FORM-14159 R000*

Periodic Safety Review - Final Document Review Traveler

Bruce Power

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Bruce Power Document Title:
Safety Factor 13 – Emergency Planning

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Accepted for use at Bruce Power by:	**Signature:**	**Date**
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Sheet # 2 of 3

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candesco
Division of Kinectrics Inc.

Title: Safety Factor Report 13 - Emergency Planning

File: K-421231-00023-R00

NK21-SFR-09701-00013

A Report Submitted to Bruce Power

June 30, 2015

Issue	Reason for Issue:				
R00D0	For first internal Candesco review				
	Author: S. Petrella	Verifier:	Reviewer: G. Archinoff T. Kapaklili	Approver:	Date: Dec 19, 2014
Issue R00D1	**Reason for Issue:** For harmonization, which incorporates internal Candesco review comments				
	Author: S. Petrella	Verifier:	Reviewer: G. Archinoff T. Kapaklili	Approver:	Date: Jan 20, 2014
Issue R00D2	**Reason for Issue:** For final internal Candesco review				
	Author: S. Petrella	Verifier:	Reviewer: G. Archinoff L. Watt	Approver:	Date: Mar 3, 2014
Issue R00D3	**Reason for Issue:** Issued to Bruce Power for review				
	Author: S. Petrella	Verifier: G. Buckley	Reviewer: G. Archinoff L. Watt	Approver:	Date: Mar 19, 2014

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Issue	**Reason for Issue:**				
R00D4	Incorporates changes from Bruce Power review				
	Author: S. Petrella	Verifier: G. Aldev	Reviewer: G. Archinoff L. Watt	Approver:	Date: June 19, 2015
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R00	For use				
	Author: S. Petrella	Verifier: G. Aldev B. Rzentkowski	Reviewer: G. Archinoff L. Watt	Approver: L. Watt	Date: June 30, 2015

Document Classification: Report	Security Classification: Client Proprietary

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Acronyms and Abbreviations

AIM	Abnormal Incidents Manual
AOO	Anticipated Operational Occurrence
AR	Action Request
BDBA	Beyond Design Basis Accident
BERP	Bruce Emergency Response Projection
BEST	Bruce Emergency Services Team (not in current use)
BP	Bruce Power
BPNERP	Bruce Power Nuclear Emergency Response Plan
CESC	Corporate Emergency Support Centre
CMLF	Central Maintenance and Laundry Facility
CNSC	Canadian Nuclear Safety Commission
CSA	Canadian Standards Association
DBA	Design Basis Accident
FASA	Focus Area Self-Assessment
EA	Environmental Assessment
EFPH	Equivalent Full Power Hours
EIC	(Provincial) Emergency Information Centre
EM	Emergency Management
EMC	Emergency Management Centre
EME(G)	Emergency Mitigating Equipment (Guidance)
EOC	Emergency Operations Centre
EP	Emergency Plan
EPS	Emergency and Protective Services
ER	Emergency Response
ERF	Emergency Response Facility
ERT	Emergency Response Team
ERO	Emergency Response Organization
ESA	Emergency Shift Assistant
ESM	Emergency Services Maintainer

FAI	Fukushima Action Item
FASA	Focus Area Self Assessments
HQEOC	Headquarters Emergency Operations Centre
IAEA	International Atomic Energy Agency
IAMP	Integrated Accident Management Program
IMS	Incident Management System
ISR	Integrated Safety Review
ITB	Iodine Thyroid-Blocking
KI	Potassium Iodide
LCH	Licence Conditions Handbook
LOCA	Loss of Coolant Accident
LTEP	Long Term Energy Plan
MART	Mutual Assist Response Team
MCR	Main Control Room
MEOC	Municipal Emergency Operations Centre
NEO	Nuclear Emergency Organization
NERP	Nuclear Emergency Response Plan
NPP	Nuclear Power Plant
NSCA	Nuclear Safety and Control Act
OFI	Opportunity for Improvement
OM	Operating Manual
OPEX	Operating Experience
PBX	Private Branch Exchange
PEOC	Provincial Emergency Operations Centre
PI	Performance Indicator
PNERP	Provincial Nuclear Emergency Response Plan
PRA	Probabilistic Risk Assessment
PROL	Power Reactor Operating Licence
PSA	Probabilistic Safety Assessment (synonymous with PRA)
PSR	Periodic Safety Review
SACRG	Severe Accident Control Room Guide

SAEG	Severe Accident Exit Guide
SAG	Severe Accident Guide
SAM(G)	Severe Accident Management (Guidance)
SAT	Systematic Approach to Training
SBR	Safety Basis Report
SCA	Safety and Control Areas
SCG	Severe Challenge Guide
SCR	Station Condition Record
SEC	Shift Emergency Controller
SFR	Safety Factor Report
SMC	Site Management Centre
SME	Subject Matter Expert
VSAT	Very Small Aperture Terminal

1. Objective and Description

Bruce Power (BP), as an essential part of its operating strategy, is planning to continue operation of Units 3 and 4 as part of its contribution to the Long Term Energy Plan (LTEP) (http://www.energy.gov.on.ca/en/ltep/). Bruce Power has developed plant life integration management plans in support of operation to 247,000 Equivalent Full Power Hours (EFPH). A more intensive Asset Management program is under development, which includes a Major Component Replacement (MCR) approach to replace 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 maintenance outage will be scheduled concurrently.

