection assessments to meet the fire protection goals, objectives, and criteria specified in Clause 5. See Annex B for detailed guidance	The Bruce B FHA NK29-REP-71400-00004, FSSA NK29-REP-71400-00003 and CCR NK29-REP-71400-00002 comprising the Fire Protection Assessment, meet all specified requirements	C
11.2.1*	The fire protection assessments shall be initiated early in the design of new plants and updated when the plant design is finalized.	This is done as required. As demonstration of this, the Bruce B FHA NK29-REP-71400-00004, FSSA NK29-REP-71400-00003 and CCR NK29-REP-71400-00002 comprising the Fire Protection Assessment are currently at revision R04, R03 and R03 respectively	C
11.2.2*	The fire protection assessments shall be updated as necessary to reflect plant modifications, significant changes in fire hazards, operating experience, and operational changes.	This is done as required. As demonstration of this, the Bruce B FHA NK29-REP-71400-00004, FSSA NK29-REP-71400-00003 and CCR NK29-REP-71400-00002 comprising the Fire Protection Assessment are currently at revision R04, R03 and R03 respectively	C
11.2.3	The fire protection assessments for an operating plant shall be revised or reaffirmed at least once every five years.	Governing procedures DPT-PDE-00027, DPT-PDE-00028 and DPT-PDE-00029 specify that the FHA, FSSA and CCR shall be updated or confirmed at least once every five years. From the issue date of the current and previous revisions of NK29-REP-71400-00004, NK29-REP-71400-00003 and NK29-REP-71400-00002, this requirement is complied with.	C
11.3.1*	The fire protection assessments shall cover all locations within the protected area and areas external to the protected area that are under the scope of this Standard.	The Bruce B FHA NK29-REP-71400-00004, FSSA NK29-REP-71400-00003 and CCR NK29-REP-71400-00002 comprising the Fire Protection Assessment cover all locations within the protected area and non-nuclear areas. The buildings covered include: * Reactor Building: Unit 0, Units 5-8 * BNPD Site Pumphouse * Ancillary Services Building	C

Article No.	Clause Requirement	Assessment	Compliance Category
		* East Service Area * North Service Area * Emergency Water and Power Supply Building * Unit 5/6 Fuel Oil Pumphouse * Unit 7/8 Fuel Oil Pumphouse * Bruce B Main Guardhouse and Garage Building * Water Treatment Plant * Unit Pumphouses 5, 6, 7, & 8 * Standby Generator Buildings 5, 6, 7, & 8 * Vacuum Building * Emergency Filtered Air Discharge Building * Mechanical Maintenance Briefing Trailer * Construction Office Trailer * Emergency Response Building Trailer	
11.3.2*	The fire protection assessments shall cover fires occurring during all operational modes, including power operation, shutdown or start-up, and outages.	The FSSA (NK29-REP-71400-00003) addresses all plant operational modes.	C
11.4*	The defence-in-depth principle specified in Clause 5.3 requires that multiple, independent fire protection measures be used to achieve a high degree of assurance that nuclear safety will be maintained at all times. The defence-in-depth principle shall be used in the fire protection assessments to help determine the fire protection measures needed to ensure the achievement of the nuclear safety objectives specified in Clause 5.4.1.	The FSSA (NK29-REP-71400-00003) includes a defence-in-depth review involving an assessment of fire hazards and postulated scenarios and the impact on FSSA-credited components, including assessment of the detection and suppression systems provided. The three defence-in-depth echelons noted in FSSA Section 5.9 are: * Preventing ignition of fires; * Rapid detection, control, and extinguishment of fires that do occur, thereby limiting damage; * Adequately protecting structures, systems, and components vital to safety; such that a fire is not	C

Article No.	Clause Requirement	Assessment	Compliance Category
		capable of preventing essential plant safety functions from being performed	
11.6	Limitations and uncertainties concerning the data and methods used shall be identified. The assessment and analysis shall demonstrate that these limitations and uncertainties are adequately addressed (e.g., by the use of suitable safety margins). Note: Appropriate sensitivity analysis may be necessary to demonstrate suitable safety margins in light of uncertainties in data and methods.	The only component of the Fire Protection Assessment that entails calculational methodology is the FSSA (NK29-REP-71400-00003). FSSA Section 6.0 documents uncertainty in the fire modeling utilized and safety margins used to address limitations and uncertainties, such as those in the fire modeling calculations and fire scenario development.	C
11.7*	The following documentation is required as a minimum: (a) the SSCs required to perform the nuclear safety objectives defined in Clause 5.4 and their location; (b) the general usage of the fire compartment or zone, including the major equipment present; (c) the inventory and configuration of combustible materials in each fire zone; (d) postulation of the design basis fires in each fire zone and assessment of resulting damage to plant SSCs; (e) postulation of the failures, and potential failure modes, of equipment in applicable fire zone and assessment of resulting impacts to plant fire safe shutdown; (f) the technical basis of each step in demonstrating the achievement of safety objectives of the standard; (g) fire mitigation measures, including: (i) fire detection; (ii) automatic and manual suppression; (iii) fire separations; (iv) spatial separations; and (v) smoke control;	(a) The FHA (NK29-REP-71400-00004) and FSSA (NK29-REP-71400-00003) identify all credited safe shutdown components, potential fixed fire sources and their impact on safe shutdown, and fire protection features credited for supporting safe shutdown capability. (b) The “Fire Zone Description” field of the datasheets in the FHA Report provides the general usage of the fire zone and description of the zone, including major plant equipment. (c)The FHA datasheet field “Types and Quantities of Combustibles” identifies the in situ combustibles. The “Laydown/Storage Areas” and field of the datasheets in the FHA notes the presence of Extended Storage Areas and Transient Material Permit Storage Areas, and Radioactive Material Storage Areas and the “Transient Hazards” field identify the impacts of potential transient fires on fire safe shutdown and life safety. (d),(e),(f) The impact of all postulated fire scenarios, including fixed ignition sources, potential transient combustibles, and storage/laydown areas has been	C

Article No.	Clause Requirement	Assessment	Compliance Category
	(h) verification that the nuclear safety performance criteria specified in Clause 5.4.2 have been met, or additional fire protection measures that are required; (i) verification that the criteria for the protection of radioactive materials outside the reactor, as defined in Clause 5.4.3, have been met, or additional fire protection measures that are required; (j) compliance with the applicable requirements of this Standard and referenced documents; and (k) assessment of effectiveness, appropriateness, and reliability of the fire protection measures in meeting the goals and objectives of this Standard.	assessed individually for each fire zone in the FHA. The results of the target impacts from potential fires are addressed in the FSSA (g) The FSSA documents the detection and suppression measures credited for specific fire scenarios, including manual fire fighting capability; as well as smoke control measures, fire rated barriers, “performance” barriers, and “spatial” barriers credited as fire mitigation measures. (h) The Room Summary Sheets in the FSSA provide an assessment of the capability to achieve the nuclear safety performance criteria specified in Clause 5.4.2 based on the postulated fire scenarios. (i) The “Radiological Hazard Potential” field of the datasheets in the FHA addresses the potential for radiological release due to fire including the potential for contaminated spread of smoke or suppression water. Where potential of radiological impact is identified, recommendations are included in the "Recommendations to Improve Fire Protection Capability" field. (j), (k) The CCR (NK29-REP-71400-00002) documents compliance with the operational requirements of CSA N293 and applicable construction codes. The intent is to document the adequacy of the installed fire protection features in meetings the goals and objectives of CSA N293.	
11.8.1	The preparation and review of the fire protection assessments required by this Standard shall comply with the quality assurance requirements of CSA N286. The CSA N286 requirements shall also apply to any revisions.	The Bruce Power procedures (DPT-PDE-00027, DPT-PDE-00028, DPT-PDE-00029) governing preparation, review and update of the components of a Fire Protection Assessment all require adherence to applicable clauses of CSA N286-05.	C

Article No.	Clause Requirement	Assessment	Compliance Category
		Preparation or revision of a component of a Fire Protection Assessment is conducted as per an Analysis Plan demonstrating adherence to the quality assurance requirements of CSA N286-05. Bruce Power has committed in NK21-CORR-00531-11189/NK29-CORR-00531-11593 to perform a Gap Analysis and to prepare a detailed Transition Plan, and to subsequently implement the necessary changes to governance documentation in moving from the CSA N286-05 version of the code to the CSA N286-12 version.	
11.8.2	Fire protection assessments performed to demonstrate compliance to this Standard shall be auditable.	The Bruce Power procedures (DPT-PDE-00027, DPT-PDE-00028, DPT-PDE-00029) governing preparation, review and update of the components of a Fire Protection Assessment all require that all elements of the assessments be treated as Controlled Documents stored in PassPort.	C
11.8.3*	The fire protection assessments shall be prepared by personnel with knowledge of fire protection, plant design, and nuclear safety. This qualification of personnel applies to the preparation of the original document and to periodic updating of the assessment.	Preparation or revision of a component of a Fire Protection Assessment is conducted as per an Analysis Plan which includes the qualifications of personnel carrying out the work.	C

*An asterisk beside a clause number identifies those clauses for which further information is provided in Annex A (informative)

Appendix C – Code-to-Code Comparison for Updated Codes and Standards

C.1. Comparison of CSA N293-12 Fire Protection for Nuclear Power Plants to CSA N293-07, Fire Protection for CANDU Nuclear Power Plants

In support of the review tasks listed in Section 5, a code-to-code comparison has been performed for CSA N293-12 to the previous version assessed (CSA N293-07). CSA N293-12 clauses without equivalent clauses in CSA N293-07 have been identified in Table C1. An incremental clause-by-clause assessment of these new requirements has been performed in Appendix B.3, within Table B3.

Table C1: Code-to-Code Comparison of CSA N293-12, Fire Protection for Nuclear Power Plants, Against CSA N293-07, Fire Protection for CANDU Nuclear Power Plants

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
4		CSA N293-07 : Clause 4		Equivalent
4.1	This Standard shall come into force on the date specified by the plant license.	CSA N293-07 : Clause 4.1 This Standard shall come into force on the date specified by the plant licence.		Equivalent
4.2	Unless otherwise specified, the licensee of a plant is responsible for meeting the requirements of this Standard. The licensee may delegate a task required by this Standard, but retains overall responsibility for fulfilling its requirements.	CSA N293-07 : Clause 4.2 Unless otherwise specified, the licensee of a plant is responsible for meeting the requirements of this Standard. The licensee may delegate a task required by this Standard, but retains overall responsibility for fulfilling its requirements.		Equivalent
4.3*		CSA N293-07 : Clause 4.3		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
4.3.1*	This Standard applies to all plants where its requirements are referenced as a license condition by the AHJ. For facilities licensed for construction prior to the publication of this Standard, (a) the design and construction requirements of this Standard shall not be retroactively applied to existing structures, systems, and components; and (b) the operational requirements (e.g., general requirements, concepts, programs, operations, analyses, emergency response) of this Standard shall apply.	CSA N293-07 : Clause 4.3.1* This Standard applies to all plants where its requirements are referenced as a licence condition by the AHJ. For facilities licensed for construction prior to the publication of this Standard, (a) the design and construction requirements of this Standard shall not be retroactively applied to existing structures, systems, and components; and (b) the operational requirements (e.g., general requirements, concepts, programs, operations, analyses, emergency response) of this Standard shall apply.		Equivalent
4.3.2*	Modifications to the plant shall comply with the requirements of this Standard. Where the design or construction of an existing plant precludes compliance with the requirements of this Standard, concurrence from the AHJ shall be obtained for any deviation. The requirements of Clauses 4.4 and 4.5 shall be met under all circumstances.	CSA N293-07 : Clause 4.3.2* Modifications to the plant shall comply with the requirements of this Standard. Where the design or construction of an existing plant precludes compliance with the requirements of this Standard, concurrence from the AHJ shall be obtained for any deviation. The requirements of Clauses 4.6 and 4.7 shall be met under all circumstances.		Equivalent
4.4		CSA N293-07 : Clause 4.4		Equivalent
4.4.1	This Standard is in no way intended to preclude the use of alternative materials, means, measures, procedures, processes, approaches, or technologies where the alternative is demonstrated, with appropriate supporting documentation, to meet the intent of this Standard. Where alternatives are used, the requirements of Clauses 4.4 and 4.5 shall be met.	CSA N293-07 : Clause 4.4.1 This Standard is in no way intended to preclude the use of alternative materials, means, measures, procedures, processes, approaches, or technologies where the alternative is demonstrated, with appropriate supporting documentation, to meet the intent of this Standard, and where the AHJ concurs with the alternative approach. Where alternatives are used, the requirements of Clauses 4.6 and 4.7 shall be met.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
4.4.2	The requirements of this Standard may be met through the implementation of performance-based design or operational approaches that are in accordance with the intent of this Standard, and where the AHJ concurs with the performance-based approach. Where performance-based approaches are used, the requirements of Clauses 4.5 shall be met.	CSA N293-07 : Clause 4.4.2 The requirements of this Standard may be met through the implementation of performance-based design or operational approaches that are in accordance with the intent of this Standard, and where the AHJ concurs with the performance-based approach. Where performance-based approaches are used, the requirements of Clauses 4.6 and 4.7 shall be met.		Equivalent
4.4.3	Alternatives or performance-based design approaches shall be submitted to, and concurrence shall be obtained from, the AHJ prior to implementation.	CSA N293-07 : Clause 4.6.1 Alternatives or performance-based design approaches shall be submitted to, and concurrence shall be obtained from, the AHJ prior to implementation, in accordance with Clause 4.5.		Equivalent
4.5		CSA N293-07 : Clause 4.7*		Equivalent
4.5.1	Where alternatives or performance-based design or operational approaches are used, they shall be adequately supported by procedures, references, and documentation for review by the AHJ and a qualified third party.	CSA N293-07 : Clause 4.7.1 Where alternatives or performance-based design or operational approaches are used, they shall be adequately supported by procedures, references, and documentation in accordance with the review by the AHJ and a qualified third party.		Equivalent
4.5.2	Where alternatives or performance-based design or operational approaches are implemented, details of any deviation from the requirements and procedures stated in this Standard shall be documented in the code compliance review and considered in the fire hazard assessment.	CSA N293-07 : Clause 4.7.2 Where alternatives or performance-based approaches are implemented, details of any deviation from the requirements and procedures stated in this Standard shall be documented in the code compliance review and considered in the fire hazard assessment.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
4.5.3	The documentation shall be appropriate for the complexity of the deviation and the potential safety hazard. As a minimum, documentation shall include (a) the goals, objectives, and safety functions of the requirement for which alternatives are sought; (b) the reasons why the requirement cannot be met (e.g., high cost, impracticality, better alternative available, conflict with other safety requirements); (c) a description of the proposed alternative including, as appropriate, a design description, drawings, specifications, etc.; (d) the reasons why the alternative will achieve the intended safety functions, including assumptions, technical references, calculations, test reports, etc.; (e) the inspection, testing, and maintenance requirements of the proposed design to ensure continued performance; (f) operational requirements, such as operating procedures and training; and (g) the decommissioning requirements of the design.	CSA N293-07 : Clause 4.7.3 The documentation shall be appropriate for the complexity of the deviation and the potential safety hazard. As a minimum, documentation shall include (a) the goals, objectives, and safety functions of the requirement for which alternatives are sought; (b) the reasons why the requirement cannot be met (e.g., high cost, impracticality, better alternative available, conflict with other safety requirements); (c) a description of the proposed alternative including, as appropriate, a design description, drawings, specifications, etc.; (d) the reasons why the alternative will achieve the intended safety functions, including assumptions, technical references, calculations, test reports, etc.; (e) the inspection, testing, and maintenance requirements of the proposed design to ensure continued performance; (f) operational requirements, such as operating procedures and training; and (g) the decommissioning requirements of the design.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
4.6		CSA N293-07 : Clause 4.5	CSA N293-07 requires conduct of a Code Compliance Review (CCR), Fire Hazards Assessment (FHA) and Fire Safety Shutdown Analysis (FSSA), while N293-12 requires conduct of a fire protection assessment. At Bruce Power, a Fire Protection Assessment or Fire Safety Assessment is defined as being comprised of the three components CCR, FHA and FSSA (see DPT-PDE-00027). So the two clauses are identical in intent (see Note after clause 4.6.2).	Equivalent
4.6.1	To ensure an adequate level of fire protection, each plant shall conduct fire protection assessments demonstrating compliance with the applicable requirements of this standard. Documents forming part of the fire protection assessments shall be submitted to the AHJ for acceptance.	CSA N293-07 : Clause 4.5.1 To demonstrate an adequate level of safety, each plant shall undergo a CCR, FHA, and FSSA. Where there are no deviations, the CCR shall declare the facility as being in compliance with this Standard. The results of the CCR, FHA, and FSSA shall be documented and submitted to the AHJ for acceptance.	CSA N293-07 requires conduct of a Code Compliance Review (CCR), Fire Hazards Assessment (FHA) and Fire Safety Shutdown Analysis (FSSA), while N293-12 requires conduct of a fire protection assessment. At Bruce Power, a Fire Protection Assessment or Fire Safety Assessment is defined as being comprised of the three components CCR, FHA and FSSA (see DPT-PDE-00027). So the two clauses are identical in intent.(see Note after clause 4.6.2).	Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
4.6.2	For facilities licensed for operation prior to the publication of this Standard, the assessments referred to in Clause 4.6.1 shall demonstrate achieving (a) the goals, objectives and criteria of Clause 5; (b) the operational requirements of this standard; and (c) the applicable design and construction requirements of the codes of record. Note: It is intended by this Standard that fire protection assessments required by this Clause can be satisfied by previous analysis performed in accordance with the 2007 edition of this Standard (i.e., CCR, FHA, FSSA, etc.) and maintained in compliance with Clause 11.2.3.	CSA N293-07 : Clause 4.5.2 For facilities licensed for operation prior to the publication of this Standard, a CCR shall be performed against the operational requirements of this Standard and applicable construction codes. The FHA and FSSA shall comply with the requirements of this Standard.	CSA N293-07 Cl 4.5.2 discusses compliance of CCR, FHA & FSSA, while N293-12 Cl 4.6.2 discusses "the assessments referred to in Clause 4.6.1", ie a Fire Protection Assessment (FPA) consisting of a CCR, FHA & FSSA. These are equivalent.	Equivalent
4.6.3	When included as part of the plant's license, the facility shall comply with the requirements of this Standard.	CSA N293-07 : Clause 4.5.3 When included as part of the plant's construction license, the facility shall (a) be designed in accordance and comply with the requirements of this Standard; and (b) include the development of a CCR, FHA, and FSSA.		Equivalent
5		CSA N293-07 : Clause 5		Equivalent
5.1		CSA N293-07 : Clause 5.1		Equivalent
5.1.1	Clause 5 specifies the general fire protection concepts and performance levels applicable to the life cycle of a plant.	CSA N293-07 : Clause 5.1.1 Clause 5 specifies the general fire protection concepts and performance levels applicable to the life cycle of a plant.		Equivalent
5.1.2*	Clauses 6 to 11 state the requirements for achieving the fire protection levels specified in Clause 5.	CSA N293-07 : Clause 5.1.2* Clauses 6 to 11 state the requirements for achieving the fire protection levels specified in Clause 5.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.1.3	Where specific design or operational requirements are not addressed in this Standard, the NBCC, or the NFCC, good engineering practice shall apply and, where appropriate, recognized Standards (such as those of the National Fire Protection Association [NFPA]) shall be used.	CSA N293-07 : Clause 5.1.3 Where specific design or operational requirements are not addressed in this Standard, the NBCC, or the NFCC, good engineering practice shall apply and, where appropriate, recognized Standards (such as those of the National Fire Protection Association [NFPA]) shall be used.		Equivalent
5.1.4	The facility shall be designed, operated, inspected, tested, and maintained so that the goals, objectives, and criteria of Clause 5 are achieved for all postulated fire scenarios and failure modes within the scope of this Standard.	CSA N293-07 : Clause 5.1.4 The facility shall be designed, operated, inspected, tested, and maintained so that the safety performance goals, objectives, and criteria of Clause 5 are achieved for all postulated fire scenarios and failure modes within the scope of this Standard.		Equivalent
5.2*	The fire protection goals for plants are (a) to minimize the risk of radiological releases to the public that are a result of fire; (b) to protect plant occupants from death or injury due to fire; (c) to minimize economic loss resulting from fire damage to structures, equipment, and inventories; and (d) to minimize the impact of radioactive and hazardous materials on the environment as a result of fire.	CSA N293-07 : Clause 5.2* The fire protection goals for plants are (a) to minimize the risk of radiological releases to the public that are a result of fire; (b) to protect plant occupants from death or injury due to fire; and (c) to minimize economic loss resulting from fire damage to structures, equipment, and inventories.	Requirement (d) is new: "(d) to minimize the impact of radioactive and hazardous materials on the environment as a result of fire."	Different
5.3*		CSA N293-07 : Clause 5.3*		Equivalent
5.3.1*	The defence-in-depth principle shall be used to achieve a high degree of fire protection by providing redundancy, diversity, and balance in fire protection measures. The elements of the defence-in-depth principle are outlined in Clauses 5.3.2 to 5.3.4.	CSA N293-07 : Clause 5.3.1* The defence-in-depth principle shall be used to achieve a high degree of fire protection by providing redundancy, diversity, and balance in fire protection measures. The elements of the defence-in-depth principle are outlined in Clauses 5.3.2 to 5.3.4.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.3.2	Design measures shall be put in place to reduce or eliminate, where practicable, combustible materials, and ignition sources, and a fire protection program shall be implemented in all operational modes in order to reduce the occurrence of fires and limit their consequences and severity.	CSA N293-07 : Clause 5.3.2 Design measures shall be put in place to reduce or eliminate, where practicable, materials, oxidizers, and ignition sources, and a fire protection program shall be implemented in all operational modes in order to reduce the occurrence of fires and limit their consequences and severity.		Equivalent
5.3.3	Means shall be provided to quickly detect and extinguish or control fires.	CSA N293-07 : Clause 5.3.3 Means shall be provided to quickly detect and extinguish or control fires.		Equivalent
5.3.4*	Fire separations or other measures shall be provided to limit the spread of fire and its effects, thus minimizing the impact on the plant and its occupants.	CSA N293-07 : Clause 5.3.4* :Fire separations or other measures shall be provided to limit the spread of fire and its effects, thus ::minimizing the impact on the plant and its occupants.		Equivalent
5.4		CSA N293-07 : Clause 5.4		Equivalent
5.4.1		CSA N293-07 : Clause 5.4.1		Equivalent
5.4.1.1*	In the event of a fire, the plant shall be capable of (a) achieving and maintaining the reactor in subcritical conditions; (b) achieving and maintaining decay heat removal; (c) maintaining the integrity of the fission product boundaries; and (d) limiting the release of radioactive materials that are located outside the reactor.	CSA N293-07 : Clause 5.4.1.1* In the event of a fire, the plant shall be capable of (a) achieving and maintaining the reactor in subcritical conditions; (b) achieving and maintaining decay heat removal; (c) maintaining the integrity of the fission product boundaries; and (d) limiting the release of radioactive materials that are located outside the reactor.		Equivalent
5.4.1.2	The safety objectives of Clause 5.4.1.1 shall be maintained for all plant operational modes, including full or partial power operation, start-up, shutdown, and any outages.	CSA N293-07 : Clause 5.4.1.2 The safety objectives of Clause 5.4.1.1 shall be maintained for all plant operational modes, including full or partial power operation, start-up, shutdown, and any outages.		Equivalent
5.4.2		CSA N293-07 : Clause 5.4.2		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.4.2.1	To achieve the objectives of Clause 5.4.1.1(a) to (c), the requirements of Clauses 5.4.2.2 to 5.4.2.6 shall be met.	CSA N293-07 : Clause 5.4.2.1 To achieve the objectives of Clause 5.4.1.1, the requirements of Clauses 5.4.2.2 to 5.4.2.6 shall be met.	In N293-07, the objectives of all Clause 5.4.1.1 elements, including element (d), were cited; in N293-12, element (d) is excluded: "(d) limiting the release of radioactive materials that are located outside the reactor." Instead, achievement of element (d) is moved into added requirement 5.4.3.1	Equivalent
5.4.2.2*	Means shall be provided to rapidly insert negative reactivity into the reactor core in order to achieve and maintain subcritical conditions and ensure fuel design limits are not exceeded.	CSA N293-07 : Clause 5.4.2.2* Means shall be provided to rapidly insert negative reactivity into the reactor core in order to achieve and maintain subcritical conditions and ensure fuel design limits are not exceeded.		Equivalent
5.4.2.3*	Means shall be provided to ensure that fuel is in a safe and stable condition, through the maintenance of sufficient coolant levels and the removal of decay heat from the reactor.	CSA N293-07 : Clause 5.4.2.3* Means shall be provided to ensure that fuel is in a safe and stable condition, through the maintenance of sufficient coolant levels and the removal of decay heat from the reactor.		Equivalent
5.4.2.4*	Means shall be provided to ensure that nuclear reactor systems that contain radioactive materials or fission products, including the reactor coolant system and reactor auxiliary systems, shall not be breached. There shall be no leakage of coolant beyond the capability of the pressure and inventory make-up system. In addition, the containment system's integrity shall not be breached.	CSA N293-07 : Clause 5.4.2.4* Means shall be provided to ensure that nuclear reactor systems that contain radioactive materials or fission products, including the primary heat transport system, moderator system, and reactor auxiliary systems, shall not be breached. There shall be no leakage of coolant beyond the capability of the pressure and inventory make-up system. In addition, the containment system's integrity shall not be breached.		Equivalent
5.4.2.5	Means for supplying the necessary power, water, compressed air, and other support functions shall be provided to ensure that the criteria of Clauses 5.4.2.2 to 5.4.2.4 and Clause 5.4.2.6 are met.	CSA N293-07 : Clause 5.4.2.5 Means for supplying the necessary power, water, compressed air, and other support functions shall be provided to ensure that the criteria of Clauses 5.4.2.2 to 5.4.2.4 and 5.4.2.6 are met.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.4.2.6*	Plant monitoring means shall be provided so that operators are able to perform actions to ensure that the criteria of Clauses 5.4.2.2 to 5.4.2.5 are achieved and maintained. Sufficient instrumentation shall remain available to assess the plant status as defined in CSA N290.6.	CSA N293-07 : Clause 5.4.2.6* Plant monitoring means shall be provided so that operators are able to perform actions to ensure that the criteria of Clauses 5.4.2.2 to 5.4.2.5 are achieved and maintained. Sufficient instrumentation shall remain available to assess the plant status as defined in CSA CAN3-N290.6.		Equivalent
5.4.3		CSA N293-07 : Clause 5.4.3	N293-07 Clause title omitted the part "Nuclear Safety Performance Criteria". However, the intent is clearly the same for both clauses.	Equivalent
5.4.3.1	To achieve the objective of Clause 5.4.1.1(d), the requirements of Clauses 5.4.3.2 to 5.4.3.4 shall be met.	CSA N293-07 : Clause 5.4.2.1 To achieve the objectives of Clause 5.4.1.1, the requirements of Clauses 5.4.2.2 to 5.4.2.6 shall be met	In N293-07, the objectives of all Clause 5.4.1.1 elements, including element (d), were cited; in N293-12, element (d) is excluded: "(d) limiting the release of radioactive materials that are located outside the reactor." Instead, achievement of element (d) is moved into added requirement 5.4.3.1	Equivalent
5.4.3.2*	Radioactive and fissionable materials (including spent and new fuel, and radioactive wastes) shall be protected from the effects of fire using appropriate design measures and storage arrangements, including those that minimize exposure to combustible materials.	CSA N293-07 : Clause 5.4.3.1* Radioactive and fissionable materials (including spent and new fuel, and radioactive wastes) shall be protected from the effects of fire using appropriate design measures and storage arrangements, including those that minimize exposure to combustible materials.		Equivalent
5.4.3.3	The release of radioactive materials as a result of a fire or fire suppression activities shall be as low as is reasonably achievable.	CSA N293-07 : Clause 5.4.3.2 The release of radioactive materials as a result of a fire or fire suppression activities shall be as low as is reasonably achievable.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.4.3.4	Fissionable material shall be protected from becoming critical due to fire or fire suppression activities.	CSA N293-07 : Clause 5.4.3.3 Fissionable material shall be protected from becoming critical due to fire or fire suppression activities.		Equivalent
5.5		CSA N293-07 : Clause 5.5		Equivalent
5.5.1	The following life safety performance objectives shall be met during all operational modes and plant configurations: (a) Fire hazard controls shall be included in design and operational stages. (b) Fire notification means shall be provided. (c) Safe egress and/or areas of refuge shall be provided for occupants for use in the event of a fire. (d) A safe environment and other required supports shall be provided for essential staff so that they can perform all necessary plant control functions during and following a fire. (e) Protection for personnel performing emergency services shall be provided both during and following a fire. (f) Access and emergency lighting shall be provided for all areas where manual firefighting, evacuations, or operator field actions are expected.	CSA N293-07 : Clause 5.5.1 The following life safety performance objectives shall be met during all operational modes and plant configurations: (a) Fire hazard controls shall be included in design and operational stages. (b) Fire notification means shall be provided. (c) Safe egress and/or areas of refuge shall be provided for occupants for use in the event of a fire. (d) A safe environment and other required supports shall be provided for essential staff so that they can perform all necessary plant control functions during and following a fire. (e) Protection for personnel performing emergency services shall be provided both during and following a fire. (f) Access and emergency lighting shall be provided for all areas where manual firefighting, evacuations, or operator field actions are expected.		Equivalent
5.5.2		CSA N293-07 : Clause 5.5.2		Equivalent
5.5.2.1	The life safety objectives of Clause 5.5.1 shall be met using either the prescriptive requirements or performance-based criteria outlined in the NBCC and NFCC. Note: Compliance with the prescriptive requirements of the NBCC and NFCC might not be adequate to meet the requirements of Clause 5.5.1 in all cases.	CSA N293-07 : Clause 5.5.2.1 The life safety objectives of Clause 5.5.1 shall be met using either the prescriptive requirements or performance-based criteria outlined in the NBCC and NFCC. Note: Compliance with the prescriptive requirements of the NBCC and NFCC might not be adequate to meet the requirements of Clause 5.5.1 in all cases		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.5.2.2*	Except as otherwise indicated in this Standard, plants shall be designed, modified, and constructed in accordance with all applicable requirements of the NBCC.	CSA N293-07 : Clause 5.5.2.2* Except as otherwise indicated in this Standard, plants shall be designed, modified, and constructed in accordance with all applicable requirements of the NBCC.		Equivalent
5.5.2.3*	Except as otherwise indicated in this Standard, plants shall comply with all applicable requirements of the NFCC.	CSA N293-07 : Clause 5.5.2.3* Except as otherwise indicated in this Standard, plants shall comply with all applicable requirements of the NFCC.		Equivalent
5.6		CSA N293-07 : Clause 5.6 Note: See Annex B for guidelines for the preparation of a fire safe shutdown analysis (FSSA).	N293-12 clause 5.6 and its sub-clauses have requirements not covered in N293-07 clause 5.6, as the scope is now Fire Protection Assessments, which cover the FSSAs covered in N293-07 clause 5.6, plus Code Compliance Reviews (CCRs) and Fire Hazard Assessments (FHAs)	Different
5.6.1	The fire protection assessments shall be prepared for every plant in accordance with the requirements in Clause 11 and shall include at least the following: (a) code compliance review; (b) fire hazard assessment; and (c) fire safe shutdown analysis.	CSA N293-07 : Clause 5.6.1 Compliance with the nuclear safety criteria of Clause 5.4 is demonstrated using an FSSA.	N293-12 clause 5.6 and its sub-clauses have requirements not covered in N293-07 clause 5.6, as the scope is now Fire Protection Assessments, which cover the FSSAs covered in N293-07 clause 5.6, plus Code Compliance Reviews (CCRs) and Fire Hazard Assessments (FHAs)	Different