To support the definition and timing of practicable opportunities for enhancing the safety of Units 3 and 4, and the ongoing operation of Units 1 and 2, which have already been refurbished, Bruce Power is conducting a station-wide review of safety for Units 0A and 1-4, to be termed an Integrated Safety Review (ISR) [1]. This ISR supersedes the Bruce A portion of the interim Periodic Safety Review (PSR) that was conducted for the ongoing operation of the Bruce A and B units until 2019 [2]. This ISR is conducted in accordance with the Bruce A ISR Basis Document [1], which states that the ISR will meet or exceed the international guidelines given in International Atomic Energy Agency (IAEA) Guide SSG-25, Periodic Safety Review for Nuclear Power Plants [3]. The ISR envelops the guidelines in Canadian Nuclear Safety Commission (CNSC) Regulatory Document RD-360 [4], Life Extension for Nuclear Power Plants, with the exception of those related to the Environmental Assessment (EA), which has already been completed for Bruce A [5][1].

1.1. Objective

The overall objective of the Bruce A ISR is to conduct a review of Bruce A against modern codes and standards and international safety expectations and provide input to a practicable set of improvements to be conducted during the Major Component Replacement in Units 3 and 4, and during asset management activities to support ongoing operation of all four units, including U0A, that will enhance safety to support long term operation. The look-ahead period will be longer than that in the interim PSR performed for Units 1-8 [2]. 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. Nuclear Safety is a primary consideration for Bruce Power and the management system must support the enhancement

[1] RD-360 [4] was superseded by CNSC REGDOC-2.3.3 [6] in April 2015. CNSC REGDOC-2.3.3 was in draft at the time that the ISR Basis Document [1] was prepared. The draft version of CNSC REGDOC-2.3.3 stated that it was consistent with SSG-25, and the assessments in the Safety Factor Reports were performed on that basis. The issued version of CNSC REGDOC-2.3.3 also states that it is consistent with SSG-25, and therefore it is considered that the ISR envelops the guidelines in CNSC REGDOC-2.3.3.

and improvement of safety culture and the achievement of high levels of safety, as well as reliable and economic performance.

The specific objective of the review of this Safety Factor is to determine whether the operating organization has adequate plans, staff, facilities and equipment for dealing with emergencies at the Bruce A plant and whether the operating organization's arrangements have been adequately coordinated with local and national systems and are regularly exercised.

1.2. Description

The review is conducted in accordance with the Bruce A ISR Basis Document [1], which states that the review tasks are as follows:

1. An overall review will be performed to check that emergency planning at the plant continues to be satisfactory and to check that emergency plans (EPs) are maintained in accordance with current safety analyses, accident mitigation studies and good practices.
2. It will be verified if the operating organization has given adequate consideration to significant changes at the site of the nuclear power plant and in its use, organizational changes at the plant, changes in the maintenance and storage of emergency equipment and developments around the site that could influence emergency planning.
3. Additionally, and more specifically:
   a. Evaluate the adequacy of on-site equipment and facilities for emergencies;
   b. Evaluate the adequacy of on-site technical and operational support centres;
   c. Evaluate the efficiency of communications in the event of an emergency, in particular the interaction with organizations outside the plant;
   d. Evaluate the content and effectiveness of emergency training and exercises and check records of experience from such exercises;
   e. Evaluate arrangements for the regular review and updating of emergency plans and procedures;
   f. Examine changes in the maintenance and storage of emergency equipment; and
   g. Evaluate the effects of any recent residential and industrial developments around the site.

2. Methodology of Review

As discussed in the Bruce A ISR Basis Document [1], the methodology for an ISR should include making use of safety reviews that have already been performed for other reasons. Accordingly, the Bruce A ISR 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];

- Proposed refurbishments of Bruce Units 3 and 4 (circa 2008) [10] [11] [12]; and
- Safety Basis Report (SBR) and Periodic Safety Review (PSR) for Bruce Units 1 to 8 (2013) [2].

These reviews covered many, if not all, of the same Safety Factors that are reviewed in the current ISR. A full chronology of Bruce Power safety reviews is provided in Appendix F of [13].

The Bruce A ISR 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 ISR Basis 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 ISR 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 confirming or modifying the assessment type for each of the codes and standards and guidance documents identified for consideration. The ISR 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 ISR Basis Document.
4. **Perform gap assessment against codes and standards:** This step comprises the actual assessment of the Bruce Power programs and the Bruce A plant against the identified codes and standards. In general, this involves determining from available design or programmatic documentation whether the plant's design or programs 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 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 gap 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.
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 A 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. The list also includes any new codes or standards that came into effect after the completion of the 2013 PSR, as well as those that supersede codes or standards previously assessed. Regulatory codes and standards issued after the code effective date of August 31, 2014 were not part of the detailed review.