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.6.2	The fire protection assessments shall be updated as necessary to reflect plant modifications, significant changes in fire hazards, and operating experience.	CSA N293-07 : Clause 5.6.4 The FSSA shall be updated as necessary to reflect plant modifications, significant changes in fire hazards, and operating experience.	N293-12 clause 5.6 and its sub-clauses have requirements not covered in N293-07 clause 5.6, as the scope is now Fire Protection Assessments, which cover the FSSAs covered in N293-07 clause 5.6, plus Code Compliance Reviews (CCRs) and Fire Hazard Assessments (FHAs)	Different
5.7		CSA N293-07 : Clause 5.7		Equivalent
5.7.1		CSA N293-07 : Clause 5.7.1		Equivalent
5.7.1.1	Buildings, both in the protected area or external to the protected area but directly supporting the plant, shall be constructed using non-combustible construction, as defined in the NBCC.	CSA N293-07 : Clause 5.7.1.1* Buildings, both in the protected area or external to the protected area but directly supporting the plant, shall be constructed using non-combustible materials, as defined in the NBCC.		Equivalent
5.7.1.2	The use of building fixtures and interior finishes made of combustible materials shall be minimized in buildings in the protected area or external to the protected area but directly supporting the plant.	CSA N293-07 : Clause 5.7.1.2 The use of building fixtures and interior finishes made of combustible materials shall be minimized in buildings in the protected area or external to the protected area but directly supporting the plant.		Equivalent
5.7.1.3	The use of transient combustible materials shall be minimized and controlled so they do not pose a fire hazard beyond the capabilities of existing fire protection measures. Where a fire hazard exceeds these capabilities, temporary or permanent fire protection measures that are commensurate with the fire hazard shall be provided.	CSA N293-07 : Clause 5.7.1.3 The use of transient combustible materials shall be minimized and controlled so they do not pose a fire hazard beyond the capabilities of existing fire protection measures. Where a fire hazard exceeds these capabilities, temporary or permanent fire protection measures that are commensurate with the fire hazard shall be provided.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.7.1.4	Plant design shall ensure that combustible materials, dangerous goods, and liquids and gases used for plant operations are stored, located, and protected to minimize fire hazards and the resultant threats to nuclear and life safety.	CSA N293-07 : Clause 5.7.1.4 Plant design shall ensure that combustible materials, dangerous goods, and liquids and gases used for plant operations are stored, located, and protected to minimize fire hazards and the resultant threats to nuclear and life safety.		Equivalent
5.7.1.5*	Liquids with flash points greater than 93.3 °C (200°F) shall be treated as (a) Class IIIA liquids and protected in accordance with the NFCC; or (b) Class IIIB liquids and protected in accordance with NFPA 30. These liquids shall be considered in the FPA.	CSA N293-07 : Clause 5.7.1.5* Combustible liquids with flash points greater than 93.3 °C (200°F) shall be treated as Class IIIA liquids and protected in accordance with the NFCC as well as considered in the FSSA.	N293-07 required that liquids with high flash points be treated as Class IIIA liquids; N293-12 allows them to be treated as either Class IIIA or Class IIIB liquids and protected via a different standard. N293-12 requirement is less restrictive, so compliance with N293-07 Clause 5.7.1.5 will automatically translate into compliance with N293-12 Clause 5.7.1.5. For the purposes of this assessment, since no further work is needed, the codes are treated as equivalent.	Equivalent
5.7.2		CSA N293-07 : Clause 5.7.2		Equivalent
5.7.2.1	Installed devices and process operations that, by design, pose a fire hazard shall be identified and analyzed or addressed in the design stage of the plant and shall be eliminated or controlled in order to minimize the occurrence of fires.	CSA N293-07 : Clause 5.7.2.1 Installed devices and process operations that, by design, pose a fire hazard shall be identified and analyzed or addressed in the design stage of the plant and shall be eliminated or controlled in order to minimize the occurrence of fires.		Equivalent
5.7.2.2	Temporary ignition sources (e.g., hot work activities, use of heat producing devices) that support work shall be located or controlled in accordance with the NFCC to ensure that ignition sources do not come into contact with combustible materials or flammable liquids or vapours.	CSA N293-07 : Clause 5.7.2.2 Temporary ignition sources (e.g., hot work activities, use of heat producing devices) that support work shall be located or controlled in accordance with the NFCC to ensure that ignition sources do not come into contact with combustible materials or flammable liquids or vapours.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.7.2.3	Electrical equipment and wiring shall be installed in accordance with the Canadian Electrical Code, Part I.	CSA N293-07 : Clause 5.7.2.3 Electrical equipment and wiring shall be installed in accordance with the Canadian Electrical Code, Part I.		Equivalent
5.7.2.4*	Buildings and equipment shall be protected from lightning.	CSA N293-07 : Clause 5.7.2.4* Buildings and equipment shall be protected from lightning.		Equivalent
5.7.2.5*	The potential for fires external to the plant shall be identified, assessed, and mitigated in accordance with the nuclear and life safety criteria of Clauses 5.4 and 5.5.	CSA N293-07 : Clause 5.7.2.5* The potential for fires external to the plant shall be identified, assessed, and mitigated in accordance with the nuclear and life safety criteria of Clauses 5.4 and 5.5.		Equivalent
5.7.2.6*	Explosion hazards shall be eliminated by design, where possible. Where explosion hazards cannot be eliminated, their impact shall be assessed and features shall be provided to ensure that the nuclear and life safety criteria of Clauses 5.4 and 5.5 are met.	CSA N293-07 : Clause 5.7.2.6 Explosion hazards shall be eliminated by design, where possible. Where explosion hazards cannot be eliminated, their impact shall be assessed and features shall be provided to ensure that the nuclear and life safety criteria of Clauses 5.4 and 5.5 are met.		Equivalent
5.7.3		CSA N293-07 : Clause 5.7.3		Equivalent
5.7.3.1*	A fire alarm system shall be provided in buildings.	CSA N293-07 : Clause 5.7.3.1* A fire alarm system shall be installed in buildings. The types of fire alarm systems, their performance levels, and associated safety features shall be in accordance with this Standard and the NBCC		Equivalent
5.7.3.2*	The types of fire alarm systems, their performance levels, and associated safety features shall be as a minimum in accordance with (a) this Standard; (b) the NBCC; (c) the NFCC, (d) the FPA; and (e) good engineering practices.	CSA N293-07 : Clause 5.7.3.2* Fire alarm systems shall, at a minimum, be in accordance with (a) this Standard; (b) the NBCC; (c) the NFCC, (d) the FSSA; and (e) good engineering practices.	N293-07 cited the use of FSSA to demonstrate fire protection goals, while N293-12 cites use of FPA (ie CCR and/or FHA and/or FSSA).	Equivalent
5.7.4		CSA N293-07 : Clause 5.7.4		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.7.4.1		CSA N293-07 : Clause 5.7.4.1		Equivalent
5.7.4.1.1*	A fire response program, together with other fire protection measures, shall be capable of meeting the fire protection goals outlined in Clause 5.2. This capability shall cover the entire life cycle of the plant, with the exception of the design stage, and shall be achieved in accordance with Clause 10.	CSA N293-07 : Clause 5.7.4.1.1 A fire response program, together with other fire protection measures, shall be capable of meeting the fire protection goals outlined in Clause 5.2. This capability shall cover the entire life cycle of the plant, with the exception of the design stage, and shall be achieved in accordance with Clause 10.		Equivalent
5.7.4.1.2*	Industrial fire brigade members who are responsible for responding to the most resource-demanding fires shall have no plant duties that would prevent an immediate response to these or other fires.	CSA N293-07 : Clause 5.7.4.1.2* Industrial fire brigade members who are responsible for responding to the most resource-demanding fires shall have no plant duties that would prevent an immediate response to these or other fires.		Equivalent
5.7.4.2		CSA N293-07 : Clause 5.7.4.2		Equivalent
5.7.4.2.1*	Automatic fire suppression systems shall be provided for buildings, structures, and equipment, except where it is demonstrated by the FPA or other assessments that fire protection goals can be met using other fire protection measures.	CSA N293-07 : Clause 5.7.4.2.1* Automatic fire suppression systems shall be provided for buildings, structures, and equipment, except where it is demonstrated by the FHA or other assessments that fire protection goals can be met using other fire protection measures.	N293-07 cited the use of FHA or other assessments to demonstrate fire protection goals, while N293-12 cites use of FPA (ie CCR and/or FHA and/or FSSA) or other assessments. These citations are equivalent in intent.	Equivalent
5.7.4.2.2	Where automatic suppression systems are provided, they shall be (a) designed and installed in accordance with Clause 7; and (b) inspected, tested, and maintained in accordance with Clause 8.3.	CSA N293-07 : Clause 5.7.4.2.2 Where automatic suppression systems are provided, they shall be (a) designed and installed in accordance with Clause 7; and (b) inspected, tested, and maintained in accordance with Clause 8.	N293-07 required inspection, testing and maintenance in accordance with Clause 8, while N293-12 requires accordance with Sub-clause 8.3; however, Sub-clause 8.3 is the only part of Clause 8 dealing with inspection, testing and maintenance, so the intent is identical.	Equivalent
5.7.5		CSA N293-07 : Clause 5.7.5		Equivalent
5.7.5.1		CSA N293-07 : Clause 5.7.5.1		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.7.5.1.1	The layout of SSCs shall be identified, coordinated, and applied in the early stages of plant design in order to minimize the impact of fire.	CSA N293-07 : Clause 5.7.5.1.1 The layout of equipment and structures shall be identified, coordinated, and applied in the early stages of plant design in order to minimize the impact of fire on nuclear and life safety and to prevent loss.	N293-07 referred to layout of equipment and structures, while N293-12 refers more generally to systems, structures or components. The intent is identical.	Equivalent
5.7.5.1.2	Fire separation between floors and areas within each building and between buildings shall be provided in accordance with the NBCC, NFCC, and Clause 6, except in the containment structures.	CSA N293-07 : Clause 5.7.5.1.2 Fire separation between floors and areas within each building and between buildings shall be provided in accordance with the NBCC, NFCC, and Clause 6, except in the containment structures.		Equivalent
5.7.5.1.3*	To maintain the nuclear safety objectives of Clause 5.4.1, the fire safe shutdown systems shall be divided into redundant groups, with adequate separation between groups in accordance with Clause 6.	CSA N293-07 : Clause 5.7.5.1.3* To maintain the nuclear safety objectives of Clause 5.4, the fire safe shutdown systems shall be divided into redundant groups, with adequate separation between groups in accordance with Clause 6.		Equivalent
5.7.5.1.4	Systems, components, and materials that pose a significant fire hazard shall be located so that the consequences of fire are minimized. Safety-related systems located near a fire hazard shall be provided with a fire separation or spatial separation that is appropriate for the assessed fire hazard, in accordance with the FPA.	CSA N293-07 : Clause 5.7.5.1.4 Systems, components, and materials that pose a significant fire hazard shall be located such that the consequences of fire are minimized. Safety-related systems located near a fire hazard shall be provided with a fire separation or spatial separation that is appropriate for the assessed fire hazard, in accordance with the FSSA.	N293-07 cited an FSSA, while N293-12 more generally cites the FPA (consisting of CCR, FHA & FSSA)	Equivalent
5.7.5.1.5	Cable trays shall be located and protected to reduce the potential for fire spread. Where manual fire suppression is required to meet the fire protection objectives, access to the cable area and adequate clearance between cable trays shall be provided.	CSA N293-07 : Clause 5.7.5.1.5 Cable trays shall be located and protected so as to reduce the potential for fire spread. Where manual fire suppression is required to meet the fire protection objectives, access to the cable area and adequate clearance between cable trays shall be provided.		Equivalent
5.7.5.2		CSA N293-07 : Clause 5.7.5.2		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.7.5.2.1	Where fire separations are used, the fire resistance rating shall be appropriate for the fire hazards present in a fire compartment and its adjoining fire compartments. Maintenance of these fire separations shall be in accordance with the NFCC and Clause 8 of this Standard.	CSA N293-07 : Clause 5.7.5.2.1 Where fire separations are used, the fire resistance rating shall be appropriate for the fire hazards present in a fire compartment and its adjoining fire compartments. Maintenance of these fire separations shall be in accordance with the NFCC and Clause 6 of this Standard.		Equivalent
5.7.5.2.2*	The turbine generator building (hall) shall be designed and separated from other areas of the plant such that a fire involving the turbine generator area will not (a) spread to other areas; and (b) result in progressive structural collapse.	CSA N293-07 : Clause 5.7.5.2.2* The turbine generator building (hall) shall be designed and separated from other areas of the plant such that a fire involving the turbine generator area will not (a) spread to other areas; and (b) result in progressive structural collapse.		Equivalent
5.7.6*	The production and propagation of smoke and hot gases and their effects on occupants, plant equipment, and building structures shall be addressed in the FPA. Where smoke and heat venting are deemed necessary by the FPA, the design shall be in accordance with Clause 6. Smoke management related to the control room complex shall be in accordance with Clause 5.7.8.5.	CSA N293-07 : Clause 5.7.6* The production and propagation of smoke and hot gases and their effects on occupants, plant equipment, and building structures shall be addressed in the FHA. Where smoke and heat venting are deemed necessary by the FHA, the design shall be in accordance with Clause 6. Smoke management related to the control room complex shall be in accordance with Clause 5.7.8.6.	N293-07 cited an FSSA, while N293-12 more generally cites the FPA (consisting of CCR, FHA & FSSA)	Equivalent
5.7.7		CSA N293-07 : Clause 5.7.7		Equivalent
5.7.7.1*	Fires that are caused by an earthquake and have an impact on nuclear safety shall be assessed and addressed. These fires shall be prevented, suppressed, or contained such that sufficient SSCs remain available to meet the nuclear safety criteria in Clause 5.4, taking into account the potential failure of structures and systems that are not qualified to withstand earthquakes. Fire suppression systems and fire separations credited for earthquakes shall be designed to remain functional following an earthquake.	CSA N293-07 : Clause 5.7.7.1* Fires that are caused by an earthquake and have an impact on nuclear safety shall be assessed and addressed. These fires shall be prevented, suppressed, or contained such that sufficient structures, systems, and components remain available to meet the nuclear safety criteria in Clause 5.4, taking into account the potential failure of structures and systems that are not qualified to withstand earthquakes. Fire suppression systems and fire separations credited for earthquakes shall be designed to remain functional following an earthquake.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.7.7.2*	Where the failure (both direct and consequential) of fire protection systems or fire separations can cause the failure of the plant SSCs required to perform nuclear safety functions after an earthquake, these fire protection systems and fire separations shall be seismically qualified to prevent such failures.	CSA N293-07 : Clause 5.7.7.2 Where the failure (both direct and consequential) of fire protection systems or fire separations can cause the failure of the plant structures, systems, and components required to perform nuclear safety functions after an earthquake, these fire protection systems and fire separations shall be seismically qualified to prevent such failures.		Equivalent
5.7.7.3*	Regardless of the results of the assessment required by Clause 5.7.7.1, manual fire suppression shall be provided for fires that might occur following an earthquake but are not a direct result of an earthquake.	CSA N293-07 : Clause 5.7.7.3 Regardless of the results of the assessment required by Clause 5.7.7.1, manual fire suppression shall be provided for fires that might occur following an earthquake but are not a direct result of an earthquake.		Equivalent
5.7.7.4*	Fire suppression systems that are designed to function after an earthquake shall be provided with services (e.g., power, water, compressed air) that are qualified to remain functional following the design basis earthquake defined for the plant.	CSA N293-07 : Clause 5.7.7.4 Fire-extinguishing systems that are designed to function after an earthquake shall be provided with services (e.g., power, water, compressed air) that are qualified to remain functional following the design basis earthquake defined for the plant.		Equivalent
5.7.7.5	Where manual activation of fire suppression and smoke control systems is credited in the assessment required by Clause 5.7.7.1, control areas and the paths leading to them shall be seismically qualified to remain accessible.	CSA N293-07 : Clause 5.7.7.5 Where manual activation of fire suppression and smoke control systems is credited in the assessment required by Clause 5.7.7.1, control areas and the paths leading to them shall be seismically qualified to remain accessible.		Equivalent
5.7.8*		CSA N293-07 : Clause 5.7.8		Equivalent
5.7.8.1	The control room complex shall be separated from adjoining areas by a fire separation with a fire resistance rating as specified in Clause 6.7.1.1.	CSA N293-07 : Clause 5.7.8.2 The control room complex shall be separated from adjoining areas by a fire separation with a fire resistance rating appropriate for the applicable fire hazards. Note: See Clause 6.7.1.1.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.7.8.2	Special consideration shall be given to the prevention of fires in the control room complex. Note: See Clause 6.8 for fire prevention requirements.	CSA N293-07 : Clause 5.7.8.3 Special consideration shall be given to the prevention of fires in the control room complex. Note: See Clause 6.8 for fire prevention requirements.		Equivalent
5.7.8.3*	The control room complex shall be equipped with means to detect fires at their incipient stages.	CSA N293-07 : Clause 5.7.8.4* The control room complex shall be equipped with means to detect fires at their incipient stages.		Equivalent
5.7.8.4*	Means shall be provided to limit the spread of fire across equipment within the control room complex. Areas of the control room complex that lie outside the control room, control equipment room(s), and control computer room shall be protected by automatic fire suppression systems and shall be separated from the control room and the control equipment room(s) by a fire separation.	CSA N293-07 : Clause 5.7.8.5* Means shall be provided to limit the spread of fire across equipment within the control room complex. Areas of the control room complex that lie outside the control room, control equipment room(s), and control computer room shall be protected by automatic fire suppression systems and shall be separated from the control room and the control equipment room(s) by a fire separation.		Equivalent
5.7.8.5*	A smoke management system shall be provided to ensure that (a) the control room remains habitable throughout all fires that are external to the control room complex; and (b) in the event of a fire within the control room complex, including a fire in the control room, the control room remains habitable for a period of time sufficient to enable safe transfer of control to the SCA.	CSA N293-07 : Clause 5.7.8.6* A smoke management system shall be provided to ensure that (a) the control room remains habitable throughout all fires that are external to the control room complex; and (b) in the event of a fire within the control room complex, including a fire in the control room, the control room remains habitable for a period of time sufficient to enable safe transfer of control to the SCA.		Equivalent
5.8		CSA N293-07 : Clause 5.8		Equivalent
5.8.1	The licensee of the plant shall prepare a policy document that establishes and outlines the implementation of a fire protection program. The policy document shall define management's authority and responsibilities.	CSA N293-07 : Clause 5.8.1 The licensee of the plant shall prepare a policy document that establishes and outlines the implementation of a fire protection program. The policy document shall define management's authority and responsibilities.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.8.2	A fire protection program shall be developed and implemented in a coordinated manner that takes into account the various fire protection activities of different engineering disciplines, functional groups, and other organizations.	CSA N293-07 : Clause 5.8.2 A fire protection program shall be developed and implemented in a coordinated manner that takes into account the various fire protection activities of different engineering disciplines, functional groups, and other organizations.		Equivalent
5.8.3*	The fire protection program shall detail how the program will be implemented, managed, monitored, and modified during each phase of the life cycle of a plant. Activities specified in the fire protection program for each phase shall include (a) specifying the fire protection organization and their responsibilities; (b) establishing the standards and procedures for design, analysis, and operation, including impairments and compensatory measures; (c) providing staff and training to carry out fire protection responsibilities; (d) preparing and maintaining the FPA; (e) preparing and maintaining documentation of the fire protection design of the plant; (f) managing changes that affect fire protection; (g) managing the storage and handling of flammable liquids, combustible liquids, and compressed gases; (h) housekeeping (including combustible waste); (i) inspection, testing, and maintenance of fire protection design features and equipment; (j) controlling transient combustible material and non-combustible material; (k) managing fire safety during work activities; (l) fire reporting; (m) controlling sources of ignition; (n) preparing pre-fire plans;	CSA N293-07 : Clause 5.8.3* The fire protection program shall detail how the program will be implemented, managed, monitored, and modified during each phase of the life cycle of a plant. Activities specified in the fire protection program for each phase shall include (a) specifying the fire protection organization and their responsibilities; (b) establishing the standards and procedures for design, analysis, and operation, including impairments and compensator)/ measures; (c) providing staff and training to carry out fire protection responsibilities; (d) preparing and maintaining the FHA; (e) preparing and maintaining documentation of the fire protection design of the plane (f) managing changes that affect fire protection; (g) managing the storage and handling of flammable liquids, combustible liquids, and compressed gases; (h) housekeeping; (i) inspection, testing, and maintenance of fire protection design features and equipment; (j) controlling transient combustible material and non-combustible material; (k) managing fire safety during work activities; (l) fire reporting; (m) controlling sources of ignition;		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
	(o) conducting drills; and (p) providing quality assurance for the activities outlined in Items (a) to (o).	(n) preparing pre-fire plans; (o) conducting drills; and (p) providing quality assurance for the activities outlined in Items (a) to (o).		
5.8.4	Fire safety plans shall be developed and implemented in accordance with the requirements of the NFCC and shall address the life cycle of the plant.	CSA N293-07 : Clause 5.8.4 Fire safety plans shall be developed and implemented in accordance with the requirements of the NFCC and shall address the life cycle of the plant.		Equivalent
5.8.5*	All fires shall be reported and shall be investigated with respect to any damage to SSCs, including whether such damage could affect future performance.	CSA N293-07 : Clause 5.8.5* All fires shall be reported and shall be investigated with respect to any damage to structures and equipment, including whether such damage could affect future performance.		Equivalent
5.8.6	All activities or work shall be managed in accordance with the fire protection goals of this Standard.	CSA N293-07 : Clause 5.8.6 All activities or work shall be managed in accordance with the fire protection goals of this Standard.		Equivalent
5.9*		CSA N293-07 : Clause 5.9*		Equivalent
5.9.1*	All proposed modifications to operating plants shall be assessed to determine their potential impact on fire safety. This assessment shall be completed by the design authority in accordance with Clause 5.9.2.	CSA N293-07 : Clause 5.9.1* All proposed modifications to operating plants shall be assessed to determine their potential impact on fire safety. This assessment shall be completed by the design authority in accordance with Clause 5.9.2.		Equivalent
5.9.2*		CSA N293-07 : Clause 5.9.2*		Equivalent
5.9.2.1	Assessments of modifications shall be performed in two stages, in accordance with Clauses 5.9.2.2 to 5.9.2.8.	CSA N293-07 : Clause 5.9.2.1 Assessments of modifications shall be performed in two stages, in accordance with Clauses 5.9.2.2 to 5.9.2.8.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.9.2.2	The first stage shall be a screening assessment of all modifications for their potential to affect (a) the established design basis of fire protection SSCs; or (b) the fire protection goals and criteria of Clauses 5.2 to 5.5. Note: This Clause does not apply to economic goals beyond those established by the licensee in accordance with Clause 5.2, Item (c).	CSA N293-07 : Clause 5.9.2.2 The first stage shall be a screening assessment of all modifications for their potential to affect (a) the established design basis of fire protection systems, structures, or components; or (b) the fire protection goals and criteria of Clauses 5.2 to 5.5. Note: This Clause does not apply to economic goals beyond those established by the licensee in accordance with Clause 5.2, Item (c).		Equivalent
5.9.2.3	The second stage shall be a detailed assessment of those modifications whose first-stage screening assessment indicates a potential to affect fire protection design basis, goals, or criteria.	CSA N293-07 : Clause 5.9.2.3 The second stage shall be a detailed assessment of those modifications whose first stage screening assessment indicates a potential to affect fire protection design basis, goals, or criteria.		Equivalent
5.9.2.4	Modifications for which the first-stage assessment indicates a potential impact on fire protection design basis, goals, or criteria shall be subject to a qualified third-party review and the review shall be submitted to the AHJ. Note: The purpose of this review is to provide assurance that the modification will not adversely affect the fire protection design basis, goals, or criteria and to verify compliance with this Standard.	CSA N293-07 : Clause 5.9.2.4 Modifications for which the first stage assessment indicates a potential impact on fire protection design basis, goals, or criteria shall be subject to a qualified third party review and the review shall be submitted to the AHJ. Note: The purpose of this review is to provide assurance that the modification will not adversely affect the fire protection design basis, goals, or criteria and to verify compliance with this Standard.		Equivalent
5.9.2.5	Modifications for which the first-stage assessment indicates no potential impact on fire protection goals shall not be subject to any further qualified third-party review or require submission to the AHJ.	CSA N293-07 : Clause 5.9.2.5 Modifications for which the first stage assessment indicates no potential impact on fire protection goals shall not be subject to any further qualified third party review or require submission to the AHJ.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
5.9.2.6	All third-party reviews shall be conducted by qualified persons from organizations whose management and financial operations are independent of the design organization. Licensees may, with the concurrence of the AHJ, use their qualified design staff, provided that it can be demonstrated that the appropriate level of independence can be maintained.	CSA N293-07 : Clause 5.9.2.6 All third party reviews shall be conducted by qualified persons from organizations whose management and financial operations are independent of the design organization. Licensees may, with the concurrence of the AHJ, use their qualified design staff, provided that it can be demonstrated that the appropriate level of independence can be maintained.		Equivalent
5.9.2.7	Modifications for which the first-stage assessment indicates a potential impact on fire protection design basis, goals, or criteria shall be considered as new construction for the application of required Codes and Standards.	CSA N293-07 : Clause 5.9.2.7 Modifications for which the first stage assessment indicates a potential impact on fire protection design basis, goals, or criteria shall be considered as new construction for the application of required Codes and Standards.		Equivalent
5.9.2.8	All assessments carried out in accordance with Clause 5.9 shall be maintained as permanent plant records.	CSA N293-07 : Clause 5.9.2.8 All assessments carried out in accordance with Clause 5.9 shall be maintained as permanent plant records.		Equivalent
5.10*	The fire protection program for the life cycle of a plant shall comply with the quality assurance requirements of CSA N286. In addition, (a) periodic audits shall be performed to ensure that the fire protection program is adequate and is being implemented in accordance with Clause 8; and (b) the licensee shall establish a systematic approach to staff training that defines the qualifications required for the various responsibilities under the fire protection program.	CSA N293-07 : Clause 5.10* The fire protection program for the life cycle of a plant shall comply with the quality assurance requirements of CSA N286. In addition, (a) periodic audits shall be performed to ensure that the fire protection program is adequate and is being implemented in accordance with Clause 8; and (b) the licensee shall establish a systematic approach to staff training that defines the qualifications required for the various responsibilities under the fire protection program.		Equivalent
6				Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.1	Clause 6 specifies design requirements for the prevention and control of fires, the mitigation of fire hazards, and the protection of plant occupants, equipment, and structures. Clause 6 also specifies some of the means to achieve the nuclear safety goals, objectives, and criteria of Clause 5.	CSA N293-07 : Clause 6.1 Clause 6 specifies design requirements for the prevention and control of fires, the mitigation of fire hazards, and the protection of plant occupants, equipment, and structures. Clause 6 also specifies some of the means to achieve the nuclear safety goals, objectives, and criteria of Clause 5.		Equivalent
6.2		CSA N293-07 : Clause 6.2		Equivalent
6.2.1*	To ensure that the nuclear safety objectives stated in Clause 5.4.1 are satisfied, the plant shall be provided with redundant fire safe shutdown systems. These systems shall be functionally independent and physically separated such that at least one group is able to perform the required safety functions in the event of a fire.	CSA N293-07 : Clause 6.2.1* To ensure that the nuclear safety objectives stated in Clause 5.4 are satisfied, the plant shall be provided with redundant fire safe shutdown systems. These systems shall be functionally independent and physically separated such that at least one group is able to perform the required safety functions in the event of a fire.	N293-07 clause 6.2.1 refers to the nuclear safety objectives in clause 5.4, while N293-12 refers to the objectives in Clause 5.4.1. These references are equivalent, since the only specification of nuclear safety objectives in clause 5.4 is in subclause 5.4.1.	Equivalent
6.2.2*	Fire mitigation measures shall include one or more of the following: (a) firewalls; (b) fire separations; (c) spatial separations; (d) heat shields; (e) smoke and heat control; (f) firestop systems; and (g) fire-resistant coatings.	CSA N293-07 : Clause 6.2.2* Fire mitigation measures shall include one or more of the following: (a) firewalls; (b) fire separations; (c) spatial separations; (d) heat shields; (e) smoke and heat control; (f) firestop systems; and (g) fire-resistant coatings.		Equivalent
6.3*		CSA N293-07 : Clause 6.3*		Equivalent
6.3.1		CSA N293-07 : Clause 6.3.1		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.3.1.1*	The separation of redundant fire safe shutdown systems required by Clause 6.2.1 shall be provided by (a) fire barriers; or (b) spatial separations, in combination with the compensatory measures specified in Clause 6.3.3.3.	CSA N293-07 : Clause 6.3.1.1* The separation of redundant fire safe shutdown systems required by Clause 6.2.1 shall be provided by (a) fire barriers; or (b) spatial separations, in combination with the compensatory measures specified in Clause 6.3.3.3.		Equivalent
6.3.1.2	Except as permitted in Clause 6.3.1.3, separation between redundant fire safe shutdown systems shall be provided by fire barriers meeting the requirements of Clause 6.3.1.4.	CSA N293-07 : Clause 6.3.1.2 Except as permitted in Clause 6.3.1.3, separation between redundant fire safe shutdown systems shall be provided by fire barriers meeting the requirements of Clause 6.3.1.4.		Equivalent
6.3.1.3*	Where redundant fire safe shutdown systems are located in the same fire compartment and it is impractical to separate them as required in Clause 6.3.1.1, combustible materials within the fire compartment shall be limited to the combustible materials associated with the SSCs needed for operation.	CSA N293-07 : Clause 6.3.1.3* Where redundant fire safe shutdown systems are located in the same fire compartment and it is impractical to separate them as required in Clause 6.3.1.1, combustible materials within the fire compartment shall be limited to the combustible materials associated with the structures, systems, and components needed for operation.		Equivalent
6.3.1.4*	The fire resistance rating of the separation specified in Item (a) of Clause 6.3.1.1 shall be (a) 3 h; or (b) a lower rating determined by the FPA, when the fire separation is provided in conjunction with an automatic fire suppression system.	CSA N293-07 : Clause 6.3.1.4* The fire resistance rating of the separation specified in Item (a) of Clause 6.3.1.1 shall be (a) 3h; or (b) a lower rating determined by the FHA, when the fire separation is provided in conjunction with an automatic fire suppression system.	While N293-07 Clause 6.3.1.4 refers to determination of a fire resistance rating in an FHA, N293-12 Clause 6.3.14 refers more generally to determination of the rating in an FPA, which includes the FHA. So the two clauses are equivalent in intent.	Equivalent
6.3.1.5*	Where fire separations are used for the safety of essential staff or the protection of safety related systems, closures and firestops shall have a fire protection rating equal to the fire resistance rating of the separation.	CSA N293-07 : Clause 6.3.1.5* Where fire separations are used for the safety of essential staff or the protection of nuclear safety components, closures and firestops shall have a fire protection rating equal to the fire resistance rating of the separation.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.3.2		CSA N293-07 : Clause 6.3.2		Equivalent
6.3.2.1	The structure housing the turbine generator and associated ancillary process equipment (commonly referred to as the turbine generator building or turbine generator hall) may be considered a separate building as defined in the NBCC, provided that the structure is separated from other buildings or structures by a firewall or by a distance that meets the spatial separation and exposure protection requirements of the NBCC.	CSA N293-07 : Clause 6.3.2.1 The structure housing the turbine generator and associated ancillary process equipment (commonly referred to as the turbine generator building or turbine generator hall) may be considered a separate building as defined in the NBCC, provided that the structure is separated from other buildings or structures by a distance that meets the spatial separation and exposure protection requirements of the NBCC.		Equivalent
6.3.2.2*	The structure housing the turbine generator and associated ancillary process equipment shall be separated from adjacent rooms and areas by a fire separation with a fire resistance rating not less than 3 h.	CSA N293-07 : Clause 6.3.2.2* The structure housing the turbine generator and associated ancillary process equipment shall be separated from adjacent rooms and areas by a fire separation with a fire resistance rating not less than 3 h.		Equivalent
6.3.2.3	The structure housing the turbine generator and associated ancillary process equipment shall be protected against progressive structural collapse. Except as permitted by Clause 6.3.2.4, structural collapse due to fire shall be prevented by limiting the fire loading or protecting the supporting structure with measures such as insulation, sprinklers, or heat removal systems.	CSA N293-07 : Clause 6.3.2.3 The structure housing the turbine generator and associated ancillary process equipment shall be protected against progressive structural collapse. Except as permitted by Clause 6.3.2.4, structural collapse due to fire shall be prevented by limiting the fire loading or protecting the supporting structure with measures such as insulation, sprinklers, or heat removal systems.		Equivalent
6.3.2.4*	The requirements of Clauses 6.3.2.2 and 6.3.2.3 may be addressed by separating the structure housing the turbine generator and associated ancillary process equipment from adjacent rooms and areas using an intervening firewall constructed in accordance with the NBCC. However, for application of other NBCC requirements, the firewall shall be considered a fire separation.	CSA N293-07 : Clause 6.3.2.4* The requirements of Clauses 6.3.2.2 and 6.3.2.3 may be addressed by separating the structure housing the turbine generator and associated ancillary process equipment from adjacent rooms and areas using an intervening firewall constructed in accordance with the NBCC. However, for application of other NBCC requirements, the firewall shall be considered a fire separation.		Equivalent
6.3.3		CSA N293-07 : Clause 6.3.3		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.3.3.1*	Except as required by Clause 6.3.3.3, spatial separation, in combination with additional compensatory measures, may be used instead of fire barriers where the installation of a fire barrier (a) is impractical due to the design of the space or the presence of process equipment and services; or (b) would interfere with nuclear operation or pose a risk to nuclear safety.	CSA N293-07 : Clause 6.3.3.1* Except as required by Clause 6.3.3.3, spatial separation, in combination with additional compensatory measures, may be used instead of fire barriers where the installation of a fire barrier (a) is impractical due to the design of the space or the presence of process equipment and services; or (b) would interfere with nuclear operation or pose a risk to nuclear safety.		Equivalent
6.3.3.2	Spatial separation shall not be used to meet the egress and firewall requirements of the NBCC, except for inside the containment structure.	CSA N293-07 : Clause 6.3.3.2 Spatial separation shall not be used to meet the egress and firewall requirements of the NBCC, except for inside the containment structure.		Equivalent
6.3.3.3*	Where spatial separation is used to satisfy Clause 6.3.3.1, additional compensatory measures shall be used as follows: (a) There shall be no intervening combustible materials, including combustible materials that might be present due to component failure, that can spread a fire across the spatial separation. (b) The damage to more than one group of fire safe shutdown systems located within the same fire compartment that is due to the effects of fire or products of combustion across the spatial separation shall be assessed and prevented. (c) Fire detection and suppression and/or other fire protection measures shall be provided in accordance with the FPA. The electrical power supply to mechanical equipment shall meet the requirements of Clause 7.2.1.13.	CSA N293-07 : Clause 6.3.3.3* Where spatial separation is used to satisfy Clause 6.3.3.1, additional compensatory measures shall be used as follows: (a) there shall be no intervening combustible materials, including combustible materials that might be present due to component failure, that can spread a fire across the spatial separation; (b) the damage to more than one group of fire safe shutdown systems located within the same fire compartment that is due to the effects of fire or products of combustion across the spatial separation shall be assessed and prevented; and (c) fire detection and suppression and/or other fire protection measures shall be provided in accordance with the FHA. The electrical power supply to mechanical equipment shall meet the requirements of Clause 7.2.1.13.	While N293-07 Clause 6.3.3.3 refers to fire protection measures in accordance with the FHA, N293-12 Clause 6.3.3.3 refers more generally to fire protection measurements in accordance with the FPA, which includes the FHA. So the two clauses are equivalent in intent.	Equivalent
6.4*		CSA N293-07 : Clause 6.4*		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.4.1*	Where a fire hazard is located in the same fire compartment as a fire safe shutdown system or its components, and the fire hazard has the potential to damage or disable the system or its components, fire barriers or spatial separation (as required by Clause 6.2.2) shall be provided.	CSA N293-07 : Clause 6.4.1* Where a fire hazard is located in the same fire compartment as a fire safe shutdown system or its components, and the fire hazard has the potential to damage or disable the system or its components, fire barriers or spatial separation (as required by Clause 6.2.2) shall be provided.		Equivalent
6.4.2*	Physical or spatial separation between redundant equipment within a fire safe shutdown system shall be provided. The extent of the separation required shall be based on the fire hazards and the vulnerability of the components, as identified in the FPA.	CSA N293-07 : Clause 6.4.2* Physical or spatial separation between redundant equipment within a fire safe shutdown system shall be provided. The extent of the separation required shall be based on the fire hazards and the vulnerability of the components, as identified in the FSSA.	While N293-07 Clause 6.4.2 refers to separation requirements in accordance with the FSSA, N293-12 Clause 6.4.2 refers more generally to separation requirements in accordance with the FPA, which includes the FSSA. So the two clauses are equivalent in intent.	Equivalent
6.5		CSA N293-07 : Clause 6.5		Equivalent
6.5.1		CSA N293-07 : Clause 6.5.1		Equivalent
6.5.1.1	An area or room used for the storage or handling of combustible materials or flammable or combustible liquids, solids, or gases shall be separated from the remainder of the building by a fire separation having a minimum 2 hour resistance rating.	CSA N293-07 : Clause 6.5.1.1 An area or room used for the storage or handling of combustible materials or flammable or combustible liquids, solids, or gases shall be separated from the remainder of the building by a fire separation. CSA N293-07 : Clause 6.5.1.3 Fire separation shall have a minimum fire resistance rating of 2 h when required by Clause 6.5.1.1 or when the area is used for storing radioactive materials.	The intent of CSA N293-07 Clause 6.5.1.1 in conjunction with 6.5.1.3 is identical to that of CSA N293-12 Clause 6.5.1.1	Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.5.1.2	The fire resistance rating of the fire separation required by Clause 6.5.1.1 shall be determined in accordance with the NBCC, the NFCC, or the FPA, whichever is most stringent.	CSA N293-07 : Clause 6.5.1.2 The fire resistance rating of the fire separation required by Clause 6.5.1.1 shall be determined in accordance with the NBCC, the NFCC, or the FHA, whichever is most stringent.	While N293-07 Clause 6.5.1.2 refers to fire resistance ratings in accordance with the FHA, N293-12 Clause 6.5.1.2 refers more generally to fire resistance ratings in accordance with the FPA, which includes the FHA. So the two clauses are equivalent in intent.	Equivalent
6.5.2		CSA N293-07 : Clause 6.5.2		Equivalent
6.5.2.1	Piping, tubing, wiring, cables, raceways, structural supports, and other equipment that penetrates a fire separation shall be sealed by a firestop system to provide a fire protection rating equivalent to the fire resistance rating of the fire separation.	CSA N293-07 : Clause 6.5.2.1 Piping, tubing, wiring, cables, raceways, and other equipment that penetrates a fire separation shall be sealed by a firestop system to provide a fire protection rating equivalent to the fire separation.	While N293-07 Clause 6.5.2.1 specifies "piping, tubing, ... raceways, and other equipment that penetrates a fire separation ...", N293-12 Clause 6.5.2.1 specifies "piping, tubing, ... raceways, structural supports and other equipment that ...". Structural supports are obvious examples of equipment that could penetrate a fire separation, so the intent of both clauses is equivalent.	Equivalent
6.5.2.2*	Penetration firestop systems shall have an FH rating in accordance with CAN/ULC-S115.	CSA N293-07 : Clause 6.5.2.2* Penetration firestop systems shall have an FH rating in accordance with CAN/ULC-5115.		Equivalent
6.5.2.3*	All joints in a fire separation shall be sealed by a firestop system to provide a fire resistance rating equivalent to the fire resistance rating of the fire separation. Joint firestop systems shall have an FTH rating in accordance with CAN/ULC-S115.	CSA N293-07 : Clause 6.5.2.3* All joints in a fire separation shall be sealed by a firestop system to provide a fire resistance rating equivalent to the fire separation. Joint firestop systems shall have an FTH rating in accordance with CAN/ULC-5115.		Equivalent
6.5.2.4	Plant design documentation shall include a record of all firestops, including their locations, fire rating requirements, and methods of qualification (e.g., conformance to CAN/ULC S-115).	CSA N293-07 : Clause 6.5.2.4 Plant design documentation shall include a record of all firestops, including their locations, fire rating requirements, and methods of qualification (e.g., conformance to CAN/ULC 5-115).		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.5.3		CSA N293-07 : Clause 6.5.3		Equivalent
6.5.3.1	Spatial separation or fire barriers shall be provided between cable trays and risers to reduce the potential for fire spread and to allow sufficient space for firefighting.	CSA N293-07 : Clause 6.5.3.1* Spatial separation or fire barriers shall be provided between cable trays and risers to reduce the potential for fire spread and to allow sufficient space for firefighting.		Equivalent
6.5.3.2*	Where fire barriers are adjacent to or between cable trays and risers, ventilation or other measures shall be provided for cables to ensure that the design limits for temperature are not exceeded.	CSA N293-07 : Clause 6.5.3.2 Where fire barriers are adjacent to or between cable trays and risers, ventilation or other measures shall be provided for cables to ensure that the design limits for temperature are not exceeded.		Equivalent
6.5.3.3	Cable trays and risers shall be located away from fire hazards to reduce the potential for cables to be ignited or damaged by fire.	CSA N293-07 : Clause 6.5.3.3 Cable trays and risers shall be located away from fire hazards to reduce the potential for cables to be ignited or damaged by fire.		Equivalent
6.5.4*		CSA N293-07 : Clause 6.5.4*		Equivalent
6.5.4.1	To ensure the integrity of fire separation assemblies, structures supporting fire separations shall have a fire resistance rating greater than or equal to the fire separation being supported. Note: The structures supporting fire separations can include fire separation assemblies, load-bearing walls, columns, beams, and arches.	CSA N293-07 : Clause 6.5.4.1 To ensure the integrity of fire separation assemblies, structures supporting fire separations shall have a fire resistance rating greater than or equal to the fire separation being supported. Note: The structures supporting fire separations can include fire separation assemblies, load-bearing walls, columns, beams, and arches.		Equivalent
6.5.4.2*	The fire protection design of the plant shall assess the impact of fire on building structures and equipment supports. Structural failures during fires shall be prevented where such failures could create unacceptable consequences for any of the fire protection goals.	CSA N293-07 : Clause 6.5.4.2* The fire protection design of the plant shall assess the impact of fire on building structures and equipment supports. Structural failures during fires shall be prevented where such failures could create unacceptable consequences for any of the fire protection goals.		Equivalent
6.6		CSA N293-07 : Clause 6.6		Equivalent
6.6.1		CSA N293-07 : Clause 6.6.1		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.6.1.1	Interior aisles, corridors, stairs, walkways, catwalks, and platforms used for egress shall meet NBCC requirements for width, height, treads, risers, guards, handrails, and headroom.	CSA N293-07 : Clause 6.6.1.1 Interior aisles, corridors, stairs, walkways, catwalks, and platforms used for egress shall meet NBCC requirements for width, height, treads, risers, guards, handrails, and headroom.		Equivalent
6.6.1.2	Emergency and exit lighting shall be provided in airlocks and transfer chambers, in addition to the areas required by the NBCC.	CSA N293-07 : Clause 6.6.1.2 Emergency and exit lighting shall be provided in airlocks and transfer chambers, in addition to the areas required by the NBCC.		Equivalent
6.6.1.3	Emergency lighting shall be provided with a minimum 2 h emergency power supply.	CSA N293-07 : Clause 6.6.1.3 Emergency lighting shall be provided with a minimum 2 h emergency power supply.		Equivalent
6.6.1.4	Except as required in Clause 6.7.2.2, emergency lighting shall provide a minimum average lighting level of 10 lx and a minimum of 1 lx measured at the floor or tread level.	CSA N293-07 : Clause 6.6.1.4 Except as required in Clause 6.7.2.2, emergency lighting shall provide a minimum average lighting level of 10 lx and a minimum of 1 lx measured at the floor or tread level.		Equivalent
6.6.1.5*	Egress routes shall be clearly identified with exit signage, other specialized signage, emergency lighting, or floor demarcation so that exits can be readily located by occupants.	CSA N293-07 : Clause 6.6.1.5* Egress routes shall be clearly identified with exit signage, other specialized signage, emergency lighting, or floor demarcation so that exits can be readily located by occupants.		Equivalent
6.6.2*		CSA N293-07 : Clause 6.6.2*		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.6.2.1	Where compensatory measures acceptable to the AHJ are provided to protect occupants of the containment structure, the following deviations from the NBCC shall be permitted: (a) Containment structure airlocks are not required to meet the NBCC exit requirements for (i) fire protection rating; (ii) fire resistance rating; (iii) pressurization; (iv) door swing; (v) door release; and (vi) travel distance. (b) The fire separation between floor assemblies that is required by the NBCC, Division B, Articles 3.2.2.73 to 3.2.2.75, does not apply. (c) Open stairways may serve as access to an exit.	CSA N293-07 : Clause 6.6.2.1 Where compensatory measures acceptable to the AHJ are provided to protect occupants of the containment structure, the following deviations from the NBCC shall be permitted: (a) Containment structure airlocks are not required to meet the NBCC exit requirements for (i) fire protection rating; (ii) fire resistance rating; (iii) pressurization; (iv) door swing; (v) door release; and (vi) travel distance. (b) The fire separation between floor assemblies that is required by the NBCC, Division B, Articles 3.2.2.73 to 3.2.2.75, does not apply. (c) Open stairways may serve as access to an exit.		Equivalent
6.6.2.2		CSA N293-07 : Clause 6.6.2.2		Equivalent
6.6.2.2.1*	A minimum of two means of egress from the reactor containment structure shall be provided and shall be located such that one remains available should the other become inaccessible due to fire.	CSA N293-07 : Clause 6.6.2.2.1* A minimum of two means of egress from the reactor containment structure shall be provided and shall be located such that one remains available should the other become inaccessible due to fire.		Equivalent
6.6.2.2.2	Airlock doors shall be designed to remain operable in the event of a fire within the containment structure.	CSA N293-07 : Clause 6.6.2.2.2 Airlock doors shall be designed to remain operable in the event of a fire within the containment structure.		Equivalent
6.6.2.2.3	For the reactor containment structure, the travel distance to an exit may be measured from the egress door of the containment structure.	CSA N293-07 : Clause 6.6.2.2.3 For the reactor containment structure, the travel distance to an exit may be measured from the egress door of the containment structure.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.6.3*	Where compensatory measures acceptable to the AHJ are provided for window and access panel openings, the requirements of the NBCC, Division B, Sentence 3.2.5.1(1), shall not apply.	CSA N293-07 : Clause 6.6.3* Where compensatory measures acceptable to the AHJ are provided for window and access panel openings, the requirements of the NBCC, Division B, Sentence 3.2.5.1(1), shall not apply.		Equivalent
6.7		CSA N293-07 : Clause 6.7		Equivalent
6.7.1		CSA N293-07 : Clause 6.7.1		Equivalent
6.7.1.1	The control room complex shall be separated from the remainder of the building by a fire separation with a 2 h fire resistance rating, unless a greater fire resistance rating is required by the FPA.	CSA N293-07 : Clause 6.7.1.1 The control room complex shall be separated from the remainder of the building by a fire separation with a 2 h fire resistance rating, unless a greater fire resistance rating is required by the FHA.	While N293-07 Clause 6.7.1.1 refers to fire resistance ratings in accordance with the FHA, N293-12 Clause 6.7.1.1 refers more generally to fire resistance ratings in accordance with the FPA, which includes the FHA. So the two clauses are equivalent in intent.	Equivalent
6.7.1.2*	The control room complex shall be designed to minimize smoke infiltration during a fire.	CSA N293-07 : Clause 6.7.1.2* The control room complex shall be designed to minimize smoke infiltration during a fire.		Equivalent
6.7.1.3	The control room complex shall be protected so that, for a 2 h period following the start of a fire outside the control room complex, it will not contain more than 1% of contaminated air (i.e., products of combustion) by volume.	CSA N293-07 : Clause 6.7.1.3* The control room complex shall be protected so that, for a 2 h period following the start of a fire outside the control room complex, it will not contain more than 1% of contaminated air (i.e., products of combustion) by volume.		Equivalent
6.7.2*		CSA N293-07 : Clause 6.7.2*		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.7.2.1*	At least two travel routes shall be provided from the main control room to the secondary control room. These routes shall (a) not be subject to common cause failure; (b) be designed and protected in accordance with the width, height, fire resistance rating, and integrity requirements specified for exits in the NBCC; (c) be designed to minimize smoke infiltration during a fire, such that the routes will not contain more than 1% of contaminated air; and (d) be provided with emergency lighting in accordance with the NBCC, Division B, Article 3.2.7.3. Note: Where a secondary control room operator has been assigned, protected travel routes are not necessary.	CSA N293-07 : Clause 6.7.2.1* At least two travel routes shall be provided from the main control room to the secondary control room. These routes shall (a) not be subject to common cause failure; (b) be designed and protected in accordance with the width, height, fire resistance rating, and integrity requirements specified for exits in the NBCC; (c) be designed to minimize smoke infiltration during a fire, such that the routes will not contain more than 1% of contaminated air; and (d) be provided with emergency lighting in accordance with the NBCC, Division B, Article 3.2.7.3. Note: Where a secondary control room operator has been assigned, protected travel routes are not necessary.		Equivalent
6.7.2.2	In areas required for emergency operator action, a minimum lighting level of 10 lx shall be provided at floor level.	CSA N293-07 : Clause 6.7.2.2 In areas required for emergency operator action, a minimum lighting level of 10 lx shall be provided.		Equivalent
6.8		CSA N293-07 : Clause 6.8		Equivalent
6.8.1*		CSA N293-07 : Clause 6.8.1		Equivalent
6.8.1.1	Buildings shall be constructed using non-combustible construction in accordance with the NBCC. Because limited amounts of combustible material are permitted by the NBCC in buildings of non-combustible construction, the requirements of Clause 6.8.1 are in addition to the NBCC requirements.	CSA N293-07 : Clause 6.8.1.1 Buildings shall be constructed using non-combustible materials in accordance with the NBCC. Because limited amounts of combustible material are permitted by the NBCC in buildings of non-combustible material construction, the requirements of Clause 6.8.1 are in addition to the NBCC requirements.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.8.1.2	Roof decks shall be of a type that does not propagate fire beneath the deck. Types in accordance with CAN/ULC-S126 or considered Class I metal deck as defined by Factory Mutual may be used. Roof covering shall not be readily ignitable when exposed to fire. Coverings in accordance with Class A requirements in CAN/ULC-S107 may be used.	CSA N293-07 : Clause 6.8.1.2 Roof decks shall be of a type that does not propagate fire beneath the deck. Types in accordance with CAN/ULC-S126 or considered Class I metal deck as defined by Factory Mutual may be used. Roof covering shall not be readily ignitable when exposed to fire. Coverings in accordance with Class A requirements in CAN/ULC-S107 may be used.		Equivalent
6.8.1.3*		CSA N293-07 : Clause 6.8.1.3*		Equivalent
6.8.1.3.1	The use of building fixtures containing combustible materials shall be minimized in plant buildings.	CSA N293-07 : Clause 6.8.1.3.1 The use of building fixtures containing combustible materials shall be minimized in plant buildings.		Equivalent
6.8.1.3.2*	Exposed foam plastics shall not be used as parts for buildings or fixtures.	CSA N293-07 : Clause 6.8.1.3.2 Exposed foam plastics shall not be used as parts for buildings or fixtures.		Equivalent
6.8.1.3.3	Shelves and racks designed for equipment installation and storage shall not be constructed of combustible materials.	CSA N293-07 : Clause 6.8.1.3.3 Shelves and racks designed for equipment installation and storage shall not be constructed of combustible materials.		Equivalent
6.8.1.4*	Interior finishes shall meet the following requirements: (a) Interior wall or ceiling finishes shall have a flame spread rating less than or equal to 25 and smoke development of less than 100 when tested in accordance with CAN/ULC-S102. (b) Interior floor finishes shall have a flame spread rating less than or equal to 300 and smoke development classification of less than 450 when tested in accordance with ASTM E648 and ASTM E662. (c) Epoxy liner on the containment wall shall have a flame spread rating less than or equal to 40 when tested in accordance with CAN/ULC-S102 or CAN/ULC-S102.2.	CSA N293-07 : Clause 6.8.1.4* Interior finishes shall meet the following requirements: (a) Interior wall or ceiling finishes shall have a flame spread rating less than or equal to 25 and smoke development of less than 100 when tested in accordance with CAN/ULC-S102. (b) Interior floor finishes shall have a Class 1 rating when tested in accordance with CAN/ULC-S102.2. (c) Epoxy liner on the containment wall shall have a flame spread rating less than or equal to 40 when tested in accordance with CAN/ULC-5102 or CAN/ULC-S102.2.	While N293-07 Clause 6.8.1.4 requirement (b) is that "Interior floor finishes shall have a Class 1 rating when tested in accordance with CAN/ULC-S102.2", N293-12 Clause 6.8.1.4 requirement (b) is more specific: "Interior floor finishes shall have a flame spread rating less than or equal to 300 and smoke development classification of less than 450 when tested in accordance with ASTM E648 and ASTM E662". The two clauses are equivalent in intent.	Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.8.2		CSA N293-07 : Clause 6.8.2		Equivalent
6.8.2.1	Storage and laydown areas shall be appropriately located, sized, and equipped with fire protection to minimize the fire hazard they pose to nuclear and life safety.	CSA N293-07 : Clause 6.8.2.1 Storage and laydown areas shall be of adequate capacity, located appropriately, and equipped with adequate fire protection in order to minimize the fire hazard they pose to nuclear and life safety.		Equivalent
6.8.2.2	During the operation of the plant, transient materials shall be controlled so that they do not pose a hazard beyond the capabilities of existing fire protection measures. See Clause 8 for specific operational control measures.	CSA N293-07 : Clause 6.8.2.2 During the operation of the plant, transient materials shall be controlled so that they do not pose a hazard beyond the capabilities of existing fire protection measures. See Clause 8 for specific operational control measures.		Equivalent
6.8.2.3	Plant design shall incorporate storage facilities that can accommodate the greatest volume of transient combustible materials anticipated during operation and maintenance.	CSA N293-07 : Clause 6.8.2.3 Plant design shall incorporate storage facilities that can adequately accommodate the greatest volume of transient combustible materials anticipated during operation and maintenance.	While N293-07 Clause 6.8.2.3 refers to facilities that can "adequately accommodate" a volume, N293-12 Clause 6.8.2.3 refers to facilities that can "adequately accommodate" a volume. The two clauses are equivalent in intent.	Equivalent
6.8.2.4	Storage facilities shall be located so that fire within the facilities does not adversely impact safety-related equipment located nearby.	CSA N293-07 : Clause 6.8.2.4 Storage facilities shall be located so that fire within the facilities does not adversely impact safety-related equipment located nearby.		Equivalent
6.8.2.5*	The facility shall be provided with storage rooms, to minimize the need for the temporary storage or staging of materials outside of storage rooms in the containment structure, reactor auxiliary building, and control room complex.	CSA N293-07 : Clause 6.8.2.5* The facility shall be provided with adequately sized storage rooms, designed in accordance with this Standard, to eliminate the need for the temporary storage or staging of materials outside of storage rooms in the containment structure, reactor auxiliary building, and control room complex	While N293-07 Clause 6.8.2.5 refers to "adequately sized" storage rooms, N293-12 Clause 6.8.2.3 simply refers to storage rooms, without mention of adequacy of sizing. The two clauses are equivalent in intent.	Equivalent
6.8.3		CSA N293-07 : Clause 6.8.3		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.8.3.1	Air-handling ducts, duct connectors, and plenums shall be made of non-combustible materials.	CSA N293-07 : Clause 6.8.3.1 Air-handling ducts, duct connectors, and plenums shall be made of non-combustible materials.		Equivalent
6.8.3.2	Air filter media (excluding charcoal filters and high-efficiency particulate air [HEPA] filters) used in air-handling systems shall meet the combustibility requirements of Class 1 in accordance with CAN/ULC-S111.	CSA N293-07 : Clause 6.8.3.2 Air filter media (excluding charcoal filters and high-efficiency particulate air [HEPA] filters) used in air-handling systems shall meet the combustibility requirements of Class 1 in accordance with CAN/ULC-S111.		Equivalent
6.8.3.3	HEPA filters shall meet the combustibility requirements of ANSI/UL-586.	CSA N293-07 : Clause 6.8.3.3 HEPA filters shall meet the combustibility requirements of ANSI/UL-586.		Equivalent
6.8.3.4*	Fire protection for charcoal filters shall be provided to ensure that fires do not spread beyond the filter housing and to prevent the uncontrolled release of contamination into the atmosphere.	CSA N293-07 : Clause 6.8.3.4* Fire protection for charcoal filters shall be provided to ensure that fires do not spread beyond the filter housing and to prevent the uncontrolled release of contamination into the atmosphere.		Equivalent
6.8.4		CSA N293-07 : Clause 6.8.4		Equivalent
6.8.4.1*	Plant design shall minimize the use of plastics, wood, and other combustible materials in electrical equipment, cable raceways, and wiring racks.	CSA N293-07 : Clause 6.8.4.1* Plant design shall minimize the use of plastics, wood, and other combustible materials in electrical equipment, cable raceways, and wiring racks.		Equivalent
6.8.4.2*	Electric and control cabinets shall be designed to minimize flame spread across adjacent cabinets.	CSA N293-07 : Clause 6.8.4.2* Electric and control cabinets shall be designed to minimize flame spread across adjacent cabinets.		Equivalent
6.8.4.3	Electrical cable trays and conduits shall be constructed of non-combustible materials.	CSA N293-07 : Clause 6.8.4.3 Electrical cable trays and conduits shall be constructed of non-combustible materials.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.8.4.4*	Electrical cables shall have a limited flame spread rating and produce a low level of smoke and corrosive gases. The wires and cables shall exhibit a maximum vertical char of not more than 1.5 m when tested in conformance with Clause 4.11.4 of CSA C22.2 No. 0.3.	CSA N293-07 : Clause 6.8.4.4* Electrical cables shall have a limited flame spread rating and produce a low level of smoke and corrosive gases. The flame spread for electrical cables shall not be more than 1.5 m when tested in accordance with the flame and smoke test of CSA C22.2 No. 0.3.	While N293-07 Clause 6.8.4.4 states that "The flame spread for electrical cables shall not be more than 1.5 m when tested in accordance with the flame and smoke test of CSA C22.2 No. 0.3.", N293-12 Clause 6.8.4.4 more specifically states that "The wires and cables shall exhibit a maximum vertical char of not more than 1.5 m when tested in conformance with Clause 4.11.4 of CSA C22.2 No. 0.3." The two clauses are equivalent in intent.	Equivalent
6.8.5		CSA N293-07 : Clause 6.8.6		Equivalent
6.8.5.1	In addition to the requirements of the NFCC, the handling, use, and storage of flammable liquids and combustible liquids shall meet the requirements of Clauses 6.8.5.2 and 6.8.5.3.	CSA N293-07 : Clause 6.8.6.1 In addition to the requirements of the NFCC, the handling, use, and storage of flammable liquids and combustible liquids shall meet the requirements of Clauses 6.8.6.2 and 6.8.6.3.		Equivalent
6.8.5.2*	The use of flammable liquids and combustible liquids in equipment for hydraulic power, lubrication, heat transfer, and electrical insulation shall be minimized. Where they cannot be eliminated, preference shall be given to liquids with a higher flash point.	CSA N293-07 : Clause 6.8.6.2* The use of flammable liquids and combustible liquids in equipment for hydraulic power, lubrication, heat transfer, and electrical insulation shall be minimized. Where they cannot be eliminated, preference shall be given to liquids with a higher flash point.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.8.5.3*	Systems containing combustible liquids such as lubrication oils and hydraulic oils shall be designed to minimize leakage of these liquids. In locations where an uncontrolled leakage of the liquid could jeopardize fire safe shutdown systems, the design shall provide devices to collect, divert, and safely contain leakages from pressurized and non-pressurized components in order to prevent the ignition of the oil or limit the size of fire and achieve fire safe shutdown.	CSA N293-07 : Clause 6.8.6.3* Systems containing combustible liquids such as lubrication oils and hydraulic oils shall be designed to minimize leakage of these liquids. In locations where an uncontrolled leakage of the liquid could jeopardize fire safe shutdown systems, the design shall provide devices to collect, divert, and safely contain leakages from pressurized and non-pressurized components in order to prevent the ignition of the oil or limit the size of fire and achieve fire safe shutdown.		Equivalent
6.8.6		CSA N293-07 : Clause 6.8.7		Equivalent
6.8.6.1*	Systems containing hydrogen shall be designed in accordance with NFPA 55. In addition, the design shall meet the following requirements: (a) Hydrogen supply cylinders shall be located apart from safety-related systems in order to prevent damage from fire or explosion. (b) Where piping or tubing containing hydrogen is routed through fire compartments containing fire safe shutdown systems, piping or tubing shall be designed to retain pressure boundary integrity during and following a design basis earthquake.	CSA N293-07 : Clause 6.8.7.1* Systems containing hydrogen shall be designed in accordance with NFPA 55. In addition, the design shall meet the following requirements: (a) Hydrogen supply cylinders shall be located apart from safety-related systems in order to prevent damage from fire or explosion. (b) Where piping or tubing containing hydrogen is routed through fire compartments containing fire safe shutdown systems, piping or tubing shall be designed to retain pressure boundary integrity during and following a design basis earthquake.		Equivalent
6.8.6.2*	Systems that produce hydrogen or deuterium gas shall be designed to prevent the creation of an ignitable mixture. This can be achieved using venting, dilution, controlled combustion, or re-combination. The system shall be designed so that hydrogen control failure sets off an alarm in the main control room and initiates operator action.	CSA N293-07 : Clause 6.8.7.2* Systems that produce hydrogen or deuterium gas shall be designed to prevent the creation of an ignitable mixture. This can be achieved using venting, dilution, controlled combustion, or re-combination. The system shall be designed so that hydrogen control failure sets off an alarm in the main control room and initiates operator action.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.8.6.3*	In addition to the requirements of the NFCC, storage containers and piping for compressed gases shall not be located in the main control room complex and in other fire compartments with safety-related systems unless they are required for equipment or operation within that area. In this case, the design shall assess potential failures of the compressed gas components during a fire and shall ensure that the nuclear safety objectives of Clause 5.4.1 are met.	CSA N293-07 : Clause 6.8.7.3* In addition to the requirements of the NFCC, storage containers and piping for compressed gases shall not be located in the main control room complex and in other fire compartments with safety-related systems unless they are required for equipment or operation within that area. In this case, the design shall assess potential failures of the compressed gas components during a fire and shall ensure that the nuclear safety objectives of Clause 5.4.1 are met.		Equivalent
6.8.6.4	Facilities for aerosol storage shall be designed in accordance with the NFCC and NFPA 30B.	CSA N293-07 : Clause 6.8.7.4 Facilities for aerosol storage shall be designed in accordance with the NFCC and NFPA 30B.		Equivalent
6.8.7*	Bulk storage of dangerous goods shall be (a) located outdoors in detached storage buildings or cut-off rooms (see Clause 8.2.4 for additional handling requirements); (b) located to limit exposures that can impact nuclear safety; (c) separated from other buildings in accordance with the NFCC and NFPA 55; and (d) protected by fire separations or spatial separation from outdoor transformers, building egress paths, fire department vehicular access routes, ventilation intake openings, storage warehouses, buildings of combustible construction, water supplies for fire protection, isolation valves that control processes or fire protection systems, and sewage drains.	CSA N293-07 : Clause 6.8.8* Bulk storage of dangerous goods shall be (a) located outdoors in detached storage buildings or cut-off rooms (see Clause 8.2.3 for additional handling requirements); (b) located to limit exposures that can impact nuclear safety; (c) separated from other buildings in accordance with the NFCC and NFPA 55; and (d) protected by fire separations or spatial separation from outdoor transformers, building egress paths, fire department vehicular access routes, ventilation intake openings, storage warehouses, buildings of combustible construction, water supplies for fire protection, isolation valves that control processes or fire protection systems, and sewage drains		Equivalent
6.8.8	Radioactive waste storage rooms and rooms for the storage of radioactive materials shall be separated from the remainder of the building by a fire separation having a fire resistance rating of not less than 2 h.	CSA N293-07 : Clause 6.8.9 Radioactive waste storage rooms and rooms for the storage of radioactive materials shall be separated from the remainder of the building by a fire separation having a fire resistance rating of not less than 2 h.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
6.8.9		CSA N293-07 : Clause 6.8.10		Equivalent
6.8.9.1	Installed devices and process operations that, by design, pose an ignition fire hazard shall be eliminated or controlled to minimize the occurrence of fires.	CSA N293-07 : Clause 6.8.10.1 Installed devices and process operations that, by design, pose an ignition fire hazard shall be eliminated or controlled to minimize the occurrence of fires.		Equivalent
6.8.9.2	Electrical equipment and wiring shall be installed in accordance with the Canadian Electrical Code, Part I.	CSA N293-07 : Clause 6.8.10.2 Electrical equipment and wiring shall be installed in accordance with the Canadian Electrical Code, Part I.		Equivalent
6.8.9.3	All structures, including buildings, above-ground tanks, stacks, antennas, construction cranes, and meteorological towers, shall be protected by a lightning protection system in accordance with NFPA 780.	CSA N293-07 : Clause 6.8.10.3 All structures, including buildings, above-ground tanks, stacks, antennas, construction cranes, and meteorological towers shall be protected by a lightning protection system in accordance with NFPA 780.		Equivalent
6.8.9.4*	Potential external fires shall be identified and assessed and protection shall be provided to ensure that the nuclear safety criteria in Clause 5.4 are met. The impact on the plant and its occupants of fires from an external source shall be minimized by site selection, adequate spatial separation, or barriers.	CSA N293-07 : Clause 6.8.10.4* External fires shall be identified and assessed and protection shall be provided to ensure that the nuclear safety criteria in Clause 5.4 are met. The impact on the plant and its occupants of fires from an external source shall be minimized by site selection, adequate spatial separation, or barriers.		Equivalent
7		CSA N293-07 : Clause 7		Equivalent
7.1		CSA N293-07 : Clause 7.1		Equivalent
7.1.1	Clause 7 specifies requirements for the design, installation, and performance of fire alarm systems and fire suppression systems in accordance with the fire protection concepts outlined in Clause 5.	CSA N293-07 : Clause 7.1.1 Clause 7 specifies requirements for the design, installation, and performance of fire alarm systems and fire suppression systems in accordance with the fire protection objectives outlined in Clause 5.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.1.2	Equipment shall be tested by a nationally recognized fire test laboratory and marked to indicate current compliance with the applicable nationally recognized standard.	CSA N293-07 : Clause 7.1.2 Fire protection devices and equipment shall be listed and labelled by a certification organization accredited by the Standards Council of Canada.	While N293-07 Clause 7.1.2 requires that "Fire protection devices and equipment shall be listed and labelled by a certification organization accredited by the Standards Council of Canada", N293-12 Clause 7.1.2 requires that "Equipment shall be tested by a nationally recognized fire test laboratory and marked to indicate current compliance with the applicable nationally recognized standard" The two clauses are equivalent in intent.	Equivalent
7.2		CSA N293-07 : Clause 7.2		Equivalent
7.2.1*		CSA N293-07 : Clause 7.2.1*		Equivalent
7.2.1.1*	Fire alarm systems shall be designed, installed, and verified in accordance with (a) the NBCC; (b) CAN/ULC-S524; (c) CAN/ULC-S537; and (d) the additional requirements of this Standard. In the case of conflict between requirements, the most stringent requirements shall apply.	CSA N293-07 : Clause 7.2.1.1* Fire alarm systems shall be designed, installed, and verified in accordance with (a) the NBCC; (b) CAN/ULC-S524; (c) CAN/ULC-S537; and (d) the additional requirements of this Standard. In the case of conflict between requirements, the most stringent requirements shall apply. Fire alarm systems using very early warning fire detection technology shall be provided in accordance with the requirements of CAN/ULC-5524 and NFPA 76 (including Annex B of NFPA 76).	N293-07 Clause 7.2.1.1 is split into the two N293-12 Clauses 7.2.1.1 and 7.2.1.2.	Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.2.1.2*	In addition to the requirements in Clause 7.2.1.1, fire alarm systems using very early warning fire detection technology shall be designed, installed, and verified in accordance with the requirements of NFPA 76 (including Annex B).	CSA N293-07 : Clause 7.2.1.1* Fire alarm systems shall be designed, installed, and verified in accordance with (a) the NBCC; (b) CAN/ULC-S524; (c) CAN/ULC-S537; and (d) the additional requirements of this Standard. In the case of conflict between requirements, the most stringent requirements shall apply. Fire alarm systems using very early warning fire detection technology shall be provided in accordance with the requirements of CAN/ULC-5524 and NFPA 76 (including Annex B of NFPA 76).	N293-07 Clause 7.2.1.1 is split into the two N293-12 Clauses 7.2.1.1 and 7.2.1.2.	Equivalent
7.2.1.3*	In addition to the requirements of the NBCC for fire alarm and voice communication systems, fire alarm systems with integrated, supervised, one-way voice communication shall be provided in all structures and exterior areas within the protected area, as well as structures and areas external to the protected area where SSCs directly support the plant. The supervised one-way voice communication system shall provide main control room staff with a means to give one-way voice instruction to occupants during an emergency. Where intelligible voice communication is not possible (e.g., in locations remote from buildings), audible and visual signal devices and voice communication shall be provided at building entrances.	CSA N293-07 : Clause 7.2.1.2* In addition to the requirements of the NBCC for fire alarm and voice communication systems, fire alarm systems with integrated, supervised, one-way voice communication shall be provided in all structures and exterior areas within the protected area as well as structures and areas external to the protected area where SSCs directly support the plant. The supervised one-way voice communication system shall provide main control room staff with a means to give one-way voice instruction during an emergency to occupants. Where intelligible voice communication is not possible (e.g., in locations remote from buildings), audible and visual signal devices and voice communication shall be provided at building entrances		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.2.1.4*	Means shall be provided for intelligible two-way voice communication between emergency responders and the shift manager throughout the protected area and external areas under the scope of this Standard. Where redundant means of communication are provided, this two-way voice communication system shall not require electrical supervision.	CSA N293-07 : Clause 7.2.1.3* Means shall be provided for intelligible two-way voice communication between emergency responders and the shift manager throughout the protected area and external areas under the scope of this Standard. Where redundant means of communication are provided, this two-way voice communication system shall not require electrical supervision.		Equivalent
7.2.1.5*	The fire alarm system in buildings shall (a) be monitored by a display and control centre located in a central alarm and control facility (CACF) that includes the functions required by the NBCC; (b) meet the requirements of Clause 7.2.1.13 for the protection of electric cables; and (c) where data gathering panels are used, meet the requirements for large-scale networks outlined in CAN/ULC-S524.	CSA N293-07 : Clause 7.2.1.5* The fire alarm system in buildings shall (a) be monitored by a display and control centre located in a central alarm and control facility (CAC1 that includes the functions required by the NBCC; (b) meet the requirements of Clause 7.2.1.13 for the protection of electric cables; and (c) where data gathering panels are used, meet the requirements for large scale networks outlined in CAN/ULC-5524.		Equivalent
7.2.1.6		CSA N293-07 : Clause 7.2.1.6		Equivalent
7.2.1.6.1	Fire alarm systems shall provide two-stage operation, as follows: (a) first stage - an alert signal, as defined by the NBCC; and (b) second stage - an alarm signal, as defined by the NBCC.	CSA N293-07 : Clause 7.2.1.6.1 Fire alarm systems shall provide two-stage operation, as follows: (a) first stage — an alert signal, as defined by the NBCC; and (b) second stage — an alarm signal, as defined by the NBCC.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.2.1.6.2	The alert signal shall be directed to CACF staff and may remain silent throughout the balance of the building to suit the requirements of the plant's emergency notification procedures. On receipt of an alert signal, CACF staff shall have the capability to immediately provide a voice announcement over the fire alarm system, throughout the protected area and external areas under the scope of this Standard.	CSA N293-07 : Clause 7.2.1.6.2 The alert signal may be directed to CACF staff (in accordance with the NBCC) and remain silent throughout the balance of the building to suit the requirements of the plant's emergency notification procedures. On receipt of an alert signal, CACF staff shall have the capability to immediately provide a voice announcement over the fire alarm system, throughout the protected area and external areas under the scope of this Standard.		Equivalent
7.2.1.6.3	The alarm signal shall be activated automatically in the event that CACF staff do not acknowledge the signal within 5 min of initial fire alarm system activation. The alarm signal shall be supplemented by voice announcements. There shall be no delay in the ability to override the alarm signal and operate voice communication functions.	CSA N293-07 : Clause 7.2.1.6.3 The alarm signal shall be activated automatically in the event that CACF staff do not acknowledge the signal within 5 min of initial fire alarm system activation. The alarm signal shall be supplemented by voice announcements. There shall be no delay in the ability to override the alarm signal and operate voice communication functions.		Equivalent
7.2.1.6.4*	Buildings less than 500 m2 (5000 ft2) in building area may be provided with a single-stage fire alarm system.	CSA N293-07 : Clause 7.2.1.6.4 Buildings less than 500 m2 (5000 ft2) may be provided with a single-stage fire alarm system.		Equivalent
7.2.1.7	The fire alarm and voice communication systems shall be equipped with backup batteries capable of providing supervisory functions for not less than 24 h. Immediately following this 24 h period, emergency battery power under full load shall be available for not less than 2 h.	CSA N293-07 : Clause 7.2.1.7 The fire alarm and voice communication systems shall be equipped with backup batteries capable of providing supervisory functions for not less than 24 h. Immediately following this 24 h period, emergency battery power under full load shall be available for not less than 2 h.		Equivalent
7.2.1.8	The power supply for the fire alarm and voice communication systems shall be from a reliable and redundant power supply that is in compliance with CSA C282 or N290.5, and the NBCC requirements for building emergency power.	CSA N293-07 : Clause 7.2.1.8 The power supply for the fire alarm and voice communication systems shall be from a reliable and redundant power supply that is in compliance with CSA C282 or CAN/CSA-N290.5, and the NBCC requirements for building emergency power.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.2.1.9	The main control room (MCR) shall be considered the CACF.	CSA N293-07 : Clause 7.2.1.9 The main control room (MCR) shall be considered the CACF. The display and control centre shall be located inside the MCR. The display and control centre shall be a proprietary listed and labelled annunciator panel. The panel shall be capable of providing detailed information on the location and nature of the signal. In addition, the panel operator shall be able to control the fire alarm system without having to leave his or her station. Note: The panel operator need not be a licensed nuclear operator.		Equivalent
7.2.1.10		CSA N293-07 : Clause 7.2.1.10		Equivalent
7.2.1.10.1*	A display and control centre shall be located in the MCR and in each secondary control area (SCA) within the plant. The display and control centre shall be a proprietary panel that meets the requirements of Clause 7.1.2, capable of providing detailed information on the location and nature of the signal. In addition, the panel operator shall be able to control the fire alarm system without having to leave his or her station. Note: The panel operator need not be a licensed nuclear operator.	CSA N293-07 : Clause 7.2.1.9 The main control room (MCR) shall be considered the CACF. The display and control centre shall be located inside the MCR. The display and control centre shall be a proprietary listed and labelled annunciator panel. The panel shall be capable of providing detailed information on the location and nature of the signal. In addition, the panel operator shall be able to control the fire alarm system without having to leave his or her station. Note: The panel operator need not be a licensed nuclear operator. CSA N293-07 : Clause 7.2.1.10.1* A display and control centre shall be located in each secondary control area (SCA) within the plant.		Equivalent
7.2.1.10.2	Each display and control centre in an SCA shall, as a minimum, provide full display and control for all portions of the fire alarm system that are located within the area under the control of the SCA display and control centre.	CSA N293-07 : Clause 7.2.1.10.2 Each display and control centre in an SCA shall, at a minimum, provide full display and control for all portions of the fire alarm system that are located within the area under the control of the SCA display and control centre.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.2.1.10.3*	The fire alarm system shall be capable of transferring control from the MCR display and control centre to the SCA display and control centre. The transfer of control shall be initiated manually from the MCR and shall be incorporated into emergency operating procedures.	CSA N293-07 : Clause 7.2.1.10.3* The fire alarm system shall be capable of transferring control from the MCR display and control centre to the SCA display and control centre. The transfer of control shall be initiated manually from the MCR and shall be incorporated into emergency operating procedures.		Equivalent
7.2.1.11*	Two independent means of communication shall be provided to notify emergency response agencies, including off-site response agencies.	CSA N293-07 : Clause 7.2.1.11* Two independent means of communication shall be provided to notify emergency response agencies, including off-site response agencies.		Equivalent
7.2.1.12*		CSA N293-07 : Clause 7.2.1.12*		Equivalent
7.2.1.12.1	Automatic fire suppression systems that require fire detection and controls for actuation shall be equipped with hardware qualified in accordance with Clause 7.1.2 for use as an extinguishing-agent-releasing system. Releasing hardware, whether integrated in a fire alarm panel or in stand-alone panels, shall be installed and verified in accordance with the requirements for fire alarm systems in the NBCC and CAN/ULC-S524.	CSA N293-07 : Clause 7.2.1.12.1 Automatic fire suppression systems that require fire detection and controls for actuation shall be equipped with hardware listed for use as an extinguishing-agent-releasing system. Listed releasing hardware, whether integrated in a fire alarm panel or in stand-alone panels, shall be installed and verified in accordance with the requirements for fire alarm systems in the NBCC and CAN/ULC-S524.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.2.1.12.2*	Where separate extinguishing-agent-releasing panels or modules are integrated into the fire alarm panel, they shall (a) be connected to the building fire alarm system to provide system-wide visual annunciation of all fire, supervisory, and trouble signals that are annunciated on the releasing panel; (b) incorporate a common supervisory signal and a common trouble signal rather than using individual signals; (c) have a manual operation mode to discharge extinguishing agents; and (d) have a power supply, including an emergency power source, that meets the requirements for fire alarm systems in Clauses 7.2.1.7 and 7.2.1.8. Both the normal power supply and the emergency power source shall include power requirements for energized solenoid and alarm relays. In addition, each fire detection zone, individual panel, and individual module shall have its address annunciated on the building fire alarm system and shall be monitored.	CSA N293-07 : Clause 7.2.1.12.2* Where separate extinguishing-agent-releasing panels or modules are integrated into the fire alarm panel, they shall (a) be connected to the building fire alarm system to provide system-wide visual annunciation of all fire, supervisory, and trouble signals that are annunciated on the releasing panel; (b) incorporate a common supervisory signal and a common trouble signal rather than using individual signals; (c) have a manual operation mode to discharge extinguishing agents; and (d) have a power supply, including an emergency power source, that meets the requirements for fire alarm systems in Clauses 7.2.1.7 and 7.2.1.8. Both the normal power supply and the emergency power source shall include power requirements for energized solenoid and alarm relays. In addition, each fire detection zone, individual panel, and individual module shall have its address annunciated on the building fire alarm system and shall be monitored.		Equivalent
7.2.1.13		CSA N293-07 : Clause 7.2.1.13		Equivalent
7.2.1.13.1	Electrical conductors that are installed in service spaces containing other combustible materials and that are used in connection with fire alarm systems and emergency equipment, including fire alarm cables (e.g., fire-related smoke control equipment, pressurization equipment to limit smoke spread, equipment for the emergency operation of elevators, venting equipment to aid firefighting, the display and control centre fire-related equipment, and the voice communication system), shall be capable of performing their intended functions for not less than 1 h after the start of a fire.	CSA N293-07 : Clause 7.2.1.13.1 Electrical conductors that are installed in service spaces containing other combustible materials and that are used in connection with fire alarm systems and emergency equipment, including fire alarm cables (e.g., fire-related smoke control equipment, pressurization equipment to limit smoke spread, equipment for the emergency operation of elevators, venting equipment to aid firefighting, the display and control centre fire-related equipment, and the voice communication system), shall be capable of performing their intended functions for not less than 1 h after the start of a fire.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.2.1.13.2	Where the central alarm and control facility and the fire alarm control unit are in different fire compartments, the electrical conductors connecting the central alarm and control facility to the fire alarm control unit shall be protected against fire exposure to ensure continued operation for not less than 1 h after the start of a fire.	CSA N293-07 : Clause 7.2.1.13.2 Where the central alarm and control facility and the fire alarm control unit are in different fire compartments, the electrical conductors connecting the central alarm and control facility to the fire alarm control unit shall be protected against fire exposure to ensure continued operation for not less than 1 h after the start of a fire		Equivalent
7.2.2		CSA N293-07 : Clause 7.2.2		Equivalent
7.2.2.1	Manual pull stations shall be located at all exits required by the NBCC. In addition, where the NBCC 60 m (200 ft) exit rule is used (see the NBCC, Division B, Sentence 3.4.2.5(2)), manual pull stations shall be located along each main aisle so that the maximum travel distance within the aisle to a manual pull station is not more than 30 m (100 ft) in areas without sprinklers and not more than 45 m (150 ft) in areas with sprinklers. Note: The term “aisle” refers to corridors, hallways, pathways, or any other means of egress.	CSA N293-07 : Clause 7.2.2.1 Manual pull stations shall be located at all exits required by the NBCC. In addition, where the NBCC 60 m (200 ft) exit rule is used (see the NBCC, Division B, Sentence 3.4.2.5(2)), manual pull stations shall be located along each main aisle so that the maximum travel distance within the aisle to a manual pull station is not more than 30 m (100 ft) in areas without sprinklers and not more than 45 m (150 ft) in areas with sprinklers. Note: The term "aisle" refers to corridors, hallways, pathways, or any other means of egress.		Equivalent
7.2.2.2*	Where fire detection is required as specified in Clause 6.3.3.3, Item (c), a fire alarm system providing an equivalent level of performance to very early warning detection technology shall be provided.	CSA N293-07 : Clause 7.2.2.2* Where fire detection is required as specified in Clause 6.3.3.3, Item (c), a fire alarm system using very early warning detection technology shall be provided.	While N293-07 Clause 7.2.2.2 refers to use of a fire alarm system using very early warning detection technology, N293-12 Clause 7.2.2.2 more generally refers to use of a fire alarm system providing an equivalent level of performance to early warning detection technology. The two clauses are equivalent in intent.	Equivalent
7.2.2.3*	The control room complex shall be equipped with a fire alarm system that uses very early warning fire detection technology. Compensatory measures shall be provided when the system is out of service.	CSA N293-07 : Clause 7.2.2.3* The control room complex shall be equipped with a fire alarm system that uses very early warning fire detection technology. Compensatory measures shall be provided when the system is out of service.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.2.2.4*	Alternate fire detection methods shall be considered where fire detectors required by this Standard cannot operate in accordance with their design specifications or where the detection method is not practical for reasons such as high radiation levels or excessive heights. The technical justification for the alternate measure shall be documented in the plant's code compliance review and cross-referenced or otherwise noted in the plant's FPA.	CSA N293-07 : Clause 7.2.2.4* Alternate fire detection methods shall be considered where fire detectors required by this Standard cannot operate in accordance with their design specifications or where the detection method is not practical for reasons such as high radiation levels or excessive heights. The technical justification for the alternate measure shall be documented in the plant's code compliance review and cross-referenced or otherwise noted in the plant's FHA.	The N293-07 Clause 7.2.2.4 reference to the FHA is more generally replaced by the N293-12 Clause 7.2.2.4 reference to the FPA.	Equivalent
7.2.3		CSA N293-07 : Clause 7.2.3		Equivalent
7.2.3.1	Accessible spaces, with the exception of the main and secondary control rooms, shall be equipped with audible and/or visual fire alarm signal devices.	CSA N293-07 : Clause 7.2.3.1 Accessible spaces, with the exception of the main and secondary control rooms, shall be equipped with audible and/or visual fire alarm signal devices.		Equivalent
7.2.3.2	Fire alarm signals and voice announcements shall be audible and intelligible in interior areas, in accordance with the NBCC and CAN/ULC-S524. Fire and voice signals shall be distinctive and shall not be capable of being confused with other alarm signals.	CSA N293-07 : Clause 7.2.3.2 Fire alarm signals and voice announcements shall be audible and intelligible in interior areas, in accordance with the NBCC and CAN/ULC-5524. Fire and voice signals shall be distinctive and shall not be capable of being confused with other alarm signals.		Equivalent
7.2.3.3*	Where visual signals are provided, both visual and audible signals shall operate immediately and simultaneously upon activation of a fire alarm signal. Operators within the main control room shall be capable of selectively discontinuing alarm signals. Visual signals shall meet the requirements of NFPA 72 for synchronization and minimum candela.	CSA N293-07 : Clause 7.2.3.3* Where visual signals are provided, both visual and audible signals shall operate immediately and simultaneously upon activation of a fire alarm signal. Operators within the main control room shall be capable of selectively discontinuing alarm signals. Visual signals shall meet the requirements of NFPA 72 for synchronization and minimum candela.		Equivalent
7.2.3.4		CSA N293-07 : Clause 7.2.3.4		Equivalent
7.2.3.4.1	Telephone handsets for local paging announcements may interface with the voice communication system.	CSA N293-07 : Clause 7.2.3.4.1 Telephone handsets for local paging announcements may interface with the voice communication system.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.2.3.4.2	Where the interface in Clause 7.2.3.4.1 is provided, it shall be compatible with the voice communication system and shall not impair the operation of the fire alarm system.	CSA N293-07 : Clause 7.2.3.4.2 Where the interface in Clause 7.2.3.4.1 is provided, it shall be compatible with the voice communication system and shall not impair the operation of the fire alarm system.		Equivalent
7.2.3.4.3	The telephone handset interface shall be disabled during a fire alarm signal condition, except for handsets located within the MCR.	CSA N293-07 : Clause 7.2.3.4.3 The telephone handset interface shall be disabled during a fire alarm signal condition, except for handsets located within the MCR.		Equivalent
7.3		CSA N293-07 : Clause 7.3		Equivalent
7.3.1		CSA N293-07 : Clause 7.3.1		Equivalent
7.3.1.1		CSA N293-07 : Clause 7.3.1.1		Equivalent
7.3.1.1.1	The selection of a fire suppression system shall, as a minimum, take into consideration the system's effectiveness in relation to (a) the design basis fire; (b) performance levels; (c) reliability; and (d) potential damage resulting from the fire suppression agent.	CSA N293-07 : Clause 7.3.1.1.1 The selection of a fire suppression system shall, as a minimum, take into consideration the system's effectiveness in relation to (a) the design basis fire; (b) performance levels; (c) reliability; and (d) potential damage resulting from the fire suppression agent.		Equivalent
7.3.1.1.2	Fire suppression protection, where required by this Standard, shall be provided in accordance with (a) this Standard and in particular with Clause 7.1.2; (b) the NBCC; (c) the NFCC; and (d) additional applicable technical requirements specified in the documents listed in Clause 7.3.1.1.3.	CSA N293-07 : Clause 7.3.1.1.2 Fire suppression protection, where required by this Standard, shall be provided in accordance with (a) this Standard; (b) the NBCC; (c) the NFCC; and (d) additional applicable technical requirements specified in the documents listed in Clauses 7.3.1.1.3 and 7.3.1.1.4.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.3.1.1.3*	Design of systems shall comply with the requirements of the AHJ for pressure-retaining components and shall be in accordance with the following, as applicable: (a) NFPA 10; (b) NFPA 11; (c) NFPA 12; (d) NFPA 12A; (e) NFPA 13; (f) NFPA 14; (g) NFPA 15; (h) NFPA 16; (i) NFPA 17; (j) NFPA 17A; (k) NFPA 20; (l) NFPA 22; (m) NFPA 24; (n) NFPA 25; (o) NFPA 750; (p) NFPA 2001; and (q) FM 7-101.	CSA N293-07 : Clause 7.3.1.1.3* Design of systems shall comply with the requirements of the AHJ for pressure-retaining components and shall be in accordance with the following, as applicable: (a) NFPA 10; (b) NFPA 11; (c) NFPA 12; (d) NFPA 12A; (e) NFPA 13; (f) NFPA 14; (g) NFPA 15; (h) NFPA 16; (i) NFPA 17; (j) NFPA 17A; (k) NFPA 20; (l) NFPA 22; (m) NFPA 24; (n) NFPA 25; (o) NFPA 750; (p) NFPA 2001; and (q) FM 7-101.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.3.1.2*	The automatic fire suppression required by Clause 5.7.4.2.1 shall be provided using automatic sprinkler systems. Where automatic fire suppression systems are not provided, the FPA shall demonstrate that adequate manual fire suppression or passive fire mitigation is provided and that all the fire protection goals are met. Special extinguishing systems may be used in place of automatic sprinkler systems where it can be demonstrated that they provide (a) an adequate level of fire protection for the specific hazard; and (b) an acceptable level of reliability.	CSA N293-07 : Clause 7.3.1.2* The automatic fire suppression required by Clause 5.7.4.2.1 shall be provided using automatic sprinkler systems. Where automatic fire suppression systems are not provided, the FHA or another assessment shall demonstrate that adequate manual fire suppression or passive fire mitigation is provided and that all the fire protection goals are met. Special extinguishing systems may be used in place of automatic sprinkler systems where it can be demonstrated that they provide (a) an adequate level of fire protection for the specific hazard; and (b) an acceptable level of reliability	The N293-07 Clause 7.3.1.2 reference to the FHA is more generally replaced by the N293-12 Clause 7.3.1.2 reference to the FPA.	Equivalent
7.3.1.3	The design of automatic fire suppression systems shall include means to mitigate hazards created by the operation of the suppression system. These hazards include (a) the noise of suppression system discharge; (b) the loss of visibility due to suppression system discharge; (c) asphyxiation hazards created by suppression system discharge; (d) dispersion of the extinguishing agent; (e) flooding; (f) additional loads on structures; (g) shorting of electrical circuits; (h) cooling effects; (i) pressurization; (j) residues and deposits; (k) corrosive products; (l) life safety considerations for plant operators and firefighters (e.g., electric shocks, toxic gases); and	CSA N293-07 : Clause 7.3.1.3 The design of automatic fire suppression systems shall include means to mitigate hazards created by the operation of the suppression system. These hazards include (a) the noise of suppression system discharge; (b) the loss of visibility due to suppression system discharge; (c) asphyxiation hazards created by suppression system discharge; (d) dispersion of the extinguishing agent; (e) flooding; (f) additional loads on structures; (g) shorting of electrical circuits; (h) cooling effects; (i) pressurization; (j) residues and deposits; (k) corrosive products; (l) life safety considerations for plant operators and		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
	(m) discharge of liquids and gases into the environment.	firefighters (e.g., electric shocks, toxic gases); and (m) discharge of liquids and gases into the environment.		
7.3.1.4		CSA N293-07 : Clause 7.3.1.4*		Equivalent
7.3.1.4.1	In order to achieve the required level of fire safety, fire suppression systems shall be designed and installed in accordance with the applicable documents listed in Clause 7.3.1.1.3.	CSA N293-07 : Clause 7.3.1.4.1 In order to achieve the required level of fire safety, fire suppression systems shall be designed and installed in accordance with the applicable documents listed in Clause 7.3.1.1.3.		Equivalent
7.3.1.4.2*	In order to meet the structural integrity and material quality control requirements to ensure adequate provisions are made for component support and pressure boundary integrity, fire suppression systems shall be designed, installed, and registered in accordance with the pressure-retaining component requirements of the AHJ. The performance requirements and functional attributes mandated by this Standard shall be maintained.	CSA N293-07 : Clause 7.3.1.4.2 In order to meet the structural integrity and material quality control requirements to ensure adequate provisions are made for component support and pressure boundary integrity, fire suppression systems shall be designed, installed, and registered in accordance with the pressure-retaining component requirements of the AHJ. The performance requirements and functional attributes mandated by this Standard shall be maintained.		Equivalent
7.3.2		CSA N293-07 : Clause 7.3.2		Equivalent
7.3.2.1*		CSA N293-07 : Clause 7.3.2.1*		Equivalent
7.3.2.1.1*	Sources of water shall meet the following requirements: (a) Water for fire protection shall be stored in reservoirs or tanks, or taken from a large natural body of fresh water (i.e., a lake or river). (b) Only fresh water shall be used as the primary source of supply. Sea water may be used only as a backup water supply. (c) Municipal water supplies shall not be the primary source of water for fire protection. However, they may be used to supply make-up water to the reservoir or tank.	CSA N293-07 : Clause 7.3.2.1.1* Sources of water shall meet the following requirements: (a) water for fire protection shall be stored in reservoirs or tanks, or taken from a large natural body of fresh water (i.e., a lake or river); (b) only fresh water shall be used as the primary source of supply. Sea water may be used only as a backup water supply; and (c) municipal water supplies shall not be the primary source of water for fire protection. However, they may be used to supply make-up water to the reservoir or tank.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.3.2.1.2*	The fire protection water supply volume shall be calculated based on the largest expected flow rate for a period of 2 h. The expected flow rate shall be based on the largest concurrent design demand of any automatic water-based suppression system designed in accordance with this Standard, taking into account the corresponding allowance for manual hose streams (including standpipe demands). The hose stream demand shall include the calculated demand for large hoses (88.9 mm [3.5 in] and larger) where required by pre-fire plans described in Clause 10.3 and a minimum attack hose demand of 2850 L/min (750 US gpm). The fire protection water supply shall be capable of delivering this design demand in the event that the hydraulically most favourable portion of the fire main loop is out of service.	CSA N293-07 : Clause 7.3.2.1.2* The fire protection water supply volume shall be calculated based on the largest expected flow rate for a period of 2 h. The expected flow rate shall be based on the largest concurrent design demand of any automatic water-based suppression system designed in accordance with this Standard, taking into account the corresponding allowance for manual hose streams (including standpipe demands). The hose stream demand shall include the calculated demand for large hoses (88.9 mm [3.5 in] and larger) and a minimum attack hose demand of 2850 L/min (750 US gpm). The fire protection water supply shall be capable of delivering this design demand in the event that the hydraulically most favourable portion of the fire main loop is out of service.		Equivalent
7.3.2.1.3	Where reservoirs or tanks are used, two separate reservoirs or tanks, each having 100% of the supply volume required in Clause 7.3.2.1.2, shall be provided.	CSA N293-07 : Clause 7.3.2.1.3 Where reservoirs or tanks are used, two separate reservoirs or tanks, each having 100% of the supply volume required in Clause 7.3.2.1.2, shall be provided.		Equivalent
7.3.2.1.4	Reservoirs or tanks shall be designed in accordance with NFPA 22 and interconnected such that fire pumps can take suction from one or both. A failure in one reservoir or tank or its piping shall not cause both reservoirs or tanks to drain.	CSA N293-07 : Clause 7.3.2.1.4 Reservoirs or tanks shall be designed in accordance with NFPA 22 and interconnected such that fire pumps can take suction from one or both. A failure in one reservoir or tank or its piping shall not cause both reservoirs or tanks to drain.		Equivalent
7.3.2.1.5*	The ability to draft water from the supply source with fire trucks and inject it into the fire protection water supply system shall be provided. The design drafting capacity shall be the capacity required by the FPA but not less than 7600 L/min (2000 US gpm).	CSA N293-07 : Clause 7.3.2.1.5* The ability to draft water from the supply source with fire trucks and inject it into the fire protection water supply system shall be provided. The design drafting capacity shall be greater than or equal to 7600 L/min (2000 US gpm).		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.3.2.1.6*	The fire protection water supply may be used on an emergency basis to provide backup to nuclear safety-related systems, as long as the fire protection water supply systems are designed to deliver the combined fire and nuclear safety flow demands for the duration specified by the applicable design.	CSA N293-07 : Clause 7.3.2.1.6* The fire protection water supply may be used on an emergency basis to provide backup to nuclear safety systems, as long as the fire protection water supply systems are designed to deliver the combined fire and nuclear safety flow demands for the duration specified by the applicable design	N293-07 Clause 7.3.2.1.6 speaks to providing backup to nuclear safety systems, while N293-12 Clause 7.3.2.1.6 more generally speaks to providing backup to nuclear safety-related systems. The intent is the same for both clauses.	Equivalent
7.3.2.2*	Fire pumps shall be provided in accordance with this Standard and NFPA 20. In addition, the following requirements shall apply: (a) As a minimum, the fire protection water pumping system design shall be capable of providing 120% of the total required flow rate at the design pressure, assuming failure of the largest pump. (b) Fire pumps shall have automatic start and manual shut-off capabilities. (c) The water supply system for fire protection shall be provided with an automatic pressure maintenance method (e.g., jockey pumps) independent of the fire pumps. (d) As a minimum, the fire protection water pumping system shall consist of at least one diesel-engine-driven fire pump set and one electric-motor-driven fire pump set, with each pump set being capable of providing, the flow rate and pressure specified in Item (a). (e) The fire pump arrangement shall be designed to prevent common cause failure. (f) To prevent common cause failure due to fire, each diesel-driven fire pump, including its engine driver, controls, and day tank, shall be separated from the remaining fire pumps and from the plant by fire separation with a minimum rating of 3 h. (g) Diesel fuel for fire pumps shall be separated so that the fuel is not a fire hazard to safety-related SSCs. (h)	CSA N293-07 : Clause 7.3.2.2* Fire pumps shall be provided in accordance with this Standard and NFPA 20. In addition, the following requirements shall apply: (a) At a minimum, the fire protection water pumping system design shall be capable of providing 120% of the total required flow rate at the design pressure, assuming failure of the largest pump. (b) Fire pumps shall have automatic start and manual shut-off capabilities. (c) The water supply system for fire protection shall be provided with an automatic pressure maintenance method (e.g., jockey pumps) independent of the fire pumps. (d) At a minimum, the fire protection water pumping system shall consist of at least one diesel-engine-driven fire pump and one electric-motor-driven fire pump, with each being capable of providing the flow rate and pressure specified in Item (a). (e) The fire pump arrangement shall be designed to prevent common cause failure. (f) To prevent common cause failure due to fire, each diesel-driven fire pump, including its engine driver, controls, and day tank, shall be separated from the remaining fire pumps and from the plant by fire separation with a minimum rating of 3 h. (g) Diesel fuel for fire pumps shall be separated so that		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
	Each fire pump shall be individually connected to the yard fire main. (i) The following operational elements of fire pumps shall have individual indicators in the CACF: (i) low water level in reservoir or tanks; (ii) power failure to fire pump motor or fire pump engine controllers; (iii) running of fire pump; (iv) fire pump trouble; (v) low temperature in the fire pump room and reservoirs or tanks; (vi) abnormal position of isolation valves; and (vii) miscellaneous supervisory signal for other trouble indicators that can be important, such as abnormally high or low water pressures or failure of compressed air source.	the fuel is not a fire hazard to safety-related equipment. (h) Each fire pump shall be individually connected to the yard fire main. (i) The following operational elements of fire pumps shall have individual indicators in the CACF: (i) low water level in reservoir or tanks; (ii) power failure to fire pump motor or fire pump engine controllers; (iii) running of fire pump; (iv) fire pump trouble; (v) low temperature in the fire pump room and reservoirs or tanks; (vi) abnormal position of isolation valves; and (vii) miscellaneous supervisory signal for other trouble indicators that can be important, such as abnormally high or low water pressures or failure of compressed air source.		