3.1. Act and Regulations

The *Nuclear Safety and Control Act* (NSCA) [14] establishes the Canadian Nuclear Safety Commission and its authority to regulate nuclear activities in Canada. The NSCA has been amended on July 3, 2013 to provide the CNSC with the authority to establish an administrative monetary penalty system. The Administrative Monetary Penalties Regulations were introduced in 2013, and set out the list of violations that are subject to administrative monetary penalties, as well as the method and criteria for penalties administration. However, these changes do not impact this Safety Factor. Furthermore, following the Fukushima nuclear events of March 2011, the Fukushima Omnibus Amendment Project was undertaken and completed in 2012, and resulted in amendments to regulatory documents to reflect lessons learned from these events. Bruce Power has a process to ensure compliance with the NSCA [14] and its Regulations. Therefore, the NSCA and Regulations were not considered further in this review.

3.2. Power Reactor Operating Licence

The Bruce A Nuclear Generating Station operates under the authority of the Power Reactor Operating Licence (PROL) issued by the CNSC [15]. Licence Condition 7, Emergency Preparedness, is directly relevant to this review. This condition requires:

> "The licensee shall implement and maintain an emergency plan for the nuclear facility".

The PROL Licence Conditions Handbook (LCH) [16] Section 7 identifies Bruce Power's Nuclear Emergency Response Plan, BP-PLAN-00001 [17] as subject to document version control (i.e., changes to Bruce Power's Nuclear Emergency Response Plan require notification to the Commission, or a person authorized by the Commission, prior to implementation). The LCH also requires that, as part of the emergency preparedness program, the licensee is to have a public information program acceptable to the CNSC and consistent with CNSC Regulatory Document RD/GD-99.3, Public Information and Disclosure.

The list of codes and standards related to emergency planning that are referenced in the Bruce Power PROL [15] and LCH [16] are identified in Table 1.[2] The edition dates referenced in the third column of the table are the modern versions used for comparison.

[2] PROL 18.00/2020 [18] and LCH-BNGS-R000 [19] came into effect on June 1, 2015. However, PROL 15.00/2015 [15] and LCH-BNGSA-R8 [16] are the versions referred to in this ISR, as these were in force when the assessments in the Safety Factor Reports were performed.

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

Document Number	Document Title	Modern Version used for ISR Comparison	Type of Review
CNSC RD/GD-99.3 (2012/03)	Public Information and Disclosure	CNSC RD/GD-99.3 (2012/03) [20]	NR
CNSC RD-360 (2008)	Life Extension of Nuclear Power Plants	CNSC RD-360 (2008) [4]	NR
CSA N286-05 (R2011)	Management System Requirements for Nuclear Power Plants	CSA N286-12 [21]	NR
Assessment type: Clause-by-Clause (CBC); Code-to-Code (CTC); High Level (HL); No Assessment Required (NR); Confirm Validity of Previous Assessments (CV)			

CNSC RD/GD-99.3: Table C-1 of the ISR Basis Document [1] calls for a clause-by-clause assessment of CNSC RD/99.3. As noted above, the LCH requires that, as part of the emergency preparedness program, the licensee is to have a public information program acceptable to the CNSC and consistent with CNSC regulatory document RD/GD-99.3, Public Information and Disclosure. This regulatory document is included in the current licence and accordingly no further assessment of RD/GD-99.3 requirements is performed for this ISR.

CNSC RD-360: This ISR is being conducted as part of ongoing operation for Units 1 and 2 and to support Major Component Replacement of Units 3 and 4, so it also envelops the guidelines in RD-360, Life Extension for Nuclear Power Plants, issued February 2008. Therefore, RD-360 [4] *de facto* continues to provide guidance on how this review should be conducted. However, RD-360 [4] was superseded by CNSC REGDOC-2.3.3 [6] in April 2015, which was in draft at the time that the ISR Basis Document [1] was prepared. The draft version of CNSC REGDOC-2.3.3 stated that it was consistent with SSG-25, and the assessments in the Safety Factor Reports were performed on that basis. The issued version of CNSC REGDOC-2.3.3 also states that it is consistent with SSG-25, and therefore it is considered that the ISR envelops the guidelines in CNSC REGDOC-2.3.3.

CSA N286-05: Table C-1 of the ISR Basis Document [1] calls for a code-to-code review against Canadian Standards Association (CSA) standard CSA N286-05. 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" [22].

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 next licensing period [23]. 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 [24]. Bruce Power further stated CSA N286-12 does not establish any significant or immediate new safety requirements that would merit a more accelerated implementation. 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.

3.3. Regulatory Documents

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

Table 2: Regulatory Documents

Document Number	Document Title	Reference	Type of Review
CNSC REGDOC-2.3.2 (2014)	Operating Performance: Accident Management	[25]	CBC
CNSC REGDOC-2.10.1 (2014)	Emergency Management and Fire Protection: Nuclear Emergency Preparedness and Response	[26]	CBC
CNSC RD-353	Testing and Implementation of Emergency Measures	[27]	NR
CNSC P-325 (2006)	Nuclear Emergency Management	[28]	NR
Assessment type: Clause-by-Clause (CBC); Code-to-Code (CTC); High Level (HL); No Assessment Required (NR); Confirm Validity of Previous Assessments (CV)			

CNSC REGDOC-2.3.2: CNSC REGDOC-2.3.2 [25], which supersedes G-306, sets out the CNSC's requirements and guidance related to the development, implementation and validation of integrated accident management programs (IAMPs) for reactor facilities encompassing anticipated operational occurrences (AOOs), design basis accidents (DBAs) and beyond design basis accidents (BDBAs), including severe accidents. Note that accident management, which deals with preventing the escalation of an accident and mitigating its consequences, supports emergency preparedness and response, by mitigating the effects of an off-site release. A clause-by-clause assessment of CNSC REGDOC-2.3.2 is provided in Appendix B (B.2).

CNSC REGDOC- 2.10.1: Table C-1 of the ISR Basis Document [1] does not identify CNSC REGDOC-2.10.1 as requiring an assessment, since it was issued after the code effective date of August 31, 2014. CNSC REGDOC-2.10.1 [29] sets out the CNSC's requirements and guidance related to the development of emergency measures for Class I nuclear facilities licensees, and supersedes both RD-353 [27] and G-225 [30]. CNSC REGDOC-2.10.1 and CNSC REGDOC-2.3.2 had interim revisions published in 2013. Bruce Power has asked the CNSC that these interim revisions be used in the upcoming LCH pending the resolution of issues with the 2014 revisions [31]. A clause-by-clause assessment of CNSC REGDOC-2.10.1 is provided in Appendix B (B.1).

CNSC RD-353: Table C-1 of the ISR Basis Document [1] calls for a clause-by-clause assessment of CNSC RD-353. CNSC RD-353 was superseded by CNSC REGDOC-2.10.1, on which a clause-by-clause assessment was performed, and thus CNSC RD-353 was not assessed in this ISR.

CNSC P-325: In addition to the codes and standards listed in Table C-1 of the ISR Basis Document [1], Regulatory Policy P-325 [28] was considered which describes the guiding principles and direction for CNSC staff activities related to nuclear emergency management. It also describes the organization of the CNSC's Nuclear Emergency Organization (NEO) and the roles and responsibilities of Commission members and CNSC support staff within the NEO. Given P-325 was not identified in the ISR basis and given the policy does not impose any specific obligations on licensees, the Policy was not reviewed further.

3.4. CSA Standards

The Canadian Standards Association (CSA) has issued standards that form the basis of the QA programs for all Canadian nuclear facilities, as well as providing both programmatic and technical requirements. These are used primarily as a foundation or basis on which nuclear utility operators have developed specific, internal policies, programs, and procedures. The CSA Standards listed in Table 3 are relevant to emergency planning.

Table 3: CSA Standards

Document Number	Document Title	Reference	Type of Review
CSA N288.2-91	Guidelines for Calculating Radiation Doses to the Public from a Release under Airborne Radioactive Material Under Hypothetical Accident Conditions in Nuclear Reactors	[33]	NR
CSA N1600-14	General requirements for nuclear emergency management programs	[34]	HL
CSA Z731-03	Emergency Planning for Industry	[35]	NR
Assessment type: Clause-by-Clause (CBC); Code-to-Code (CTC); High Level (HL); No Assessment Required (NR); Confirm Validity of Previous Assessments (CV)			

CSA N288.2-91: CSA N288.2-91 [33] provides guidelines for calculating radiation doses to the public from a release of airborne radioactive material under hypothetical accident conditions in nuclear reactors. This standard was used for the Bruce A Environmental Assessment that formed part of the Bruce 1 and 2 ISR. The EA was submitted and found to be acceptable by the CNSC, as documented in the Record of Proceedings July 5, 2006 [36]. Therefore, an EA, and the assessment of codes that specifically supported the EA, is not required in the scope of this ISR [1].

CSA N1600: Table C-1 of the ISR Basis Document [1] calls for a clause-by-clause assessment of CSA N1600. Given the similarity in scope between CSA N1600 [34] and CNSC REGDOC-2.10.1 [29] and CNSC REGDOC-2.3.2 [25], and the fact that these CNSC REGDOCs are assessed clause-by-clause, a high level assessment was considered to be appropriate. This is provided in Appendix A.

CSA Z731: Table C-1 of the ISR Basis Document [1] calls for confirming the validity of the previous assessment of CSA Z731 [35]. However, CSA N1600 is a new standard specific to nuclear emergency management, which is assessed in this ISR (A-1). As such, an assessment of CSA Z731 is not required.

3.5. International Standards

The international standards listed in Table 4 are relevant to this Safety Factor and were considered for this review.

Table 4: International Standards

Document Number	Document Title	Reference	Type of Review
IAEA SSG-25	Periodic Safety Review For Nuclear Power Plants	[3]	NR
Assessment type: Clause-by-Clause (CBC); Code-to-Code (CTC); High Level (HL); No Assessment Required (NR); Confirm Validity of Previous Assessments (CV)			

IAEA SSG-25: IAEA SSG-25 [3] addresses the periodic safety review of nuclear power plants and is the governing document for the review of the ISR, as identified in the Bruce A ISR Basis Document [1]. It defines the review tasks that should be considered for this Safety Factor. However, no assessment is performed specifically on IAEA SSG-25.

3.6. Other Applicable Codes and Standards

The codes and standards discussed in the previous sub-sections have been determined to be sufficient for the completion of the review tasks of this Safety Factor. Accordingly, additional codes and standards are not considered in this Safety Factor Report.

4. Overview of Applicable Bruce A Station Programs and Processes

This section provides a brief overview of the key Bruce Power programs, procedures and practices related to this Safety Factor.