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.3.2.3*	The fire protection water distribution system shall be provided in accordance with NFPA 24. In addition, the following requirements shall apply: (a) Distribution of water to fire protection systems shall be through a loop main such that water can reach each building connection from two independent directions. Water mains shall not be buried under buildings. (b) At least two independent connections to the loop main shall be provided for each major building such that each connection is capable of providing the maximum water flow to meet demand and pressure requirements. (c) Means for inspection and flushing of the piping systems shall be provided. (d) Approved visually indicating sectional control valves (e.g., post-indicator valves) shall be provided such that portions of the main can be isolated for maintenance or repair without impairing the fire protection water supply to each major building. (e) Building fire water supply entry points, sprinkler control equipment, standpipe control equipment, and feed mains and bulk mains to water-based suppression systems that are used to satisfy the requirements of Item (b) may be located within buildings in order to supply sprinkler and standpipe systems. (f) Building fire water supply entry points, sprinkler control equipment, standpipe control equipment, and feed mains and bulk mains to water-based suppression systems shall be located in an area that has sprinkler protection, unless the FPA determines that the hazard present is insufficient to challenge the integrity of the piping and supports.	CSA N293-07 : Clause 7.3.2.3* The fire protection water distribution system shall be provided in accordance with NFPA 24. In addition, the following requirements shall apply: (a) Distribution of water to fire protection systems shall be through a loop main such that water can reach each building connection from two independent directions. Water mains shall not be buried under buildings. (b) At least two independent connections to the loop main shall be provided for each major building such that each connection is capable of providing the maximum water flow to meet demand and pressure requirements. (c) Means for inspection and flushing of the piping systems shall be provided. (d) Approved visually indicating sectional control valves (e.g., post-indicator valves) shall be provided such that portions of the main can be isolated for maintenance or repair without impairing the fire protection water supply to each major building. (e) Building fire water supply entry points, sprinkler control equipment, standpipe control equipment, and feed mains and bulk mains to water-based suppression systems that are used to satisfy the requirements of Item (b) may be located within buildings in order to supply sprinkler and standpipe systems. (f) Building fire water supply entry points, sprinkler control equipment, standpipe control equipment, and feed mains and bulk mains to water-based suppression systems shall be located in an area that has sprinkler protection, unless the FHA determines that the hazard present is insufficient to challenge the integrity of the piping and supports.	The N293-07 Clause 7.3.2.3 reference to the FHA determination of hazard is more generally replaced by the N293-12 Clause 7.3.2.3 reference to the FPA.	Equivalent
7.3.3		CSA N293-07 : Clause 7.3.3		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.3.3.1*	Where an automatic sprinkler system is required, the design and installation shall be in accordance with NFPA 13 and NFPA 15. The NFPA requirements may be modified in accordance with the requirements of this Standard in order to meet the performance objectives of the system.	CSA N293-07 : Clause 7.3.3.1* Where an automatic sprinkler system is required, the design and installation shall be in accordance with NFPA 13 and NFPA 15. The NFPA requirements may be modified in accordance with the requirements of this Standard in order to meet the performance objectives of the system.		Equivalent
7.3.3.2	Where multiple automatic sprinkler systems are provided within a common area and can reasonably be expected to operate simultaneously during a fire, the concurrent demand of the automatic sprinkler systems, taking into account hose stream allowance, shall be added to establish the total water demand.	CSA N293-07 : Clause 7.3.3.2 Where multiple automatic sprinkler systems are provided within a common area and can reasonably be expected to operate simultaneously during a fire, the concurrent demand of the automatic sprinkler systems, taking into account hose stream allowance, shall be added to establish the total water demand		Equivalent
7.3.3.3	Where main structural steel columns are protected with sidewall sprinklers instead of fireproofing, sidewall sprinklers shall be arranged so that (a) The vertical distance between sprinklers does not exceed 3 m (10 ft). (b) The highest sidewall sprinkler shall be located within 0.3 m (12 in) of the bottom of the ceiling beams. (c) The sprinklers are placed in an alternating pattern on opposing sides of the column. (d) The sprinklers discharge on the web. Obstructions on the web shall be considered when arranging sidewall sprinklers.	CSA N293-07 : Clause 7.3.3.3 Where main structural steel columns are protected with sidewall sprinklers instead of fireproofing, sidewall sprinklers shall be arranged so that (a) the vertical distance between sprinklers does not exceed 3 m (10 ft); (b) the highest sidewall sprinkler shall be located within 0.3 m (12 in) of the bottom of the ceiling beams; (c) the sprinklers are placed in an alternating pattern on opposing sides of the column; and (d) the sprinklers discharge on the web. Obstructions on the web shall be considered when arranging sidewall sprinklers.		Equivalent
7.3.3.4*	Cable trays shall be located a minimum of 0.45 m (18 in) below automatic sprinkler deflectors located at ceiling level. Automatic sprinklers shall be arranged such that sprinkler discharge will provide effective fire suppression where cable trays are stacked.	CSA N293-07 : Clause 7.3.3.4* Cable trays shall be located a minimum of 0.45 m (18 in) below automatic sprinkler deflectors located at ceiling level. Automatic sprinklers shall be arranged such that sprinkler discharge will provide effective fire suppression where cable trays are stacked.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.3.3.5*	Where automatic sprinkler protection is provided, and where sprinklers are installed below cable trays, they shall be a maximum of 0.15 m (6 in) below the bottom of the cable tray. A passive heat barrier shall be provided that protects the cables and remains in place until the sprinklers have been activated.	CSA N293-07 : Clause 7.3.3.5* Where automatic sprinkler protection is provided, and where sprinklers are installed below cable trays, they shall be a maximum of 0.15 m (6 in) below the bottom of the cable tray.	N293-12 Clause 7.3.3.5 has the additional requirement "A passive heat barrier shall be provided that protects the cables and remains in place until the sprinklers have been activated." This requirement is taken from N293-07 Appendix A Clause A.7.3.3.5. Therefore, the intent remains the same.	Equivalent
7.3.3.6*	Diking, drainage, a combination of both, or other means of containment shall be provided to limit the spread of flammable and combustible liquids (including firefighting water contaminated with flammable and combustible liquids) and to divert liquid from equipment that, when damaged by water, becomes inoperable and affects nuclear safety. Individual dike areas shall not exceed 25% of the sprinkler design area, except where the size of the fire compartment is less than 1000 m2 (10 000 ft2). Diking or the diking/drainage combination shall contain and/or control the volume of liquid and firefighting water within the sprinkler design area based on a 30 min discharge.	CSA N293-07 : Clause 7.3.3.6* Diking, drainage, a combination of both, or other means of containment shall be provided to limit the spread of flammable and combustible liquids (including firefighting water contaminated with flammable and combustible liquids) and to divert liquid from equipment that, when damaged by water, becomes inoperable and affects nuclear safety. Individual dike areas shall not exceed 25% of the sprinkler design area, except where the size of the fire compartment is less than 1000 m2 (10 000 ft2). Diking or the diking/drainage combination shall contain and/or control the volume of liquid and firefighting water within the sprinkler design area based on a 30 min discharge.		Equivalent
7.3.3.7*	Oil-filled transformers, including their adjacent non-absorbing ground areas, shall be protected with an automatic water-based spray system, in accordance with NFPA 15 or NFPA 16.	CSA N293-07 : Clause 7.3.3.7* Oil-filled transformers, including their adjacent non-absorbing ground areas, shall be protected with an automatic water-based spray system, in accordance with NFPA 15 or NFPA 16.		Equivalent
7.3.4		CSA N293-07 : Clause 7.3.4		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.3.4.1*	Where an automatic sprinkler system is required, and where it is demonstrated in the FPA that an automatic sprinkler system can create an unacceptable hazard, special extinguishing systems may be used. Special extinguishing systems include (a) water mist systems; (b) clean agent extinguishing systems; (c) carbon dioxide extinguishing systems; (d) foam extinguishing systems; (e) water spray extinguishing systems; (f) foam-water sprinkler systems and foam-water spray extinguishing systems; and (g) dry and wet chemical extinguishing systems.	CSA N293-07 : Clause 7.3.4.1 Where an automatic sprinkler system is required, and where it is demonstrated in the FHA that an automatic sprinkler system can create an unacceptable hazard, special extinguishing systems may be used. Special extinguishing systems include (a) water mist systems; (b) clean agent extinguishing systems; (c) carbon dioxide extinguishing systems; (d) foam extinguishing systems; (e) water spray extinguishing systems; (f) foam-water sprinkler systems and foam-water spray extinguishing systems; and (g) dry and wet chemical extinguishing systems.	The N293-07 Clause 7.3.4 reference to the FHA demonstration of unacceptable hazard is more generally replaced by the N293-12 Clause 7.3.4 reference to the FPA.	Equivalent
7.3.4.2	Where special extinguishing systems are used, they shall be designed, installed, maintained, and inspected in accordance with applicable NFPA Standards.	CSA N293-07 : Clause 7.3.4.2 Where special extinguishing systems are used, they shall be designed, installed, maintained, and inspected in accordance with applicable NFPA Standards.		Equivalent
7.3.5*		CSA N293-07 : Clause 7.3.5*		Equivalent
7.3.5.1	All areas of the plant shall be protected by portable fire extinguishers, in accordance with the NFCC and NFPA 10.	CSA N293-07 : Clause 7.3.5.1 All areas of the plant shall be protected by portable fire extinguishers, in accordance with the NFCC and NFPA 10.		Equivalent
7.3.5.2*	Extinguishers may be located outside of a fire zone due to radiological conditions or because the area is normally inaccessible.	CSA N293-07 : Clause 7.3.5.2 Extinguishers may be located outside of a fire zone due to radiological conditions or because the area is normally inaccessible.		Equivalent
7.3.6		CSA N293-07 : Clause 7.3.6		Equivalent
7.3.6.1	Outdoor areas shall be provided with fire hydrants, in accordance with NFPA 24.	CSA N293-07 : Clause 7.3.6.1 Outdoor areas shall be provided with fire hydrants, in accordance with NFPA 24.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.3.6.2*	Fire hydrants shall be spaced a maximum of 75 m (250 ft) apart and shall be located not less than 12.2 m (40 ft) from the buildings to be protected.	CSA N293-07 : Clause 7.3.6.2* Fire hydrants shall be spaced a maximum of 75 m (250 ft) apart and shall be located not less than 12.2 m (40 ft) from the buildings to be protected.		Equivalent
7.3.6.3*	Fire hydrants shall have one pumper outlet and two hose outlets. Fire hydrants shall have one pumper connection with a diameter of 89 mm (3.5 in) or larger and shall have two hose outlets each having a diameter of 64 mm (2.5 in).	CSA N293-07 : Clause 7.3.6.3* Fire hydrants shall have one pumper outlet and two hose outlets. Fire hydrants shall have one pumper connection with a diameter of 89 mm (3.5 in) or larger and shall have two hose outlets each having a diameter of 64 mm (2.5 in).		Equivalent
7.3.6.4	Isolation valves that control only water supplies to a fire hydrant shall be post-indicating valves and may be locked open in lieu of fire alarm supervision.	CSA N293-07 : Clause 7.3.6.4 Isolation valves that control only water supplies to a fire hydrant shall be post-indicating valves and may be locked open in lieu of fire alarm supervision.		Equivalent
7.3.6.5	Wall hydrants shall not be a substitute for yard hydrants.	CSA N293-07 : Clause 7.3.6.5 Wall hydrants shall not be a substitute for yard hydrants		Equivalent
7.3.6.6	Fire hydrants shall be marked in accordance with NFPA 291.	CSA N293-07 : Clause 7.3.6.6 Fire hydrants shall be marked in accordance with NFPA 291.		Equivalent
7.3.7*	Standpipes shall be provided in accordance with NFPA 14. In addition, the following requirements shall apply: (a) A minimum of 2850 L/min (750 US gpm) shall be included for manual hose stream demand for all automatic fire suppression system designs. (b) Areas inside the containment structure shall be provided with Class I (as defined in NFPA 14) standpipe systems. A dry connection through the containment structure may be manually connected to the standpipe. (c) The minimum pressure available at the Class I hose valve shall be 690 kPa (100 psig) at a flow rate of 950 L/min (250 US gpm).	CSA N293-07 : Clause 7.3.7* Standpipes shall be provided in accordance with NFPA 14. In addition, the following requirements shall apply: (a) A minimum of 2850 L/min (750 US gpm) shall be included for manual hose stream demand for all automatic fire suppression system designs. (b) Areas inside the containment structure shall be provided with Class I (as defined in NFPA 14) standpipe systems. A dry connection through the containment structure may be manually connected to the standpipe. (c) The minimum pressure available at the Class I hose valve shall be 690 kPa (100 psig) at a flow rate of 950 L/min (250 US gpm).		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.3.8		CSA N293-07 : Clause 7.3.8		Equivalent
7.3.8.1	Means for manual firefighting shall be provided in accordance with the NBCC and/or the FPA.	CSA N293-07 : Clause 7.3.8.1 Means for manual firefighting shall be provided in accordance with the NBCC and/or the FHA	The N293-07 Clause 7.3.8.1 reference to the FHA is more generally replaced by the N293-12 Clause 7.3.8.1 reference to the FPA.	Equivalent
7.3.8.2*	Where manual firefighting is credited as a means of fire suppression in the FPA, access for firefighting shall be provided. The access shall be adequate in size for a firefighter dressed in full fire-protective clothing, including a self-contained breathing apparatus (SCBA).	CSA N293-07 : Clause 7.3.8.2* Where manual firefighting is credited as a means of fire suppression in the FHA, access for firefighting shall be provided. The access shall be adequate in size for a firefighter dressed in full fire-protective clothing, including a self-contained breathing apparatus (SCBA).	The N293-07 Clause 7.3.8.2 reference to the FHA is more generally replaced by the N293-12 Clause 7.3.8.2 reference to the FPA.	Equivalent
7.4		CSA N293-07 : Clause 7.4		Equivalent
7.4.1	All fire protection systems shall be seismically designed to satisfy the requirements of NFPA 13 and NBCC, except for fire protection systems specified in Clauses 7.4.2 and 7.4.3. The design and installation of fire protection systems specified in Clause 7.4.2 and 7.4.3 shall comply with CSA N289.3. The following seismic categories shall be used to identify the extent to which SSCs are required to remain operational after an earthquake: (a) Seismic Category A - SSCs that must retain their pressure boundary integrity, structural integrity, or passive function (i.e., equipment that does not have an active mechanical function but might have an electrical or load-bearing function) during and following an earthquake. (b) Seismic Category B - SSCs that must retain their pressure boundary integrity, structural integrity, or active function and in addition must remain operable during and following an earthquake. Category B includes equipment that is not part of the pressure boundary but must operate during and following an earthquake.	CSA N293-07 : Clause 7.4.1 The design and installation of fire protection systems specified in Clause 7.4.2 and 7.4.3 shall comply with CSA N289.3. The following seismic categories shall be used to identify the extent to which SSCs are required to remain operational after an earthquake: (a) Seismic Category A — SSCs that must retain their pressure boundary integrity, structural integrity, or passive function (i.e., equipment that does not have an active mechanical function but might have an electrical or load-bearing function) during and following an earthquake. (b) Seismic Category B — SSCs that must retain their pressure boundary integrity, structural integrity, or active function and in addition must remain operable during and following an earthquake. Category B includes equipment that is not part of the pressure boundary but must operate during and following an earthquake.	Additional requirement in CSA N293-12 Clause 7.4.1: All fire protection systems shall be seismically designed to satisfy the requirements of NFPA 13 and NBCC, except for fire protection systems specified in Clauses 7.4.2 and 7.4.3.	Different