Emergency planning is addressed at the highest level (Level 0) of the hierarchy in the Management System Manual BP-MSM-1 [37]. BP-MSM-1 includes Bruce Power Policy Statements for a number of different programs, including Emergency Management. The policy for Emergency Management states:

> “Bruce Power shall ensure adequate planning and preparation is in place to deal with any emergency situations that could endanger the safety of site staff, impact on the protection of the environment, and/or impact on the safety of members of the public.
>
> Bruce Power shall manage emergencies using an “all hazards” approach, encompassing mitigation, preparedness, response and recovery.”

Bruce Power’s BP-PROG-08.01 Emergency Measures Program (Level 1) [38] defines the overall business need, constituent elements, functional requirements, implementing approaches and key responsibilities associated with the emergency management process. The objective of emergency measures is to develop and implement plans/procedures that mitigate or lessen the consequences of events that pose a hazard deemed unacceptable to staff, the public, the environment and/or the continuity of Bruce Power's business.

The Emergency Measures Program includes:

- Identification and classification of emergencies;
- Development of emergency plans for all classifications identified;
- Establishment of an emergency response organization;
- Establishment of emergency facilities, equipment and resources;
- Development of personnel protection procedures to control radiation exposures;
- Establishment of a public information process; and
- Audits and drills to evaluate the effectiveness of the program.

The Emergency Measures Program is implemented through six (6) Level 2 plans and one Level 2 procedure. The six Level 2 plans are:

- Bruce Power Nuclear Emergency Response Plan (BP-PLAN-00001) [17];
- Winter Storm Transportation Plan (BP-PLAN-00002) [39];
- Bruce Power Electricity Emergency Plan (BP-PLAN-00003) [40];
- Business Continuity Management (BP-PLAN-00004) [41];
- Radioactive Materials Transportation Emergency Response Plan (BP-PLAN-00005) [42]; and
- Conventional Emergency Management (BP-PLAN-00006) [43].

The Level 2 procedure is:

- Emergency Management Programs Assessment [44].

In addition, the Level 3 Emergency Preparedness Drill and Exercises procedure (BP-PROC-00010) [45] describes the procedures for assessing emergency readiness.

The primary aim of the Bruce Power Nuclear Emergency Response Plan [17] is to describe the concepts, structures, roles and processes needed to implement and maintain Bruce Power's radiological emergency response capability. The Nuclear Emergency Response Plan (NERP) applies to all facilities within the Bruce Power Site. It was developed to support response to design basis accidents that occur at Bruce A or Bruce B which endanger the safety of personnel in the incident station, personnel on-site, members of the public and the environment. The NERP predominantly deals with releases of radioactive materials from fixed facilities. It takes into account the requirements in G-225, Emergency Planning at Class I Nuclear Facilities and Uranium Mines and Mills and supports the mandate of the Provincial Nuclear Emergency Response Plan (PNERP) to safeguard the public and property. However, the infrastructures that are defined within this plan can be used to support the planning and response to all emergencies at the Bruce Power site.

For those events where accident consequences indicate that the design basis response has not been effective, the Bruce Power Nuclear Emergency Response Plan activates BP-PROC-00659 [46], Severe Accident Management (SAM). This procedure interfaces with BP-PLAN-00001 in order to utilize the structures and processes contained therein.

The Nuclear Emergency Response Plan describes:

- The basis for emergency planning;
- The stages of the response to an emergency and the major activities performed during each stage;
- Mutual aid agreements;
- Facilities and equipment;
- Public education;
- Preparedness, maintenance and administration;
- Program assessment; and
- Personnel training and qualifications.

The Nuclear Emergency Response Plan also represents a basis for controlling changes and modifications to the Bruce Power emergency preparedness capability. This plan identifies the Shift Crew emergency staffing requirements associated with conduct of plant operations identified in BP-PROG-12.01 Conduct of Plant Operations [26]. Appendix B of the Nuclear Emergency Response Plan identifies station specific documents that either implement or support the emergency plan.

The Bruce Power Nuclear Emergency Response Plan is submitted to and accepted by the CNSC. It is also referenced in PROL issued by the CNSC [15]. This Plan has also been discussed with, agreed to, and rehearsed with the local authorities.

The list of Bruce Power policies, programs and key implementing procedures that are relevant to emergency planning is provided in Table 5.[3]

[3] Table 5 lists the key governance documents used to support the assessments of the review tasks for this Safety Factor Report. There is a continual process to update the governance documents; document versions may differ amongst individual Safety Factor Reports depending on the actual assessment review date. A full set of current sub-tier documents is provided within each current PROG document.