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
7.4.2	Automatic fire suppression systems and all other fire protection equipment shall be seismically qualified to Category A for the following areas: (a) the control room complex; (b) the SCA; (c) seismically qualified access or egress routes; (d) seismically qualified instrumentation rooms; (e) the containment structure; and (f) other areas identified in the seismic design basis. The fire suppression systems design shall prevent seismically induced failure, flooding, or the release of a fire suppression agent.	CSA N293-07 : Clause 7.4.2 Automatic fire suppression systems and all other fire protection equipment shall be seismically qualified to Category A for the following areas: (a) the control room complex; (b) the SCA; (c) seismically qualified access or egress routes; (d) instrumentation rooms; (e) the containment structure; and (f) other areas identified in the seismic design basis. The fire suppression systems design shall prevent seismically induced failure, flooding, or the release of a fire suppression agent.		Equivalent
7.4.3	In areas containing Category B seismically qualified SSCs, a Class I standpipe system, including its water supply, shall be qualified in accordance with seismic Category B. The seismically qualified standpipe system shall meet the flow and pressure design requirements for one Class I hose station in accordance with NFPA 14.	CSA N293-07 : Clause 7.4.3 In areas containing seismically qualified safety SSCs, a Class 1 standpipe system shall be qualified in accordance with seismic Category B. The seismically qualified standpipe system shall meet the flow and pressure design requirements for Class I in NFPA 14. Note: Seismic design and installation requirements extend to the water supply to ensure that the standpipe system is functional during and following a seismic event.	CSA N293-07 Clause 7.4.3 has an additional clarifying note no longer present in N293-12: "Seismic design and installation requirements extend to the water supply to ensure that the standpipe system is functional during and following a seismic event." Compliance with N293-07 Clause 7.4.3 therefore automatically implies compliance with N293-12 Clause 7.4.3.	Equivalent
8		CSA N293-07 : Clause 8		Equivalent
8.1*	Clause 8 provides detailed requirements for the fire protection program outlined in Clause 5.8 for the life cycle of the plant. The requirements of Clause 8 are in addition to the requirements of the NBCC and NFCC.	CSA N293-07 : Clause 8.1* Clause 8 provides detailed requirements for the fire protection program outlined in Clause 5.8 for the life cycle of the plant. The requirements of Clause 8 are in addition to the requirements of the NBCC and NFCC		Equivalent
8.2		CSA N293-07 : Clause 8.2		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
8.2.1		CSA N293-07 : Clause 8.2.1		Equivalent
8.2.1.1	A fire safety training needs analysis shall be performed to identify and document the staff training that is necessary. The needs analysis shall be based on a review of work activities, fire hazards, and required responses.	CSA N293-07 : Clause 8.2.1.1 A fire safety training needs analysis shall be performed to identify and document the staff training that is necessary. The needs analysis shall be based on a review of work activities, fire hazards, and required responses		Equivalent
8.2.1.2	All personnel who work in or access the protected area or buildings under the scope of this Standard shall be trained according to the requirements determined by the training needs analysis.	CSA N293-07 : Clause 8.2.1.2 All personnel who work in or access the protected area or buildings under the scope of this Standard shall be trained according to the requirements determined by the training needs analysis		Equivalent
8.2.1.3	Training shall be provided within one year of hire for all new staff. Staff with a term of employment of three months or less shall be exempt from this requirement. Note: This exemption does not apply to those involved in hot work or fire watch activities.	CSA N293-07 : Clause 8.2.1.3 Training shall be provided within one year of hire for all new staff. Staff with a term of employment of three months or less shall be exempt from this requirement. Note: This exemption does not apply to those involved in hot work or fire watch activities.		Equivalent
8.2.1.4	Fire safety training shall include, as a minimum, the following topics and procedures: (a) fire protection program goals; (b) basic fire prevention; (c) life safety; (d) the use of portable extinguishers; (e) emergency procedures; (f) the maintenance of egress routes; (g) fire equipment availability; (h) the control of transient material, hot work, and ignition sources, as identified and documented by the plant; and (i) the reporting of a fire.	CSA N293-07 : Clause 8.2.1.4 Fire safety training shall include, as a minimum, the following topics and procedures: (a) fire protection program goals; (b) basic fire prevention; (c) life safety; (d) the use of portable extinguishers; (e) emergency procedures; (f) the maintenance of egress routes; (g) fire equipment availability; (h) the control of transient material, hot work, and ignition sources, as identified and documented by the plant; and (i) the reporting of a fire.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
8.2.1.5	During initial training, all staff shall have hands-on training in the use of portable fire extinguishers. This training shall include practice using a portable fire extinguisher in the suppression of a live fire or interactive simulation acceptable to the AHJ.	CSA N293-07 : Clause 8.2.1.5 During initial training, all staff shall have hands-on training in the use of portable fire extinguishers. This training shall include practice using a portable fire extinguisher in the suppression of a live fire or interactive simulation acceptable to the AHJ.		Equivalent
8.2.1.6*	The re-qualification interval for those topics and procedures specified in Clause 8.2.1.4 shall be based on the training needs analysis, but shall in no case exceed three years.	CSA N293-07 : Clause 8.2.1.6* The re-qualification interval for those topics and procedures specified in Clause 8.2.1.4 shall be based on the training needs analysis, but shall in no case exceed three years.		Equivalent
8.2.1.7	For individuals involved in fire watch or hot work activities, hands-on training in the use of portable extinguishers shall be provided at intervals not exceeding three years.	CSA N293-07 : Clause 8.2.1.7 For individuals involved in fire watch or hot work activities, hands-on training in the use of portable extinguishers shall be provided at intervals not exceeding three years.		Equivalent
8.2.2	Housekeeping shall be performed in such a manner as to minimize the probability of fire and the consequences resulting from a fire.	CSA N293-07 : Clause 8.2.2 Housekeeping shall be performed in such a manner as to minimize the probability of fire and the consequences resulting from a fire.		Equivalent
8.2.3		CSA N293-07 : Clause 8.2.3		Equivalent
8.2.3.1	Combustible waste shall not be allowed to accumulate at work areas. A program shall be established for the staging, handling, and/or collecting of combustible waste. The intent of Clause 8.2.3.1 is to reduce the amount of combustible material waste to a level as low as is reasonably achievable.	CSA N293-07 : Clause 8.2.3.1* Combustible waste shall be relocated from the work area to an area designed for the staging, handling, or collecting of combustible waste immediately following the completion of work or at the end of the shift, whichever comes first. CSA N293-07 : Clause 8.2.3.2* Combustible dust shall not be allowed to accumulate on surfaces, cable trays, or on the inside or outside of ducting to a level that will propagate fire.	N293-12 Clause 8.2.3.1 combines and restates N293-07 Clauses 8.2.3.1 and 8.2.3.2, and adds a summary to apply As Low As Reasonably Achievable (ALARA) to the amount of combustible waste. Equivalent intent to N293-07 Clause 8.2.3.1.	Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
8.2.3.2	The combustible contents of buildings shall be minimized and, where practical, non-combustible alternatives shall be used. Panels and screens shall be of non-combustible materials or approved materials having fire-retardant characteristics. Tarpaulins, fabrics, or plastic films shall be certified in accordance with the testing specified in NFPA 701 or CAN/ULC-S109.	CSA N293-07 : Clause 8.2.3.3 The combustible contents of buildings shall be minimized and, where practical, non-combustible alternatives shall be used. Panels, tarpaulins, and screens shall be of non-combustible construction or approved materials having equivalent fire-retardant characteristics. Any other fabrics or plastic films shall be certified in accordance with the large-scale fire test in NFPA 701 or CAN/ULC-S109.		Equivalent
8.2.3.3*	When SSCs are replaced, repaired, or modified, combustible material components shall be identified and consideration shall be given as to whether there are non-combustible material alternatives available that can be substituted without impacting the design intent of the equipment.	CSA N293-07 : Clause 8.2.3.4 When SSCs are replaced, repaired, or modified, combustible material components shall be identified and consideration shall be given as to whether there are non-combustible material alternatives available that can be substituted without impacting the design intent of the equipment.		Equivalent
8.2.3.4		CSA N293-07 : Clause 8.2.3.5		Equivalent
8.2.3.4.1*	Combustible materials shall be stored in areas designed in accordance with Clause 6.5.1.	CSA N293-07 : Clause 8.2.3.5.1* Combustible materials shall be stored in accordance with Clause 6.8.5.	CSA N293-12 Clause 8.2.3.4.1 references the more general clause 6.5.1 re combustible material storage rather than the more specific clause and superseded CSA N293-07 Clause 6.8.5	Equivalent
8.2.3.4.2	Combustible materials, including fire-retardant coated or treated combustible materials, shall not be stored in the containment structure or in areas designated as sensitive by the FPA.	CSA N293-07 : Clause 8.2.3.5.2 Combustible materials, including fire-retardant coated or treated combustible materials, shall not be stored in the containment structure or in areas designated as sensitive by the FSSA.	The N293-07 8.2.3.5.2 reference to the FSSA is more generally replaced by the N293-12 Clause 8.2.3.4.2 reference to the FPA.	Equivalent
8.2.3.4.3*	Transient materials shall be minimized and controlled.	CSA N293-07 : Clause 8.2.3.5.3* Transient materials shall be minimized and controlled.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
8.2.3.4.4*	Wood shall only be used where there is no reasonable alternative. Where wood is used, it shall be qualified as fire-retardant-treated-wood in accordance with the National Code of Canada. Fire-retardant-treated- wood means wood or a wood product that has had its surface-burning characteristics, such as flame spread, rate of fuel contribution, and density of smoke developed, reduced by impregnation with fire retardant chemicals. Wood blocks larger than 150 × 150 mm shall not require fire-retardant treatment.	CSA N293-07 : Clause 8.2.3.5.4* Wood shall only be used where there is no reasonable alternative. Where wood is used, it shall be listed as non-leaching by UL or ULC, approved by FM as being pressure-treated or coated with a fire-retardant treatment, or coated in accordance with CAN/ULC-S102. Wood blocks larger than 150 x 150 mm (6 x 6 in) shall not require fire-retardant treatment.		Equivalent
8.2.3.4.5*	Where wood is treated in accordance with Clause 8.2.3.4.4, it shall be inspected prior to each use to ensure that the treatment or coating is intact. Where the treatment or coating is not intact, the wood shall be re-treated or re-coated.	CSA N293-07 : Clause 8.2.3.5.5* Where wood is treated or coated in accordance with Clause 8.2.3.5.4, it shall be inspected prior to each use to ensure that the treatment or coating is intact. Where the treatment or coating is not intact, the wood shall be re-treated or re-coated.		Equivalent
8.2.3.4.6	Where wood is treated in accordance with Clause 8.2.3.4.4, ends of wood pieces shall be treated or coated after the wood has been cut.	CSA N293-07 : Clause 8.2.3.5.6 Where wood is treated or coated in accordance with Clause 8.2.3.5.4, ends of wood pieces shall be treated or coated after the wood has been cut.		Equivalent
8.2.3.5		CSA N293-07 : Clause 8.2.3.6		Equivalent
8.2.3.5.1	Radioactive materials shall only be handled, used, and stored in areas designated for these purposes.	CSA N293-07 : Clause 8.2.3.6.1 Radioactive materials shall only be handled, used, and stored in areas designated for these purposes.		Equivalent
8.2.3.5.2*	Radioactive materials shall be stored in areas designed in accordance with Clause 6.8.8.	CSA N293-07 : Clause 8.2.3.6.2 Radioactive materials shall be stored in accordance with Clause 6.8.9.		Equivalent
8.2.3.5.3	Combustible materials shall not be stored in the same fire compartment as radioactive materials unless the fire compartment is a radioactive waste storage room in accordance with Clause 6.8.8.	CSA N293-07 : Clause 8.2.3.6.3 Combustible materials shall not be stored in the same fire compartment as radioactive materials unless the fire compartment is a radioactive waste storage room in accordance with Clause 8.2.3.6.4.	N293-07 Clause 8.2.3.6.3 cites 8.2.3.6.4 for radioactive waste storage rooms, while N293-12 Clause 8.2.3.5.3 cites the more specific Clause 6.8.8. Equivalent intent.	Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
8.2.3.5.5*	Radioactive materials shall be stored such that they are protected from fires and firefighting activities.	CSA N293-07 : Clause 8.2.3.6.5* Radioactive materials shall be stored such that they are protected from fires and firefighting activities.		Equivalent
8.2.3.6		CSA N293-07 : Clause 8.2.3.7		Equivalent
8.2.3.6.1*	The control of fire loads in the protected area and areas under the scope of this Standard is essential to providing defence-in-depth fire protection. This includes controlling the construction, location, contents, and use of relocatable structures.	CSA N293-07 : Clause 8.2.3.7.1* The control of fire loads in the protected area and areas under the scope of this Standard is essential to providing defence-in-depth fire protection. This includes controlling the construction, location, contents, and use of relocatable structures.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
8.2.3.6.2*	Relocatable structures intended for human occupancy, including associated walkways, stairways, insulation, and skirting, shall comply with the requirements of this Standard and shall be (a) constructed using non-combustible construction, as defined in the NBCC; (b) located in accordance with the NBCC; (c) assessed for additional fire protection provisions in accordance with the objectives of Clause 5.5; (d) equipped with a fire alarm system in accordance with Clause 7.2. This system shall communicate with the CACF and provide information to identify a fire condition or trouble situation affecting a structure and shall identify the structure's location; (e) equipped with portable fire extinguishers, in accordance with Clause 7.3.5; (f) where located outside a building, assessed to determine whether an automatic fire suppression system is required in addition to the requirements of this Standard; and (g) where located inside a building, protected by a fire suppression system that is installed in accordance with this Standard. Note: The requirements of Clause 8.2.3.6.2 except for Clause 8.2.3.6.2, Item (e), do not apply to existing relocatable structures unless moved or relocated. These structures still require assessment under the FPA.	CSA N293-07 : Clause 8.2.3.7.2* Relocatable structures shall comply with the requirements of this Standard and shall be (a) constructed of non-combustible materials, as defined in the NBCC; Note: This includes materials for walkways, stairways, insulation, and skirting. (b) located in accordance with the NBCC; (c) assessed for additional fire protection provisions in accordance with the objectives of Clause 5.5; (d) equipped with a fire alarm system in accordance with Clause 7. This system shall communicate with the CACF and provide information to identify a fire condition or trouble situation affecting a structure and shall identify the structure's location; (e) equipped with portable fire extinguishers, in accordance with Clause 7; (f) where located outside a building, assessed to determine whether an automatic fire suppression system is required in addition to the requirements of this Standard; and (g) where located inside a building, protected by a fire suppression system that is installed in accordance with this Standard.	N293-12 Clause 8.2.3.6.2 has an additional clarifying Note that its requirements, other than Item (e), do not apply to existing relocatable structures unless moved or relocated; and that these structures still require assessment under the FPA. Equivalent in intent.	Equivalent
8.2.3.6.3	A visual inspection of the fire alarm and fire suppression systems shall be performed after each relocation of the structure.	CSA N293-07 : Clause 8.2.3.7.3 A visual inspection of the fire alarm and fire suppression systems shall be performed after each relocation of the structure.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
8.2.3.6.4*	Prior to the installation of a relocatable structure, the plant FPA shall be reviewed and the impact of the structure shall be assessed. Where the structure impacts the plant, the FPA shall be updated.	CSA N293-07 : Clause 8.2.3.7.4* Prior to the installation of a relocatable structure, the plant FHA shall be reviewed and the impact of the structure shall be assessed. Where the structure impacts the plant, the FHA shall be updated.	The N293-07 8.2.3.7.4 reference to the FHA is more generally replaced by the N293-12 Clause 8.2.3.6.4 reference to the FPA.	Equivalent
8.2.3.7	Thermal insulating materials	CSA N293-07 : Clause 8.2.3.8 Thermal insulating materials		Equivalent
8.2.3.7.1	Thermal insulating materials shall be provided with suitable protective coverings or drip guards to prevent them from absorbing flammable or combustible liquids or from being physically damaged.	CSA N293-07 : Clause 8.2.3.8.1 Thermal insulating materials shall be provided with suitable protective coverings or drip guards to prevent them from absorbing flammable or combustible liquids or from being physically damaged.		Equivalent
8.2.3.7.2	Following the completion of a maintenance activity on insulated equipment, the insulation shall be inspected to ensure that it has not absorbed any flammable or combustible liquids and has not deteriorated in any way.	CSA N293-07 : Clause 8.2.3.8.2 Following the completion of a maintenance activity on insulated equipment, the insulation shall be inspected to ensure that it has not absorbed any flammable or combustible liquids and has not deteriorated in any way.		Equivalent
8.2.3.7.3	Insulating materials that have been exposed to flammable or combustible liquids or that exhibit signs of deterioration shall be replaced.	CSA N293-07 : Clause 8.2.3.8.3 Insulating materials that have been exposed to flammable or combustible liquids or that exhibit signs of deterioration shall be replaced.		Equivalent
8.2.4		CSA N293-07 : Clause 8.2.4		Equivalent
8.2.4.1	Dangerous goods shall be handled, used, and stored in accordance with the NFCC.	CSA N293-07 : Clause 8.2.4.1 Dangerous goods shall be handled, used, and stored in accordance with the NFCC		Equivalent
8.2.4.2	Administrative procedures shall manage the location, condition, and contents of flammable liquid cabinets to limit their numbers and inventory to those necessary for the operation of the plant.	CSA N293-07 : Clause 8.2.4.2 Administrative procedures shall manage the location, condition, and contents of flammable liquid cabinets to limit their numbers and inventory to those necessary for the operation of the plant.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
8.2.4.3	Flammable liquids, flammable solids, combustible liquids, and flammable gases shall not be stored in the containment structure.	CSA N293-07 : Clause 8.2.4.3 Flammable liquids, flammable solids, combustible liquids, and flammable gases shall not be stored in the containment structure.		Equivalent
8.2.4.4	Compressed gases and cryogenic fluids in portable and stationary containers, cylinders, and tanks shall be stored, used, maintained, and inspected in accordance with the requirements of the NFCC and NFPA 55.	CSA N293-07 : Clause 8.2.4.5 Compressed gases and cryogenic fluids in portable and stationary containers, cylinders, and tanks shall be stored, used, maintained, and inspected in accordance with the requirements of the NFCC and NFPA 55.		Equivalent
8.2.4.5	Transient compressed gases and cryogenic fluids shall not be handled, used, located, or stored near safety-related equipment unless an assessment determines the consequence of failure is acceptable.	CSA N293-07 : Clause 8.2.4.6 Transient compressed gases and cryogenic fluids shall not be handled, used, located, or stored near safety-related equipment unless an assessment determines the consequence of failure is acceptable.		Equivalent
8.2.4.6	The amount of transient compressed gas or cryogenic fluids located in portable containers, cylinders, or tanks shall be minimized.	CSA N293-07 : Clause 8.2.4.7 The amount of transient compressed gas or cryogenic fluids located in portable containers, cylinders, or tanks shall be minimized.		Equivalent
8.2.4.7	Aerosols shall be handled, used, and stored in accordance with the requirements of the NFCC and NFPA 30B.	CSA N293-07 : Clause 8.2.4.8 Aerosols shall be handled, used, and stored in accordance with the requirements of the NFCC and NFPA 30B.		Equivalent
8.2.4.8	The handling and storage of dangerous goods shall not be located near the control room or other areas that contain safety-related systems.	CSA N293-07 : Clause 8.2.4.9 The handling and storage of dangerous goods shall not be located near the control room or other areas that contain safety-related systems.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
8.2.5*	A hot work procedure and permit system shall be developed and implemented in accordance with the requirements of the NFCC. In addition to the requirements of the NFCC, hot work roofing activities shall be checked 2 h and 3 h after the completion of work. These checks shall be done with the use of a thermal imaging camera.	CSA N293-07 : Clause 8.2.5* A hot work procedure and permit system shall be developed and implemented in accordance with the requirements of the NFCC. In addition to the requirements of the NFCC, hot work roofing activities shall be checked 2 h and 3 h after the completion of work. These checks shall be done with the use of a thermal imaging camera.		Equivalent
8.2.6	Smoking shall be prohibited, except where allowed by applicable by-laws or statutes. Where permitted by applicable by-laws or statutes, smoking shall only take place in designated smoking areas.	CSA N293-07 : Clause 8.2.6 Smoking shall be prohibited, except where allowed by applicable by-laws or statutes. Where permitted by applicable by-laws or statutes, smoking shall only take place in designated smoking areas.		Equivalent
8.2.7*		CSA N293-07 : Clause 8.2.7*		Equivalent
8.2.7.1	Combustible material, other than that forming part of the approved facilities design, that is located outside of storage areas shall be eliminated where possible or, when required, minimized, controlled, located, and analyzed under a transient material control process such that a fire involving the material is precluded from damaging safety-related systems, or fire safe shutdown SSCs.	CSA N293-07 : Clause 8.2.7.1 Combustible material, other than that forming part of the approved facilities design, that is located outside of storage areas shall be eliminated where possible and, when required, minimized, controlled, located, and analyzed under a transient material control process such that a fire involving the material is precluded from damaging safety-related systems, safety systems, or fire safe shutdown systems, structures, or components.	N293-12 Clause 8.2.7.1 mentions damage to safety-related systems, while N293-07 Clause 8.2.7.1 mentions damage to safety-related systems or safety systems. Equivalent intent.	Equivalent
8.2.7.2	Areas of the facility that contain safety-related systems or fire safe shutdown SSCs shall not be used for the maintenance, charging, storage, or parking (temporary or permanent) of vehicles (e.g., sweepers, motorized hand trucks, forklifts, tractors, and industrial trucks).	CSA N293-07 : Clause 8.2.7.2 Areas of the facility that contain safety-related systems, safety systems, or fire safe shutdown systems, structures, or components shall not be used for the maintenance, charging, storage, or parking (temporary or permanent) of vehicles (e.g., sweepers, motorized hand trucks, forklifts, tractors, and industrial trucks).	N293-12 Clause 8.2.7.2 mentions damage to safety-related systems, while N293-07 Clause 8.2.7.2 mentions damage to safety-related systems or safety systems. Equivalent intent.	Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
8.2.7.3*	Ignition sources (e.g., hot work, vehicles, temporary equipment or wiring, portable heaters, and portable lighting) other than those forming part of the approved facilities design shall be eliminated where possible or, when required, minimized, controlled, located, and analyzed under an ignition source control process so as to prevent the ignition of combustibles and minimize the hazard posed in areas of the facility that contain safety-related systems or fire safe shutdown SSCs.	CSA N293-07 : Clause 8.2.7.3* Ignition sources (e.g., hot work, vehicles, temporary equipment or wiring, portable heaters, and portable lighting) other than those forming part of the approved facilities design shall be eliminated where possible and, when required, minimized, controlled, located, and analyzed under an ignition source control process so as to prevent the ignition of combustibles and minimize the hazard posed in areas of the facility that contain safety-related systems, safety systems, or fire safe shutdown systems, structures, or components.		Equivalent
8.2.8		CSA N293-07 : Clause 8.2.8		Equivalent
8.2.8.1	Work activities shall be planned and coordinated in accordance with the fire protection goals of this Standard.	CSA N293-07 : Clause 8.2.8.1 Work activities shall be planned and coordinated in accordance with the fire protection goals of this Standard.		Equivalent
8.2.8.2*	Work activities and control of transient materials shall be planned and managed to ensure that (a) egress paths are not obstructed; (b) access paths to firefighting equipment are not obstructed; (c) firefighting activities are not compromised; (d) operator field actions are not compromised; and (e) their potential impacts on nuclear safety have been evaluated and minimized.	CSA N293-07 : Clause 8.2.8.2* Work activities and control of transient materials shall be planned and managed to ensure that (a) egress paths are not obstructed; (b) access paths to firefighting equipment are not obstructed; (c) firefighting activities are not compromised; (d) operator field actions are not compromised; and (e) their potential impacts on nuclear safety have been evaluated and minimized.		Equivalent
8.2.9*		CSA N293-07 : Clause 8.2.9*		Equivalent
8.2.9.1	The industrial fire brigade shall be notified of an identified emergency incident within 1 min of the CACF being notified of the emergency.	CSA N293-07 : Clause 8.2.9.1 The industrial fire brigade shall be notified of an identified emergency incident within 1 min of the CACF being notified of the emergency.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
8.2.9.2*	Fire incidents shall be investigated. The depth of investigation or analysis shall be determined by the severity of the fire and risk to occupants, environment, and nuclear safety. The scope of any investigation related to economic loss shall be determined by the licensee.	CSA N293-07 : Clause 8.2.9.2* Fire incidents shall be investigated. The depth of investigation or analysis shall be determined by the severity of the fire and risk to occupants, environment, and nuclear safety. The scope of any investigation related to economic loss shall be determined by the licensee.		Equivalent
8.2.9.3	The AHJ shall be notified of any incident that (a) causes personal injury or property damage; (b) results in the mobilization of the emergency response team; or (c) causes fires that result in, or have significant potential to result in, an operating transient.	CSA N293-07 : Clause 8.2.9.3 The AHJ shall be notified of (a) any uncontrolled combustion, not restricted to open flame, that causes personal injury or property damage, or that results in the mobilization of the emergency response team; or (b) fires that result in, or have significant potential to result in, an operating transient.	Similar wording	Equivalent
8.2.9.4	A system shall be developed for each plant that identifies and trends fire incidents, as well as any corrective actions taken. Where deficiencies are identified, action plans shall be developed and implemented to prevent the occurrence of similar incidents.	CSA N293-07 : Clause 8.2.9.4 A system shall be developed for each plant that identifies and trends fire incidents as well as any corrective actions taken. Where deficiencies are identified, action plans shall be developed and implemented to prevent the occurrence of similar incidents.		Equivalent
8.2.9.5	The investigation specified in Clause 8.2.9.2 shall also determine the impact on the future performance of the SSCs exposed to fire.	CSA N293-07 : Clause 8.2.9.6 The investigation specified in Clause 8.2.9.2 shall also determine the impact on the future performance of the equipment exposed to fire.		Equivalent
8.3		CSA N293-07 : Clause 8.3		Equivalent
8.3.1		CSA N293-07 : Clause 8.3.1		Equivalent
8.3.1.1*	The inspection, testing, maintenance, and operation of fire protection equipment shall comply with the requirements of this Standard.	CSA N293-07 : Clause 8.3.1.1* The inspection, testing, maintenance, and operation of fire protection equipment shall comply with the requirements of this Standard.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
8.3.1.2*	A performance-based inspection, testing, and maintenance program may be implemented with the concurrence of the AHJ. The performance-based program shall be in accordance with Clauses 4.4 and 4.5 and the NFCC requirements for equivalencies or alternatives.	CSA N293-07 : Clause 8.3.1.2* A performance-based inspection, testing, and maintenance program may be implemented with the agreement of the AHJ. The performance-based program shall be in accordance with Clauses 4.6 and 4.7 and the NFCC requirements for equivalencies or alternatives		Equivalent
8.3.2*	When a fire protection system is out of service, compensatory measures shall be provided. Impairments to fire protection systems shall be managed through the development of an impairment plan. The impairment plan shall meet the following requirements: (a) The duration of the impairment shall be the shortest period possible. (b) The AHJ shall be notified of the impairment within 24 h, and a copy of the impairment plan shall be submitted to the AHJ where (i) the impairment results in a fire protection system being unavailable to meet its design intent for a period longer than 12 h; or (ii) the fire protection system is specified in the FPA as protecting fire safe shutdown equipment. (c) Post-maintenance testing shall be performed as required to ensure system functionality. (d) Impairments shall be monitored and delays in return to service shall be reported to management. (e) The impairment plan shall ensure that adequate measures are taken during the impairment to minimize the potential for increased risks. (f) The industrial fire brigade shall be informed of all fire protection system impairments. (g) A written procedure shall be developed and implemented to manage the impairment. As a minimum, the procedure shall include (i) compensatory measures to manage and	CSA N293-07 : Clause 8.3.2* When a fire protection system is out of service, compensatory measures shall be provided. Impairments to fire protection systems shall be managed through the development of an impairment plan. The impairment plan shall meet the following requirements: (a) The duration of the impairment shall be the shortest period possible. (b) The AHJ shall be notified of the impairment within 24 h, and a copy of the impairment plan shall be submitted to the AHJ where (i) the impairment results in a fire protection system being unavailable to meet its design intent for a period longer than 12 h; or (ii) the fire protection system is specified in the FSSA as protecting fire safe shutdown equipment. (c) Post-maintenance testing shall be performed as required to ensure system functionality. (d) Impairments shall be monitored and delays in return to service shall be reported to management. (e) The impairment plan shall ensure that adequate measures are taken during the impairment to minimize the potential for increased risks. (f) The industrial fire brigade shall be informed of all fire protection system impairments. (g) A written procedure shall be developed and implemented to manage the impairment. At a minimum, the procedure shall include	The N293-07 8.3.2 reference to the FSSA is more generally replaced by the N293-12 Clause 8.3.2 reference to the FPA. Equivalent intent.	Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
	minimize the risk associated with the impairment; (ii) identification, tagging, and locking out of all impaired fire equipment and fire systems; (iii) notification of impairment to appropriate personnel, including plant staff, off-site monitoring companies, in-plant and off-site emergency responders, and others affected by the impairment; (iv) required action and notification following the return of impaired equipment and systems to operational service, including post-maintenance testing requirements; (v) additional activities to minimize risk and ensure life safety; and (vi) inspection and oversight necessary to monitor the implementation of procedures during the impairment. (h) Compensatory measures shall be provided for impairments to the very early warning detection system(s) located in the control equipment room(s) and control computer room(s).	(i) compensatory measures to manage and minimize the risk associated with the impairment; (ii) identification, tagging, and locking out of all impaired fire equipment and fire systems; (iii)notification of impairment to appropriate personnel, including plant staff, off-site monitoring companies, in-plant and off-site emergency responders, and others impacted by the impairment; (iv) required action and notification following the return of impaired equipment and systems to operational service, including post-maintenance testing requirements; (v) additional activities to minimize risk and ensure life safety; and (vi) inspection and oversight necessary to monitor the implementation of procedures during the impairment. (h) Compensatory measures shall be provided for impairments to the very early warning detection system(s) located in the control equipment room(s) and control computer room(s).		
8.3.3		CSA N293-07 : Clause 8.3.3		Equivalent
8.3.3.1*	In addition to inspection requirements of the NFCC, the following inspections shall be conducted: (a) Combustible-material-free fire zones, as identified in the FPA, shall be inspected once per day to ensure that no unauthorized combustible materials or fire hazards are present. Where these areas are inaccessible, alternative measures shall be taken to ensure compliance. (b) Welding and other hot work areas (permanent or temporary) shall be inspected at the start of work activities to ensure adequate provisions are in place to prevent the start of fire and to determine that the area is free of unnecessary combustible materials. (c) Areas with high fire hazards and fire sensitive areas, as identified in the FPA, shall be inspected once	CSA N293-07 : Clause 8.3.3.1* In addition to inspection requirements of the NFCC, the following inspections shall be conducted: (a) Combustible-material-free fire zones, as identified in the FSSA, shall be inspected once per day to ensure that no unauthorized combustible materials or fire hazards are present. Where these areas are inaccessible, alternative measures shall be taken to ensure compliance. (b) Welding and other hot work areas (permanent or temporary) shall be inspected at the start of work activities to ensure adequate provisions are in place to prevent the start of fire and to determine that the area is free of unnecessary combustible materials.	The N293-07 8.3.3.1 reference to the FSSA is more generally replaced by the N293-12 Clause 8.3.3.1 reference to the FPA. Equivalent intent.	Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
	per day for unsafe conditions that include unauthorized combustible materials, fire hazards, and obstructions to emergency response (e.g., firefighting actions). (d) Doors that are identified in the FPA as fire barriers ensuring fire safe shutdown shall be inspected once per week. (e) Fire barriers (including performance barriers) shall be inspected for degradation or violation. A minimum of 10% of fire barriers shall be inspected each year so that all fire barriers are inspected over a ten-year period.	(c) Areas with high fire hazards and fire sensitive areas, as identified in the FSSA, shall be inspected once per day for unsafe conditions that include unauthorized combustible materials, fire hazards, and obstructions to emergency response (e.g., firefighting actions). (d) Doors that are identified in the FSSA as fire barriers ensuring fire safe shutdown shall be inspected once per week. (e) Fire barriers (including performance barriers) shall be inspected for degradation or violation. A minimum of 10% of fire barriers shall be inspected each year so that all fire barriers are inspected over a ten-year period.		
8.3.4		CSA N293-07 : Clause 8.3.4		Equivalent
8.3.4.1*	A fire protection program audit is an assessment of each program element to confirm compliance with this Standard and other applicable Codes, Standards, and industry best practices in fire protection. The fire protection program audit shall (a) be performed in accordance with CSA N286 by a qualified third party external to the owner or operator of the plant at least once every three years. The audit may be conducted over a three-year period, provided that all aspects of plant operation are reviewed at least once every three years in accordance with this Standard; and (b) review areas of identified weakness in the fire protection program and areas containing precursors to unsafe fire conditions.	CSA N293-07 : Clause 8.3.4.1* A fire protection program audit is an assessment of each program element to confirm compliance with this Standard and other applicable Codes, Standards, and industry best practices in fire protection. The fire protection program audit shall be performed in accordance with CSA N286 by a qualified third party external to the owner or operator of the plant at least once every three years. The audit may be conducted over a three-year period, provided that all aspects of plant operation are reviewed at least once every three years in accordance with this Standard; and review areas of identified weakness in the fire protection program and areas containing precursors to unsafe fire conditions.		Equivalent
8.3.4.2	The fire protection program audit shall, as a minimum, review (a) documentation and records to demonstrate compliance with this Standard; Note: Compliance can include conformance with applicable Standards, use of industry best practices, and meeting inspection, testing, and maintenance	CSA N293-07 : Clause 8.3.4.2 The fire protection program audit shall, as a minimum, review (a) documentation and records to demonstrate compliance with this Standard; Note: Compliance can include conformance with applicable Standards, use of industry best practices, and	The N293-07 8.3.4.2 reference to the FSSA is more generally replaced by the N293-12 Clause 8.3.4.2 reference to the FPA.	Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
	requirements. (b) fire incidents and follow-up actions; (c) the role of the industrial fire brigade and their responses to incidents; (d) procedures related to the fire protection program; (e) fire protection procedures for inclusion of industry operating experience and evolving industry standards; (f) representative samples of the fire protection inspection, testing, and maintenance program; (g) a sample of plant modifications to ensure compliance with the NBCC and NFCC, as well as to ensure that the impact on the FPA has been evaluated; (h) at least one emergency response team drill, through direct observation, and assessment of performance levels; (i) identified adverse conditions and their corrective actions, in addition to actual fire incidents. This review shall include the response or corrective actions of management and of the fire protection organization, including the industrial fire brigade; (j) compliance with fire procedures by performing a field inspection of selected areas for procedures such as housekeeping and control of hazards; and (k) the plant's documented fire protection program for compliance and alignment with Codes, Standards, and good practice.	meeting inspection, testing, and maintenance requirements. (b) fire incidents and follow-up actions; (c) the role of the industrial fire brigade and their responses to incidents; (d) procedures related to the fire protection program; (e) fire protection procedures for inclusion of industry OPEX and evolving industry standards; (f) representative samples of the fire protection inspection, testing, and maintenance program; (g) a sample of plant modifications to ensure compliance with the NBCC and NFCC, as well as to ensure that the impact on the FSSA has been evaluated; (h) at least one emergency response team drill, through direct observation, and assess performance levels; (i) identified adverse conditions and their corrective actions, in addition to actual fire incidents. This review shall include the response or corrective actions of management and of the fire protection organization, including the industrial fire brigade; (j) compliance with fire procedures by performing a field inspection of selected areas for procedures such as housekeeping and control of hazards; and (k) the plant's documented fire protection program for compliance and alignment with Codes, Standards, and good practice.		
8.3.5*		CSA N293-07 : Clause 8.3.5*		Equivalent
8.3.5.1	A plant condition inspection shall be performed by a qualified third party at least once per year.	CSA N293-07 : Clause 8.3.5.1 A plant condition inspection shall be performed by a qualified third party at least once per year.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
8.3.5.2	The plant condition inspection shall consist of a visual inspection of the plant (i.e., a walkdown) to confirm compliance with this Standard and the NFCC.	CSA N293-07 : Clause 8.3.5.2 The plant condition inspection shall consist of a visual inspection of the plant (i.e., a walkdown) to confirm compliance with this Standard and the NFCC.		Equivalent
9		CSA N293-07 : Clause 9		Equivalent
9.1		CSA N293-07 : Clause 9.1		Equivalent
9.1.1	Clause 9 specifies requirements for the three phases of the decommissioning process, which are (a) mothballing; (b) encasement; and (c) dismantling and removal.	CSA N293-07 : Clause 9.1.1 Clause 9 specifies requirements for the three phases of the decommissioning process, which are (a) mothballing; (b) encasement; and (c) dismantling and removal.		Equivalent
9.1.2	Clause 9 is not intended to apply to plants in a laid-up state where the intention is to restart.	CSA N293-07 : Clause 9.1.2 Clause 9 is not intended to apply to plants in a laid-up state where the intention is to restart		Equivalent
9.1.3	Site fire safety shall be provided in accordance with the NFCC. Demolition activities shall be conducted in accordance with Division B, Section 5.6 of the NFCC and with NFPA 241.	CSA N293-07 : Clause 9.1.3 Site fire safety shall be provided in accordance with the NFCC. Demolition activities shall be conducted in accordance with Division B, Section 5.6 of the NFCC and with NFPA 241.		Equivalent
9.1.4*	A fire safety plan shall be prepared and maintained for all stages of decommissioning.	CSA N293-07 : Clause 9.1.4* A fire safety plan shall be prepared and maintained for all stages of decommissioning.		Equivalent
9.2*		CSA N293-07 : Clause 9.2*		Equivalent
9.2.1	Mothballing is the stage of the decommissioning process when the reactor containment is retained but all fuel and radioactive materials are removed.	CSA N293-07 : Clause 9.2.1 Mothballing is the stage of the decommissioning process when the reactor containment is retained but all fuel and radioactive materials are removed		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
9.2.2	The FPA shall be maintained through the mothballing phase of the plant.	CSA N293-07 : Clause 9.2.2 The FHA shall be maintained through the mothballing phase of the plant.	The N293-07 9.2.2 reference to the FHA is more generally replaced by the N293-12 Clause 9.2.2 reference to the FPA.	Equivalent
9.2.3	Where practical, combustible materials shall be removed from the plant.	CSA N293-07 : Clause 9.2.3 Where practical, combustible materials shall be removed from the plant.		Equivalent
9.2.4	Ignition sources shall be managed in accordance with Clause 8.	CSA N293-07 : Clause 9.2.4 Ignition sources shall be managed in accordance with Clause 8.		Equivalent
9.2.5	Accessible areas of the plant shall be provided with a fire alarm system using detection as required by the NBCC and the FPA. The system shall signal an alarm at a constantly staffed location on site.	CSA N293-07 : Clause 9.2.5 Accessible areas of the plant shall be provided with a fire alarm system using detection as required by the NBCC and the FHA. The system shall signal an alarm at a constantly staffed location on site.	The N293-07 9.2.5 reference to the FHA is more generally replaced by the N293-12 Clause 9.2.5 reference to the FPA.	Equivalent
9.2.6	Fire exits shall be maintained in accordance with the NFCC.	CSA N293-07 : Clause 9.2.6 Fire exits shall be maintained in accordance with the NFCC.		Equivalent
9.2.7	The fire protection water supply system shall be maintained to supply hydrants, standpipes, hoses, and all other fire protection systems in service in accessible locations.	CSA N293-07 : Clause 9.2.7 The fire protection water supply system shall be maintained to supply hydrants, standpipes, hoses, and all other fire protection systems in service in accessible locations		Equivalent
9.2.8	Fire separation shall be provided and maintained in accordance with the FPA.	CSA N293-07 : Clause 9.2.8 Fire separation shall be provided and maintained in accordance with the FHA.	The N293-07 9.2.8 reference to the FHA is more generally replaced by the N293-12 Clause 9.2.8 reference to the FPA.	Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
9.2.9	In multi-unit plants, the units can be at different stages in the decommissioning process. The FPA for the operating unit(s) shall include a review of the impact of the mothballed unit on the operating unit(s). Services (e.g., electricity, air supplies) routed through mothballed areas shall be protected.	CSA N293-07 : Clause 9.2.9 In multi-unit plants, the units can be at different stages in the decommissioning process. The FHA for the operating unit(s) shall include a review of the impact of the mothballed unit on the operating unit(s). Services (e.g., electricity, air supplies) routed through mothballed areas shall be protected.	The N293-07 9.2.9 reference to the FHA is more generally replaced by the N293-12 Clause 9.2.9 reference to the FPA.	Equivalent
9.3		CSA N293-07 : Clause 9.3		Equivalent
9.3.1	Encasement is the stage of the decommissioning process when all easily removed parts have been dismantled and removed, and remaining radioactive materials are encased inside some form of shielding structure.	CSA N293-07 : Clause 9.3.1 Encasement is the stage of the decommissioning process when all easily removed parts have been dismantled and removed, and remaining radioactive materials are encased inside some form of shielding structure.		Equivalent
9.3.2	The FPA shall be maintained for the plant during the encasement phase, and the consequences of fires on the encased areas shall be assessed.	CSA N293-07 : Clause 9.3.2 The FHA shall be maintained for the plant during the encasement phase, and the consequences of fires on the encased areas shall be assessed.	The N293-07 9.3.2 reference to the FHA is more generally replaced by the N293-12 Clause 9.3.2 reference to the FPA, including in the change of clause title. Equivalent intent.	Equivalent
9.3.3	All combustible materials and ignition sources shall be removed from encased areas.	CSA N293-07 : Clause 9.3.3 All combustible materials and ignition sources shall be removed from encased areas		Equivalent
9.3.4	The encasement shall be constructed to ensure its integrity in the event of an external fire. The fire resistance of this encasement shall be determined by the FPA in accordance with the fire loading of the remainder of the protected area or the adjacent outside grounds.	CSA N293-07 : Clause 9.3.4 The encasement shall be constructed to ensure its integrity in the event of an external fire. The fire resistance of this encasement shall be determined by the FHA in accordance with the fire loading of the remainder of the protected area or the adjacent outside grounds.	The N293-07 9.3.4 reference to the FHA is more generally replaced by the N293-12 Clause 9.3.4 reference to the FPA.	Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
9.3.5	The fire protection water supply system shall be maintained to supply hydrants, standpipes, hoses, and all other in-service fire protection systems in accessible locations.	CSA N293-07 : Clause 9.3.5 The fire protection water supply system shall be maintained to supply hydrants, standpipes, hoses, and all other in-service fire protection systems in accessible locations		Equivalent
9.3.6	In multi-unit plants, the units can be at different stages in the decommissioning process. The FPA for the operating unit(s) shall include a review of the impact of the encased unit on the operating unit(s).	CSA N293-07 : Clause 9.3.6 In multi-unit plants, the units can be at different stages in the decommissioning process. The FHA for the operating unit(s) shall include a review of the impact of the encased unit on the operating unit(s).	The N293-07 9.3.6 reference to the FHA is more generally replaced by the N293-12 Clause 9.3.6 reference to the FPA.	Equivalent
9.4		CSA N293-07 : Clause 9.4		Equivalent
9.4.1	Dismantling and removal is the stage of the decommissioning process when all remaining parts of the plant are dismantled and removed or buried.	CSA N293-07 : Clause 9.4.1 Dismantling and removal is the stage of the decommissioning process when all remaining parts of the plant are dismantled and removed or buried.		Equivalent
9.4.2	An FPA shall be maintained during the plant dismantling and removal phase, and the consequences of fires shall be assessed.	CSA N293-07 : Clause 9.4.2 An FHA shall be maintained during the plant dismantling and removal phase, and the consequences of fires shall be assessed.	The N293-07 9.4.2 reference to the FHA is more generally replaced by the N293-12 Clause 9.4.2 reference to the FPA, including in the change of clause title. Equivalent intent.	Equivalent
9.4.3	Where practical, combustible materials shall be removed from the demolition site.	CSA N293-07 : Clause 9.4.3 Where practical, combustible materials shall be removed from the demolition site		Equivalent
9.4.4	The fire protection water supply and fire hydrants shall be functional until work is completed.	CSA N293-07 : Clause 9.4.4 The fire protection water supply and fire hydrants shall be functional until work is completed		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
9.4.5	After the removal of the building fire alarm system, fire detection shall be provided by a fire watch that makes regular rounds of the site. The fire watch shall continue until the building is demolished or until all fire hazards are removed.	CSA N293-07 : Clause 9.4.5 After the removal of the building fire alarm system, fire detection shall be provided by a fire watch that makes regular rounds of the site. The fire watch shall continue until the building is demolished or until all fire hazards are removed.		Equivalent
9.4.6*	An on-site fire brigade shall be organized in accordance with Clause 10 and NFPA 600. The fire brigade shall remain in service until all fire hazards have been removed from the site.	CSA N293-07 : Clause 9.4.6* An on-site fire brigade shall be organized in accordance with Clause 10 and NFPA 600. The fire brigade shall remain in service until all fire hazards have been removed from the site.		Equivalent
9.4.7	In multi-unit plants, the units can be at different stages of the decommissioning process. The FPA for the operating unit(s) shall include a review of the impact of the unit being dismantled on the other unit(s). Services (e.g., electricity, air supplies) shall be protected during the dismantling phase.	CSA N293-07 : Clause 9.4.7 In multi-unit plants, the units can be at different stages of the decommissioning process. The FHA for the operating unit(s) shall include a review of the impact of the unit being dismantled on the other unit(s). Services (e.g., electricity, air supplies) shall be protected during the dismantling phase.	The N293-07 9.4.7 reference to the FHA is more generally replaced by the N293-12 Clause 9.4.7 reference to the FPA.	Equivalent
10		CSA N293-07 : Clause 10		Equivalent
10.1		CSA N293-07 : Clause 10.1		Equivalent
10.1.1	Fire response capability commensurate with fire hazards shall be provided for the protected area and the buildings external to the protected area that are under the scope of this Standard for the life cycle of the plant.	CSA N293-07 : Clause 10.1.1 Fire response capability commensurate with fire hazards shall be provided for the protected area and the buildings external to the protected area that are under the scope of this Standard for the life cycle of the plant.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
10.1.2	Fire response capability shall include (a) an industrial fire brigade; (b) a response organization to provide overall control of fires; (c) trained staff who are knowledgeable in the reporting of fires; and (d) trained staff who are knowledgeable in the response to fires (e.g., evacuation procedures).	CSA N293-07 : Clause 10.1.2 Fire response capability shall include (a) an industrial fire brigade; (b) a response organization to provide overall control of fires; (c) trained staff who are knowledgeable in the reporting of fires; and (d) trained staff who are knowledgeable in the response to fires (e.g., evacuation procedures).		Equivalent
10.1.3	The industrial fire brigade required by Clause 10.1.2 shall provide advanced exterior and interior firefighting for the entire life cycle of the plant, with the exception of the encasement phase.	CSA N293-07 : Clause 10.1.3 The industrial fire brigade required by Clause 10.1.2 shall provide advanced exterior and interior firefighting for the entire life cycle of the plant, with the exception of the encasement phase.		Equivalent
10.1.4*	An analysis of postulated fires shall be conducted to determine industrial fire brigade requirements.	CSA N293-07 : Clause 10.1.4* An analysis of postulated fires shall be conducted to determine industrial fire brigade requirements.		Equivalent
10.1.5	After the encasement is in place, the firefighting response required by Clause 10.1.2 may be provided by an off-site municipal fire department. The firefighting response of the municipal fire department shall meet the requirements of NFPA 1710 or NFPA 1720, as applicable, or an equivalent Standard.	CSA N293-07 : Clause 10.1.5 After the encasement is in place, the firefighting response required by Clause 10.1.2 may be provided by an off-site municipal fire department. The firefighting response of the municipal fire department shall meet the requirements of NFPA 1710 or NFPA 1720, as applicable, or an equivalent Standard.		Equivalent
10.2		CSA N293-07 : Clause 10.2		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
10.2.1	The industrial fire brigade shall meet the requirements of NFPA 600 and NFPA 1081 unless otherwise specified in this Standard. The requirement for an industrial fire brigade may be met by having a firefighting organization under contract to the licensee and located on site. The contracted organization shall meet the requirements of NFPA 600 and NFPA 1081.	CSA N293-07 : Clause 10.2.1 The industrial fire brigade shall meet the requirements of NFPA 600 and NFPA 1081 unless otherwise specified in this Standard. The requirement for an industrial fire brigade may be met by having a firefighting organization under contract to the licensee and located on site. The contracted organization shall meet the requirements of NFPA 600 and NFPA 1081.		Equivalent
10.2.2*	Industrial fire brigade members shall have no other plant duties that prevent immediate response to a fire.	CSA N293-07 : Clause 10.2.2 Industrial fire brigade members shall have no other plant duties that prevent immediate response to a fire.		Equivalent
10.2.3	The industrial fire brigade shall have sufficient personnel and equipment to protect safety-related plant areas.	CSA N293-07 : Clause 10.2.3 The industrial fire brigade shall have sufficient personnel and equipment to protect safety-related plant areas.		Equivalent
10.2.4	In the event of a fire, the industrial fire brigade leader shall inform the operations controlling authority (OCA) (i.e., the shift manager or shift supervisor) of the fire situation, firefighting actions, and fire progression. All firefighting operations shall be under the authority of the OCA. Decisions affecting plant safety shall be made by the OCA in consultation with the industrial fire brigade leader.	CSA N293-07 : Clause 10.2.4 In the event of a fire, the industrial fire brigade leader shall inform the operations controlling authority (OCA) (i.e., the shift manager or shift supervisor) of the fire situation, firefighting actions, and fire progression. All firefighting operations shall be under the authority of the OCA. Decisions affecting plant safety shall be made by the OCA in consultation with the industrial fire brigade leader.		Equivalent
10.3		CSA N293-07 : Clause 10.3		Equivalent
10.3.1	The plant shall develop and maintain pre-fire plans. Pre-fire plans shall be available to the industrial fire brigade and to the OCA.	CSA N293-07 : Clause 10.3.1 The plant shall develop and maintain pre-fire plans. Pre-fire plans shall be available to the industrial fire brigade and to the OCA.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
10.3.2	Pre-fire plans shall, as a minimum, detail the following: (a) radiological hazards; (b) chemical hazards; (c) fire hazards; (d) firefighting equipment; (e) significant SSCs of nuclear safety; (f) firefighting guidelines; (g) fire protection water supply information; and (h) electrical hazards.	CSA N293-07 : Clause 10.3.2 Pre-fire plans shall, as a minimum, detail the following: (a) radiological hazards; (b) chemical hazards; (c) fire hazards; (d) firefighting equipment; (e) significant components of nuclear safety; (f) firefighting guidelines; (g) fire protection water supply information; and (h) electrical hazards.		Equivalent
10.3.3*	Pre-fire plans shall be reviewed and updated as necessary, including when changes are made to the FPA.	CSA N293-07 : Clause 10.3.3* Pre-fire plans shall be reviewed and updated as necessary, including when changes are made to the FHA.	The N293-07 Clause 10.3.3 reference to the FHA is more generally replaced by the N293-12 Clause 10.3.3 reference to the FPA.	Equivalent
10.4		CSA N293-07 : Clause 10.4		Equivalent
10.4.1*	All industrial fire brigade members shall meet the medical fitness requirement for using a self-contained breathing apparatus (SCBA), in accordance with CAN/CSA-Z94.4.	CSA N293-07 : Clause 10.4.1 All industrial fire brigade members shall meet the medical fitness requirement for using a self-contained breathing apparatus (SCBA), in accordance with CAN/CSA-Z94.4.		Equivalent
10.4.2	All industrial fire brigade members shall receive training in plant design, including plant layout, major systems, and nuclear safety features, at levels appropriate for their specific response roles.	CSA N293-07 : Clause 10.4.2 All industrial fire brigade members shall receive training in CANDU plant design, including plant layout, major systems, and nuclear safety features, at levels appropriate for their specific response roles.	N293-07 Clause 10.4.2 reference to training in CANDU plant design is generalized in N293-1207 Clause 10.4.2 reference to training in plant design	Equivalent
10.4.3	All industrial fire brigade members shall receive radiation protection training, including the escorting of off-site mutual aid, at levels appropriate for their specific response roles.	CSA N293-07 : Clause 10.4.3 All industrial fire brigade members shall receive radiation protection training, including the escorting of off-site mutual aid, at levels appropriate for their specific response roles.		Equivalent
10.5		CSA N293-07 : Clause 10.5		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
10.5.1	An incident management system that includes the ability to activate the emergency response organization shall be implemented for large fires. Note: An emergency response organization is an appointed group established to activate a response to a major incident.	CSA N293-07 : Clause 10.5.1 An incident management system that includes the ability to activate the emergency response organization shall be implemented for large fires. Note: An emergency response organization is an appointed group established to activate a response to a major incident.		Equivalent
10.5.2	Where mutual aid agreements are entered into with local public fire departments or other private fire brigades, the agreement shall be documented.	CSA N293-07 : Clause 10.5.2 Where mutual aid agreements are entered into with local public fire departments or other private fire brigades, the agreement shall be documented.		Equivalent
10.5.3	Drills that test plant fire response capability shall be run at least once per year and shall use scenarios that test fire response and mutual aid activation.	CSA N293-07 : Clause 10.5.3 Drills that test plant fire response capability shall be run at least once per year and shall use scenarios that test fire response and mutual aid activation.		Equivalent
10.6		CSA N293-07 : Clause 10.6		Equivalent
10.6.1	The industrial fire brigade shall be equipped with an intelligible two-way communication system. Off-site firefighters shall have access to this communication system in order to communicate with the industrial fire brigade while on site.	CSA N293-07 : Clause 10.6.1 The industrial fire brigade shall be equipped with an intelligible two-way communication system. Off-site firefighters shall have access to this communication system in order to communicate with the industrial fire brigade while on site.		Equivalent
10.6.2*	Communications during drills and incidents shall be recorded.	CSA N293-07 : Clause 10.6.2* Communications during drills and incidents shall be recorded.		Equivalent
10.6.3	The industrial fire brigade shall be able to communicate with security personnel.	CSA N293-07 : Clause 10.6.3 The industrial fire brigade shall be able to communicate with security personnel.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
10.6.4	The industrial fire brigade and the OCA shall be able to communicate with each other during the response to a fire.	CSA N293-07 : Clause 10.6.4 The industrial fire brigade and the OCA shall be able to communicate with each other during the response to a fire.		Equivalent
10.7		CSA N293-07 : Clause 10.7		Equivalent
10.7.1	Protective clothing, respiratory protective equipment, radiation monitoring equipment, personal dosimeters, and fire equipment such as hoses, nozzles, and fire extinguishers shall be provided to the industrial fire brigade. This equipment shall be in accordance with all applicable Standards.	CSA N293-07 : Clause 10.7.1 Protective clothing, respiratory protective equipment, radiation monitoring equipment, personal dosimeters, and fire equipment such as hoses, nozzles, and fire extinguishers shall be provided to the industrial fire brigade. This equipment shall be in accordance with all applicable Standards.		Equivalent
10.7.2	Personal protective clothing and equipment shall be in accordance with the requirements of NFPA 600 and NFPA 1081, including the Standards referenced therein, shall apply.	CSA N293-07 : Clause 10.7.2 Personal protective clothing and equipment shall be in accordance with Canadian Standards. Where Canadian Standards are not available, the requirements of NFPA 600 and NFPA 1081, including the Standards referenced therein, shall apply.		Equivalent
10.7.3	All personal protective clothing and equipment shall be checked at the beginning of each shift to ensure it is functional and in a state of readiness.	CSA N293-07 : Clause 10.7.3 All personal protective clothing and equipment shall be checked at the beginning of each shift to ensure it is functional and in a state of readiness.		Equivalent
10.7.4	Personal protective clothing and equipment shall be maintained in accordance with manufacturer's instructions or applicable standards.	CSA N293-07 : Clause 10.7.4 Personal protective clothing and equipment shall be maintained in accordance with manufacturer instructions or applicable standards.		Equivalent
10.7.5	The number of SCBA bottles and/or SCBA refilling capability shall be sufficient to ensure that the industrial fire brigade is adequately supplied during firefighting operations.	CSA N293-07 : Clause 10.7.5 The number of SCBA bottles and/or SCBA refilling capability shall be sufficient to ensure that the industrial fire brigade is adequately supplied during firefighting operations.		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
10.7.6	Off-site fire equipment, where needed, shall be compatible with on-site equipment or shall be equipped with adapters to ensure compatibility.	CSA N293-07 : Clause 10.7.6 Off-site fire equipment, where needed, shall be compatible with on-site equipment or shall be equipped with adapters to ensure compatibility.		Equivalent
10.8		CSA N293-07 : Clause 10.8		Equivalent
10.8.1	The industrial fire brigade minimum performance requirements of Clause 10.8 are in addition to the other performance requirements specified in Clauses 10.1 to 10.7.	CSA N293-07 : Clause 10.8.1 The industrial fire brigade minimum performance requirements of Clause 10.8 are in addition to the other performance requirements specified in Clauses 10.1 to 10.7.		Equivalent
10.8.2*	The industrial fire brigade shall be capable of (a) assembling within 2 min of an emergency response tone being sounded; (b) donning turnout gear within 1 min upon tasking; and (c) donning and activating an SCBA unit within 1 min upon tasking.	CSA N293-07 : Clause 10.8.2 The industrial fire brigade shall be capable of (a) assembling within 2 min of an emergency response tone being sounded; (b) donning turnout gear within 1 min upon tasking; and (c) donning and activating an SCBA unit within 1 min upon tasking.		Equivalent
10.8.3*	During fire responses, the industrial fire brigade shall be capable of (a) establishing an incident command post within 10 min of notification of an emergency; (b) providing size-up information to incident command within 12 min of notification of an emergency; and (c) performing effective and sustained intervention through implementation of the fire attack plan (developed by incident command) within 15 min of being notified of a fire incident.	CSA N293-07 : Clause 10.8.3* During fire responses, the industrial fire brigade shall be capable of (a) establishing an incident command post within 10 min of notification of an emergency; (b) providing size-up information to incident command within 12 min of notification of an emergency; and (c) performing effective and sustained intervention through implementation of the fire attack plan (developed by incident command) within 15 min of being notified of a fire incident.		Equivalent
10.8.4	The capabilities required by Clauses 10.8.2 and 10.8.3 shall be evaluated by qualified persons.	CSA N293-07 : Clause 10.8.4 The capabilities required by Clauses 10.8.2 and 10.8.3 shall be evaluated by qualified persons		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
11		CSA N293-07 : Clause 11	N293-12 clause 11 and its sub-clauses have requirements not covered in N293-07 clause 11, as the scope is now Fire Protection Assessments, which cover the FSSAs covered in N293-07 clause 11, plus Code Compliance Reviews (CCRs) and Fire Hazard Assessments (FHAs).	Different
11.1*	Clause 11 specifies requirements for the preparation of fire protection assessments to meet the fire protection goals, objectives, and criteria specified in Clause 5. See Annex B for detailed guidance.	CSA N293-07 : Clause 11.1.1 Clause 11 specifies requirements for the preparation of a fire safe shutdown analysis (FSSA) for plants. See Annex B for guidance on the methods of conducting an FSSA. CSA N293-07 : Clause 11.1*	N293-07 Clause 11.1.1 notes that Clause 11 specifies requirements for preparation of an FSSA only, while N293-12 Clause 11.1 notes that Clause 11 specifies requirements for FPA, ie. FSSAs, CCRs and FHAs.	Different
11.2		CSA N293-07 : Clause 11.2	N293-07 scope is FSSA only, while N293-12 scope is FPA (FSSA, CCR and FHA)	Different
11.2.1*	The fire protection assessments shall be initiated early in the design of new plants and updated when the plant design is finalized.	CSA N293-07 : Clause 11.2.1* The FSSA shall be initiated early in the design of new plants and updated before the initial loading of fuel into the reactor.	N293-07 scope is FSSA only, while N293-12 scope is FPA (FSSA, CCR and FHA)	Different
11.2.2*	The fire protection assessments shall be updated as necessary to reflect plant modifications, significant changes in fire hazards, operating experience, and operational changes.	CSA N293-07 : Clause 11.2.2* Proposed plant modifications and operational changes within an operating plant, including changes to fire hazards or a change in the level of fire protection, shall be reviewed for potential impacts to fire safe shutdown or the protection of radioactive materials outside the reactor. Where permanent modifications have an impact on these objectives, the FSSA shall be revised to reflect the modifications and shall demonstrate that the nuclear safety objectives specified in Clause 5.4.1 continue to be met.	N293-07 scope is FSSA only, while N293-12 scope is FPA (FSSA, CCR and FHA)	Different

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
11.2.3	The fire protection assessments for an operating plant shall be revised or reaffirmed at least once every five years.	CSA N293-07 : Clause 11.2.3 The FSSA for an operating plant is a living document and shall be updated or confirmed at least once every five years.	N293-07 scope is FSSA only, while N293-12 scope is FPA (FSSA, CCR and FHA)	Different
11.3		CSA N293-07 : Clause 11.5	N293-07 scope is FSSA only, while N293-12 scope is FPA (FSSA, CCR and FHA)	Different
11.3.1*	The fire protection assessments shall cover all locations within the protected area and areas external to the protected area that are under the scope of this Standard.	CSA N293-07 : Clause 11.5.1* To ensure that all fire hazards that have the potential for affecting nuclear safety are identified, the FSSA shall cover all locations within the protected area and areas external to the protected area that are under the scope of this Standard, including non-nuclear facilities and exposures.	N293-07 scope is FSSA only, while N293-12 scope is FPA (FSSA, CCR and FHA)	Different
11.3.2*	The fire protection assessments shall cover fires occurring during all operational modes, including power operation, shutdown or start-up, and outages.	CSA N293-07 : Clause 11.5.2* The FSSA shall cover fires occurring during all operational modes, including power operation, shutdown or start-up, and outages.	N293-07 scope is FSSA only, while N293-12 scope is FPA (FSSA, CCR and FHA)	Different
11.4*	The defence-in-depth principle specified in Clause 5.3 requires that multiple, independent fire protection measures be used to achieve a high degree of assurance that nuclear safety will be maintained at all times. The defence-in-depth principle shall be used in the fire protection assessments to help determine the fire protection measures needed to ensure the achievement of the nuclear safety objectives specified in Clause 5.4.1.	CSA N293-07 : Clause 11.6* The defence-in-depth principle specified in Clause 5.3 requires that multiple, independent fire protection measures be used to achieve a high degree of assurance that nuclear safety will be maintained at all times. The defence-in-depth principle shall be used in the FSSA evaluation to help determine the fire protection measures needed to ensure the achievement of the nuclear safety objectives specified in Clause 5.4.1.	N293-07 scope is FSSA only, while N293-12 scope is FPA (FSSA, CCR and FHA)	Different
11.5	Assumptions used and not specified in Clause 11.5, Items (a) to (f), shall be clearly stated and justified in the documentation. When assessing fire hazards and consequences of fires, the following are considered acceptable assumptions:	CSA N293-07 : Clause 11.8 CSA N293-07 : Clause 11.8.1 When assessing fire hazards and consequences of fires, the following are considered acceptable assumptions: (a) Fires need not be postulated coincident with independent, low-frequency events or accidents in the		Equivalent