Table 5: Key Implementing Documents

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
BP-MSM-1: Management System Manual [37]	BP-PROG-08.01: Emergency Measures Program [38]	BP-PLAN-00001: Bruce Power Nuclear Emergency response Plan [17]	BP-PROC-00010: Emergency Management Drills and Exercises [45]
			BP-PROC-00011: Emergency Response Organization, Staffing and Availability [47]
			BP-PROC-00845: Emergency Dose Projection Process [48]
			BP-PROC-00846: Emergency Off-site Radiological Monitoring Process for Airborne Releases of Radioactive Materials [49]
			BP-ERP-XXXXX: Bruce Power Emergency Response Procedures (various)
		BP-PROC-00659: Severe Accident Management [46]	
		BP-PROC-00317: Crisis Management [50]	

First Tier Documents	Second Tier Documents	Third Tier Documents	Fourth Tier Documents
		SEC-EPP-00007: Emergency Management Programs Assessment [44]	
	BP-PROG-01.07: Corrective Action [51]	BP-PROC-00059: Event Response and Reporting [52]	
	BP-PROG-09.02: Stakeholder Interaction [53]	BP-PROC-00402: Duty Media Officer [54]	
	BP-PROG-12.01: Conduct of Plant Operations [55]	DIV-OPA-00001: Station Shift Complement – Bruce A [56]	TQD-00005: Emergency Response Organization Training and Qualification Description [57]
	BP-PROG-08.02: Nuclear Security [58]		

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 addressed in this section have not changed from those identified in Section 1.2.

5.1. Overall Review of Emergency Planning

This task requires an overall review be performed to check that emergency planning at the plant continues to be satisfactory and to check that emergency plans are maintained in accordance with current safety analyses, accident mitigation studies and good practices.

Bruce Power's Nuclear Emergency Response Plan, BP-PLAN-00001 [17] is referenced in the Licence Conditions Handbook [16] and is subject to document version control such that changes to Bruce Power's Nuclear Emergency Plan require notification to the Commission, or a person authorized by the Commission, prior to implementation.

Bruce Power's Nuclear Emergency Plan [17] and the supporting site-specific procedures listed in Appendix A to the Nuclear Emergency Plan include:

a) On-going review of corporate risks (conducted a minimum of every five years) to determine planning requirements;

b) A planning basis that, in addition to Design Basis Accidents (DBAs), takes into account requirements to support a sustained response to a Beyond Design Basis multi-unit event resulting in an extended loss of off-site power for up to 72 hours without assistance;

c) The designation of persons for directing on-site activities and for ensuring liaison with off-site organizations;

d) The conditions under which an emergency shall be declared, a list of job titles and/or functions of persons empowered to declare it, and a description of suitable means for alerting response personnel and public authorities;

e) The arrangements for initial and subsequent assessment of the radiological conditions on and off the site;

f) Provisions for minimizing the exposure of persons to ionizing radiation and for ensuring medical treatment of casualties;

g) Assessment of the state of the installation and the actions to be taken on the site to limit the extent of radioactive release;

h) The chain of command and communication, including a description of related facilities and procedures;

i) An inventory of the emergency equipment to be kept in readiness at specified locations;

j) The actions to be taken by persons and organizations involved in the implementation of the plan; and

k) Provisions for declaring the termination of an emergency.

The overall review of emergency planning included clause-by-clause reviews with the requirements and guidance in CNSC REGDOC-2.10.1 [29] and CNSC REGDOC-2.3.2 [25] documented in Appendix B, a high level review against CSA N1600 [34] documented in Appendix B, and reviews of audits, reviews, evaluations, self-assessments and performance indicators documented in Section 7.

The assessment of Bruce Power's program for emergency planning against the codes and standards includes consideration of not only whether there is direct or indirect compliances against a clause, but also whether any non-compliance represents an acceptable deviation with the clause. Assessed against the codes and standards of Appendix A and Appendix B, Bruce Power's overall program for emergency planning continues to be satisfactory. Details of the assessments are provided in Table B1, Table B2 and Table A1, and the gaps are summarized as follows:

CNSC REGDOC-2.10.1 [29]:

- SAMG implementation to extend the planning basis to cater to a wider range of multi-unit severe accidents is not yet in place (clause 2.1),
- real-time off-site fixed radiological detection and monitoring equipment has been installed but processes have not yet been updated (clause 2.2.3),
- There is no mention of a requirement to provide recommendations to off-site authorities on required protective actions in the Bruce Power Nuclear Emergency Response Plan (BPNERP) (clause 2.2.4),
- Security arrangements to prevent nuisance factors from interfering with emergency response are not addressed in the BPNERP (clause 2.2.6),
- Pre-distribution of iodine thyroid-blocking (ITB) agents to the public is not currently a requirement of either Bruce governance or the BPNERP (clause 2.3.4).

CNSC REGDOC-2.3.2 [25]:

- Fukushima Action Items remain open per NK21-CORR-00531-11379 (e.g., protection of containment integrity, shield tank overpressure protection) (clause 3.3),
- Confirmation of the adequacy of equipment and instrumentation for SAMG is not yet complete (clauses 3.3, 3.4),
- There is no direct measurement of combustible gas concentration during severe accidents (clauses 3.3, 3.4),
- Guidance for multi-unit severe core damage events is not yet in place (clauses 3.4, 3.5),
- Plant habitability assessments to support SAMG implementation are not yet completed (section 3.5)
- Increased expectations for an Integrated Accident Management Program need to be addressed. This includes: targeted stress tests; effectiveness of the most suitable or preferable measures for each reactor damage state assessed and documentation in detail; use of PRA to verify SAMG effectiveness, specification of time periods, and scenarios for training and drills; and control of contaminated run-off water to the environment (guidance clauses in Section 4).