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
	(a) Fires need not be postulated coincident with independent, low-frequency events or accidents in the plant. (b) Two or more simultaneous, independent fires in a plant or adjacent plant units need not be postulated. (c) In a fire safe shutdown analysis, failure of a single component need not be postulated coincident with failures caused by fire. (d) Credit may be given to equipment or components that result in fail-safe conditions after damage by fire or fire suppression action (e.g., loss of power to shut-off rods resulting in reactor trip), provided that the fail-safe characteristics of the equipment or component are individually assessed against the failure modes induced by the fire or fire suppression action. (e) Manual action by operators may be credited toward the accomplishment of the nuclear safety objectives (provided that the necessary conditions for correct and timely actions have been identified and justified). (f) Credit may be given for repair or replacement of components or circuits that are damaged or disabled by fire, provided that the following conditions are met: (i) Such credits are kept to a minimum. (ii) Credit is given only for restoring long-term functions after the reactor has been shutdown, cooled, and depressurized. (iii) It is demonstrated that all necessary work can be completed before the component or circuit is required to act. (iv) Procedures and training are provided for the repair or replacement work. (v) Necessary components, cables, and parts are available on site.	plant. (b) Two or more simultaneous, independent fires in a plant or adjacent plant units need not be postulated. (c) A single failure in the fire safe shutdown systems need not be postulated coincident with failures caused by fire. (d) Credit may be given to equipment or components that result in fail-safe conditions after damage by fire or fire suppression action (e.g., loss of power to shut-off rods resulting in reactor trip), provided that the fail-safe qualities of the equipment or component are individually assessed against the failure modes induced by the fire or fire suppression action. (e) Manual action by operators may be credited toward the accomplishment of the fire safe shutdown functions, provided that the necessary conditions for correct and timely actions have been identified and justified. (f) Credit may be given for repair or replacement of components or circuits that are damaged or disabled by fire, provided that the following conditions are met: (i) such credits are kept to a minimum; (ii) credit is given only for restoring long-term functions after the reactor has been shutdown, cooled, and depressurized; (iii) it is demonstrated that all necessary work can be completed before the component or circuit is required to act; (iv) procedures and training are provided for the repair or replacement work; and (v) necessary components, cables, and parts are available on site.		

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
11.6	Limitations and uncertainties concerning the data and methods used shall be identified. The assessment and analysis shall demonstrate that these limitations and uncertainties are adequately addressed (e.g., by the use of suitable safety margins). Note: Appropriate sensitivity analysis may be necessary to demonstrate suitable safety margins in light of uncertainties in data and methods.	CSA N293-07 : Clause 11.9 Limitations and uncertainties concerning the data and methods used in the FSSA shall be identified. The FSSA shall demonstrate that these limitations and uncertainties are adequately addressed (e.g., by the use of suitable safety margins).	N293-07 scope is FSSA only, while N293-12 scope is FPA (FSSA, CCR and FHA)	Different
11.7*	The following documentation is required as a minimum: (a) the SSCs required to perform the nuclear safety objectives defined in Clause 5.4 and their location; (b) the general usage of the fire compartment or zone, including the major equipment present; (c) the inventory and configuration of combustible materials in each fire zone; (d) postulation of the design basis fires in each fire zone and assessment of resulting damage to plant SSCs; (e) postulation of the failures, and potential failure modes, of equipment in applicable fire zone and assessment of resulting impacts to plant fire safe shutdown; (f) the technical basis of each step in demonstrating the achievement of safety objectives of the standard; (g) fire mitigation measures, including: (i) fire detection; (ii) automatic and manual suppression; (iii) fire separations; (iv) spatial separations; and (v) smoke control; (h) verification that the nuclear safety performance criteria specified in Clause 5.4.2 have been met, or additional fire protection measures that are required;	CSA N293-07 : Clause 11.4* The FSSA shall provide documentation of the following: (a) the SSCs required to perform the nuclear safety functions defined in Clause 5.4 (otherwise known as fire safe shutdown systems), as well as their location; (b) the inventory and configuration of in situ combustible materials in each fire zone, including transient combustibles that could be present; (c) postulation of the design basis fires in each fire zone and assessment of resulting damage to plant SSCs. Documentation shall include the basis of each step in the assessment from fire initiation to fire growth, as well as equipment damage, failures, and consequences on nuclear safety; (d) fire detection measures as well as automatic and manual suppression measures; (e) other fire mitigation measures such as fire separations, spatial separations, and smoke control measures; (f) verification that the fire safe shutdown criteria have been met by ensuring that at least one success path remains available to perform the nuclear safety performance criteria specified in Clause 5.4.2 or, alternatively, identification of the additional fire protection measures that are required; (g) verification that the criteria for the protection of radioactive materials outside the reactor, as defined in	N293-07 scope is FSSA only, while N293-12 scope is FPA (FSSA, CCR and FHA)	Different