CSA N1600 [34]:

- There are a number of detailed additional requirements in CSA N1600 that would need to be addressed for the implementation of the current version of the standard. The more significant of these include: an evaluation of losing critical functions which might impact the ability to respond and recover from an emergency (clause 4.2.3); processes for deviating from emergency response plans or recovery plans (clauses 4.5.2, 4.5.12, 5.4); and detailed requirements for nuclear emergency recovery plans (clause 4.6.1).

With respect to implementation, while the most recent audit [59] points to some deficiencies and discrepancies between the overall plan and the implementing documents, these are not considered significant to invalidate the conclusion that emergency planning implementation also continues to be satisfactory overall. These findings (See Section 7.2 and SF13-1 in Table 8) include:

- There are non-adherences to some Nuclear Emergency Response procedures and forms in the areas of public information, performance measurement, staff selection, facility equipment maintenance, record retention and information management.
- Some Nuclear Emergency Response Plan documents have errors, inconsistencies, and omissions.
- Training for Emergency Plan personnel assigned to the Emergency Management Centre (EMC) does not adhere to the requirements of BP-PROG-02.02 R012, "Worker Learning and Qualification" for Systematic Approach to Training (SAT).
- Agreements with some external agencies have not been maintained.

Note that the finding on staff selection from the most recent audit [59] is similar to the findings of lack of BEST qualification from the self-assessment on out of station ERO complement, SA-TRGD-2011-09 [60] (See Section 7.1, and SF13-1 in Table 8).

CNSC Type II Inspections of the Fall 2013 emergency exercise [61] also identified various issues for Bruce Power follow-up relating to the validation process for EME guidance, and execution of key operator actions during emergency exercises (See Section 7.3, and SF13-1 in Table 8).

On-going reviews of emergency planning, including Fukushima Action Item follow-up studies [62], Huron Challenge Series follow-up [63], and review of the licensing basis for minimum shift complement [64], have resulted in a number of changes to emergency planning and supporting processes:

- Implementation of an “Incident Management System” organization structure to emergency response, including role re-alignment.
- A new Emergency Management Centre (EMC) including the installation of a back-up power supply to ensure the EMC is capable of providing continuous AC power to critical building loads and equipment for at least 72 hours after a Beyond Design Basis Accident.
- Communications upgrades both at the new EMC and the Central Maintenance and Laundry Facility (CMLF).
- Confirmation that the minimum shift complement is adequate for the emergency plans’ planning basis.
- Confirmation that an all-hazards approach is adequate to respond to some beyond design basis accidents.
- Implementation of EMEGs. Ongoing updates of SAMG.

5.2. Consideration of Significant Changes at Site

For this review task, it will be verified if the operating organization has given adequate consideration to significant changes at the site of the nuclear power plant and in its use, organizational changes at the plant, changes in the maintenance and storage of emergency equipment and developments around the site that could influence emergency planning.

There have been no significant changes at the site such that consideration was required for changes to the emergency planning. However, the planning basis and the implementing procedures for the nuclear emergency plan are reviewed as a result of on-going review of corporate risks and as driven by other processes (e.g., Operating Experience (OPEX), Auditing requirements, Exercises and Drills, CNSC Fukushima Action Items [62], business needs etc.). In addition, S-99[4] [65] requires the licensee to perform and report on an annual review of the licensee's off-site emergency procedures for the nuclear power plant and the licensee's arrangements with off-site authorities involved in emergency preparedness.

It is concluded that adequate consideration has been given regarding impact of changes on emergency planning. No changes at site have driven consideration of changes to emergency planning. Bruce Power meets the requirements of this review task.

5.3. Additional Evaluations and Examinations

5.3.1. Adequacy of On-Site Equipment and Facilities for Emergencies

The emergency response plan maintenance requirements are defined in Section 4.1.3 of the Bruce Power Nuclear Emergency Response Plan [17]. These include a variety of review and assessment mechanisms as further defined by implementing procedures, including maintenance and testing of equipment and facilities [66], drills and exercise [67], administrative requirements management, and program assessment [44] (which includes quality assurance assessments, self-assessments, and independent assessments). These processes, in conjunction with other reviews described in Section 5.2, provide regular reviews of the adequacy of and need for changes to on-site equipment and facilities. For example, Fukushima Action Item completion activities [62] have resulted in emergency mitigating equipment being implemented in response to potential multi-unit station loss of power events and site boundary real time radiation detection instrumentation.

While adequate processes exist to ensure the adequacy of equipment and facilities for emergencies, the latest audit, AU-2014-00005 [59] Adverse Finding No. 1 points to procedural non-adherences that result in a number of equipment deficiencies (e.g., lack of a brochure on what to do in the event of an emergency, emergency area assembly area cabinet equipment missing, defective or expired, out of date or uncontrolled documents at emergency plan facilities). Nonetheless, the audit concluded that facilities and equipment are being maintained on a routine basis.

[4]Reporting is performed under S-99 up to the end of 2014, and under CNSC REGDOC-3.1.1 for periods thereafter.