Clause	Clause Text	Associated Clause(s)	Assessment	Evaluation
	(i) verification that the criteria for the protection of radioactive materials outside the reactor, as defined in Clause 5.4.3, have been met, or additional fire protection measures that are required; (j) compliance with the applicable requirements of this Standard and referenced documents; and (k) assessment of effectiveness, appropriateness, and reliability of the fire protection measures in meeting the goals and objectives of this Standard.	Clause 5.4.3, have been met or, alternatively, identification of the additional fire protection measures that are required; and (h) the general usage of the fire compartment or zone, including the major equipment present.		
11.8		CSA N293-07 : Clause 11.7		Equivalent
11.8.1	The preparation and review of the fire protection assessments required by this Standard shall comply with the quality assurance requirements of CSA N286. The CSA N286 requirements shall also apply to any revisions.	CSA N293-07 : Clause 11.7.1 The preparation and review of the FSSA as part of the design process shall comply with the quality assurance requirements of CSA N286. The CSA N286 requirements shall also apply to any revision to the FSSA of an operating plant.	N293-07 scope is FSSA only, while N293-12 scope is FPA (FSSA, CCR and FHA)	Different
11.8.2	Fire protection assessments performed to demonstrate compliance to this Standard shall be auditable.			New Requirement
11.8.3*	The fire protection assessments shall be prepared by personnel with knowledge of fire protection, plant design, and nuclear safety. This qualification of personnel applies to the preparation of the original document and to periodic updating of the assessment.	CSA N293-07 : Clause 11.7.2* The FSSA shall be prepared by personnel with knowledge of fire protection, plant system design, and nuclear safety. The FSSA shall be subject to a peer review by persons having at least the same level of knowledge as those responsible for its preparation. This qualification of personnel applies to the preparation of the original document and to periodic updating of the assessment.	N293-07 scope is FSSA only, while N293-12 scope is FPA (FSSA, CCR and FHA)	Different

C.2. Comparison of NBCC and NFCC (2005 to 2015 Versions)

In support of the review tasks listed in Section 5, a code-to-code comparison has been performed for the 2015 versions of NBCC and NFCC to the 2005 versions, which were the previous ones assessed. In establishing these differences, the National Research Council (NRC) website sites [61] and [62] were used, rather than the codes themselves.

C.2.1. National Building Code of Canada (NBCC)

C.2.1.1. Changes from 2005 to 2010 Editions

Part 3: Fire Protection, Occupant Safety and Accessibility

Section	Section Change	Relevant to BP?
Protection Against Falls from Residential Occupancy Windows	A requirement has been introduced providing for a guard or a mechanism that prevents a window from opening more than 100 mm.	No
Spatial Separation between Buildings (also Part 9)	Additional fire protection requirements were introduced relating to the construction of all buildings and houses in proximity to one another or to the property line.	Yes, but largely superseded by 2015 changes.
Fire Alarm Systems and Smoke Alarms (also Part 9)	New requirements and clarifications were introduced for smoke alarm placement, commissioning of life safety and fire safety systems, and when fire alarm components must be installed.	Yes
Penetrations Through Fire Separations (also Part 9)	Definitions for “fire stops” and “fire blocks” have been added, as were several changes addressing penetrations through fire separations. Requirements involving attics that do not have sprinklers were clarified.	Yes
Exit Signs and Markings (also Part 9)	Requirements addressing green pictograms conforming to ISO standards and photoluminescent exit signs were introduced.	Yes
Stairs, Ramps, Handrails and Guards (also Part 9)	A set of 31 changes address inconsistencies between Part 3 and Part 9 regarding the respective requirements for stairs, ramps, handrails and guards. Many clarifications were also added.	Yes
Care Occupancies	A new occupancy classification for residential care facilities has been created (Group B3 occupancy) that relaxes requirements for smaller care occupancies having a limited number of occupants. New construction, sprinkler, emergency power and fire alarm requirements were added.	No

Part 4: Structural Design

Section	Section Change	Relevant to BP?
Live Load Due to Use and Occupancy	Crane and vehicle loads are more explicitly defined. The minimum live loads for areas in arenas, grandstands and stadia having fixed seats with backs has been reduced and the requirement extended to include churches, lecture halls and theatres.	No
Wind Loads	Buildings with very long periods of vibration, one of the most important factors determining how a structure will respond to external forces, must now be designed by experimental methods; dynamic calculations are no longer acceptable.	Yes
Earthquake Design	Revisions were made to requirements related to site properties, irregularities, steel structures, static and dynamic procedures, and diaphragms.	Yes

Part 5: Environmental Separation

Section	Section Change	Relevant to BP?
Structural Loads	Seismic effects will now be taken into account only for post-disaster buildings (i.e. buildings essential to the continued provision of services in the event of a disaster).	Yes
Windows, Doors and Skylights (also Part 9)	A new, harmonized North American standard for windows, doors and skylights is now referenced in the NBC. This resulted in a substantial reorganization of Sections 9.6. and 9.7.	Yes
Sealant Standards (also Part 9)	Outdated standards for sealants were replaced with current ASTM standards that address relevant product categories and contain equivalent or similar performance criteria.	Yes
Radon (also Parts 6 and 9)	The new Health Canada guideline of 200 Bq/m³ for indoor radon concentration has been referenced in the Appendix. Parts 5 and 6 now require that engineers and designers consider radon protection in their designs. Air barrier requirements in Part 9 were consolidated and prescriptive measures on providing a rough-in for a future radon mitigation system added.	No. Radon is a major consideration where uranium mining activities are conducted, but not for nuclear power plants.

Part 6: Heating, Ventilation and Air-conditioning

Section	Section Change	Relevant to BP?
Ventilation	New requirements relating to acceptable building air ventilation have been added. They specify maximum levels of particulate matter, ground-level ozone and carbon monoxide in air for building ventilation purposes.	Yes

Part 9: Housing and Small Buildings

Section	Section Change	Relevant to BP?
Secondary Suites in Houses	Changes in requirements include limiting their size, making “secondary suite” a defined term, and inserting “house” into many requirements that previously only applied to dwelling units	No
Lateral Loads	A probabilistic-based approach for exposure to wind and seismic forces using environmental load data was added, as were prescriptive requirements for high-load areas. The concept of braced wall panels was introduced. Requirements for fastening and framing based on local wind and seismic conditions have also been added.	Yes
Low Permeance Materials in the Building Envelope	A simplified approach to requiring the correct position and properties for low air and vapour permeance materials in building envelopes was introduced.	Yes
Garage Floors	Inconsistencies were resolved in the requirement that garage floors be sloped to the exterior to limit heavier-than-air gas inflow into habitable spaces below the garage floor level.	No
Tables A-9.10.3.1.A and A-9.10.3.1.B	Two footnotes were added to clarify requirements for adhesives employed in finger-joined studs and prefabricated I-joists used in assemblies requiring a fire-resistance rating in buildings.	Yes

Appendix C, Table C-2

Section	Section Change	Relevant to BP?
Seismic Values and Climatic Data	Climatic data and localities were updated and the equation derived to fit the seismic observational data was improved.	Yes, but largely superseded by 2015 changes.

C.2.1.2. Changes from 2010 to 2015 Editions

Part 3: Fire Protection, Occupant Safety and Accessibility

Section	Section Change	Relevant to BP?
Self-service storage buildings (1 storey with external access)	The change introduces requirements for self-service storage buildings that are one storey in height with no basement or mezzanine and only external access to storage units, as many jurisdictions currently have no building code requirements specific to self-service storage buildings. These requirements provide specific relaxations in terms of fire protection, such as spatial separations and egress, and represent the first step towards introducing requirements for multi-storey self-service storage buildings.	No
Building on sloped sites (also Part 9)	The changes resolve confusion regarding the definition of grade and its application to buildings located on sloping sites. They expand the building height from three to four stories and permit the consideration of assembly, business and personal services, as well as mercantile major occupancies, when dealing with four-storey Part 3 buildings and non-residential major occupancies in Part 9.	No
Soffit protection (also Part 9)	The change clarifies and relaxes roof soffit protection when facing a street, lane or a public thoroughfare. It provides for harmonization with similar provisions for spatial separation in Part 9.	No
Handrail graspability	This change deletes the notion of “graspable portion” of handrails for Part 3 public stairs.	No

Part 4: Structural Design

Section	Section Change	Relevant to BP?
Appendix C: Ground snow load	Changes to the ground snow load values for different areas of Canada. About 84% of the locations listed in Table C-2 of Appendix C of the NBC remain unchanged.	Yes
Appendix C: Seismic Model (also Part 9)	A major overhaul of the seismic model for Canada has resulted in changes relating to seismicity. These changes are based on improved ground motion data from large earthquakes in the last decade, as well as an improved understanding of the relationship between earthquake occurrence and the geological structure of the earth’s crust. The new seismic model for Canada incorporates these advancements and is the first major update in 20 years. It provides better risk coverage against seismic events. The proposed changes fall into three categories: location-specific changes as listed in Table C-2 of Appendix C of the NBC; site-specific changes such as revised foundation factors and equations; and structure-specific changes such as revised higher mode factors. These changes are interrelated. Consequently, design seismic loads will change in some areas, and a different trigger zone may apply. Some jurisdictions may end up falling under a different zone after the trigger value is calculated. This may result in either an increase or a decrease in the requirements. The seismicity changes also impact Part 9 buildings and housing, as the prescriptive solutions in Part 9 use the spectral hazard values as triggers	Yes

Section	Section Change	Relevant to BP?
	for construction requirements. For example, an increase in the spectral hazard for short period buildings may trigger more stringent construction requirements for elements such as braced wall bands, roof sheathing nailing, masonry and ICF wall construction, and the attachment of HVAC equipment.	

Part 9: Housing and Small Buildings

Section	Section Change	Relevant to BP?
Spatial separation of houses	A 10-minute response time was introduced into Part 9 of the 2010 NBC as a trigger for more stringent spatial separation requirements for houses. The new change deletes the 10-minute response time for spatial separation of houses and restores the wording used in the 2005 NBC with some additional changes. It does, however, maintain the two levels of requirements – a less stringent one where a fire department is organized, and a more stringent one where a fire department does not exist or is not organized, trained and equipped. Sprinklered houses will continue to be exempted from the more stringent requirements.	No
Run dimension in dwelling units	This change increases the run dimension in stairs serving single dwelling units to a minimum of 255 mm. It is based on an assessment of technical literature and statistics indicating that the current NBC residential step dimension requirement provides a less than acceptable performance level. A review of studies and reports indicated that steps with a larger run dimension provided better foot placement and greater margins of stability, resulting in a reduction of fall incidents for all fall scenarios and all age groups.	No
Fire-resistance and sound transmission class ratings	This change introduces a new exterior wall assembly, EW2, using glass fibre insulation fill, as its use in assemblies has demonstrated an acceptable fire performance when constructed in a similar way to assemblies using mineral fibre. The proposed assembly would be deemed to comply with fire-resistance ratings of 45 minutes and 1 hour and would be consistent with the existing fire-rated assembly EW1 that is still limited to mineral fibre insulation.	No
Low permeance materials	Currently, a material's water vapour permeance triggers the requirement to insulate assemblies on the exterior. Based on the results of an NRC modeling project that examined the risk potential for moisture condensation within various wall assembly configurations and key climate areas, the change allows installation of more products on the exterior without the need for additional insulation.	Yes
CSA A23.1 concrete strength	This change creates a qualified reference to the 2014 edition of CSA A23.1 by explicitly writing the existing strength and water cement ratio requirements into the body of the code. The revision to the 2014 edition of the CSA A23.1 standard calls for higher strength and lower cement-water ratios for concrete used in foundations, footings and interior floor slabs of houses and small buildings.	No

C.2.2. National Fire Code of Canada (NFCC)

C.2.2.1. Changes from 2005 to 2010 Editions

Section	Section Change	Relevant to BP?
Leak Detection and Monitoring	Changes dealing with leak detection and monitoring, as well as handling of certain dangerous goods, have been introduced. Existing requirements relating to the detection and monitoring of storage tanks, sumps, and piping systems containing flammable and combustible liquids were revised and new ones added.	Yes
Storage of Flammable and Combustible Liquids in Buildings	Limits to quantities of flammable and combustible liquids stored within buildings have been updated. New passive and active fire protective measures have been added.	Yes
Fire Safety at Demolition and Construction Sites	Adjacent buildings or facilities must now be protected from fires originating from demolition or construction sites. Requirements for fire safety plans and fire department access to sites were improved. Specific requirements on the commissioning and decommissioning of standpipe systems, as well as restrictions on rooftop bitumen kettle placement, have been added.	No

C.2.2.2. Changes from 2010 to 2015 Editions

Section	Section Change	Relevant to BP?
6 Storey Combustible Construction	The 2015 edition of the National Fire Code includes a new Subsection with additional requirements that apply during construction of 5 and 6 storey combustible buildings.	No
Dangerous Goods Classification	The NFC now harmonizes the dangerous goods classification system with the Globally Harmonized System (GHS) of classification, and introduces the Workplace Hazardous Materials Information System (WHMIS) into the NFC's dangerous goods section. The new harmonized system of classification in the NFC categorizes dangerous goods by types of hazards, harmonizing communications, labelling and safety data sheets. This substantial change improves the availability of information on physical hazards, compatibility and toxicity from chemicals in order to enhance the protection of human health, fire safety and the environment during the handling, transport and use of these chemicals. These new requirements set the precedence of dangerous goods classes and provide a description of the GHS classification system. Placards conforming to Transport of Dangerous Goods (TDG) regulations can once again be be [sic] used to identify the hazards associated with the product classified under WHMIS.	Yes
Fire Protection: Storage Limit of Flammable and Combustible Liquid in Self-Service Storage Buildings	The maximum quantities are defined for flammable and combustible liquids permitted to be stored in self-service storage buildings.	Yes

Section	Section Change	Relevant to BP?
Storage Tanks: Storage Tank Repair and Refurbishment	References to withdrawn certification programs (ULC-S601(A), ULC-S603(A), ULC-S615(A), ULC-S630(A)) are removed and references to new standards are added for reusing and refurbishing storage tanks.	Yes
Hot Works: Location of Operations	Guidance for the use of high- and low-tech inspection methods is provided, along with alternatives to the final inspection four hours following hot works. The protection of bitumen kettles during roofing applications is further refined.	Yes
Dangerous Goods: Laboratories – Placard Use in Laboratories	The requirement is clarified for placards that identify the presence of dangerous goods in laboratories.	Yes
Dangerous Goods: Laboratories – Interlocking of the Enclosure Exhaust Ventilation System with the Fire Alarm System	The enclosure exhaust ventilation system must not be interlocked with fire detection, fire alarm or makeup air system.	Yes
Dangerous Goods: Laboratories – Dangerous Goods Maximum Quantities	The quantities of all dangerous goods stored in a laboratory are limited, including the quantities 'in use' during normal operations.	Yes
Dangerous Goods: Laboratories – Containers in Laboratories	Containers used for the storage of or processing of flammable or combustible liquids in a laboratory should conform to Subsection 4.2.3. requirements, Containers and Portable Tanks, of Division B of the NFC.	Yes