5.3.2. Adequacy of On-Site Technical and Operational Support Centres

The on-site technical and operations support centres, i.e., the Main Control room, and the Emergency Operations Centre, are equipped with the necessary communications and other equipment as described in Section 4.1.2.2 of the Bruce Power Nuclear Emergency Response Plan [17]. The emergency response plan maintenance requirements are defined in Section 4.1.3 of the Bruce Power Nuclear Emergency Response Plan [17]. These include a variety of review and assessment mechanisms as further defined by implementing procedures, including maintenance and testing of equipment and facilities [66] which include the Emergency Operations Centre (EOC), drills and exercise [67], administrative requirements management, and program assessment [44] (which includes quality assurance assessments, self-assessments, and independent assessments). These provide assurance of the process for ensuring the adequacy of these on-site centres. As indicated in Section 5.3.1, facilities and equipment are being maintained on a routine basis [59].

Note that Bruce Power has recently consolidated the Site Management centre and the Corporate Emergency Support Centre into an Emergency Management Centre located at the Bruce Power Visitor's Centre in order to improve arrangements, including supporting a new proposed Incident Management System, and making ensuing changes to the emergency plan and procedures [63]. Procedures have been issued to cover the EMC positions, and drills have been performed to test the capabilities of EMC equipment and staff. However, the resulting required training to EMC staff has not yet been fully implemented [59].

Thus it is concluded that the on-site technical and operational support centre are adequate.

5.3.3. Efficiency of Communications in the Event of an Emergency

As described in section 4.1.2.2 of the Bruce Power Nuclear Emergency Response Plan [17], multiple means of communications are available to the emergency response organization responders in responding to an emergency within the site:

- Station Private Branch Exchange (PBX) is the primary telephone system. Bruce A and Bruce B have a back-up PBX or sufficient external trunk lines are provided in the main emergency response facilities to provide adequate back-up communications capability.
- Cellular phones are available and Satellite phones installed at each Unit 0 Main Control Room are used as back-up in the event of a phone outage. Fax machines equipped with station PBX and trunk lines are available.
- Both Bruce A and Bruce B have an emergency radio communications system with three dedicated frequencies. On-site and off-site field teams are equipped with portable radios. Base radio stations are available at a number of on-site locations such as the Main Control Room (MCR) and the Emergency Operations Centre (EOC). Off-site field team vehicles are equipped with mobile radio systems and back-up portables.
- A small fleet of deployable radio repeaters is also available for emergency deployment to augment degraded or overwhelmed radio channels outside the stations.

As a result of Fukushima Action Item completion [62], communications upgrades have been completed, including a radio communications infrastructure and satellite phone capability both at the new EMC and the CMLF. Further enhancements included the installation of a VSAT (Very Small Aperture Terminal) system at the EMC to provide multiple backup phone hubs and internet connectivity. These upgrades address connectivity issues between the EMC and station EOC as well as external agencies.

On-site staff are marshalled by the station emergency tone, and various communications technologies and fan-out notifications for ERO augmentation and off-site emergency notifications (section 4.2.2.5 of BP-PLAN-00001 [17]). Table 2 of the Bruce Power Nuclear Emergency Response Plan [17] provides the communication interfaces for the ERO. The Emergency Management Centre provides the ongoing operation interface with external agencies and authorities (e.g., the Provincial Emergency Operations Centre (PEOC) and the CNSC's Headquarters Emergency Operations Centre (HQEOC).

On-going emergency drills and exercises test the efficiency and effectiveness of communication links.

Audit results from AU-2014-0005 [59] identify the need for improvements in the effectiveness of public information in the event of an emergency. However, these are not identified as gaps for the purpose of this assessment.

Thus, it is concluded that that the review task of efficiency in communications in the event of an emergency is adequate.

5.3.4. Content and Effectiveness of Emergency Training and Exercises

Emergency Response Organization Training and Qualification Description, TQD-00005 [57], establishes the requirements for the training and qualification of individuals assigned to specific emergency response positions as defined in BP-PLAN-00001 [17], following a systematic approach to training methodology. Emergency Preparedness Drill and Exercises, B-PROC-00010 [45], provides a comprehensive list of drill and exercise objectives and provides for a schedule for conducting drills and exercises that all of the objectives are tested within a set period of time. The schedule is reviewed at least quarterly. The CNSC is included on the distribution list.

The Bruce Power programs in this area provide the basis for ensuring this review task is met. However, a CNSC Action Notice from a Type II inspection performed during the fall 2013 exercise [68] indicated required improvements in ensuring key operator actions are identified and executed during emergency exercises.

Thus, it is concluded that there is a gap in the content and effectiveness of emergency training and exercises, which is identified as SF13-1 in Section 8.

5.3.5. Arrangements for Regular Review and Updating of Emergency Plans and Procedures

The emergency response plan maintenance requirements are defined in Section 4.1.3 of the Bruce Power Nuclear Emergency Response Plan [17]. These include a variety of review and assessment mechanisms as further defined by implementing procedures, including drills and exercises [67], administrative requirements management, and program assessment [44] (which includes quality assurance assessments, self-assessments, and independent assessments). These processes, in conjunction with planning basis review processes, OPEX, and external jurisdiction reviews described in Section 5.1 provide regular reviews of the adequacy and need for updating of emergency plans and procedures. Also, per BP-PROC-00166 [69], all controlled documents are flagged for periodic reviews through Action Requests.

However, upon review of CNSC REGDOC-2.3.2 (Appendix B.2) it was noted that the completion and/or resolution of the following items remain outstanding:

- Fukushima Action Items, which are progressing in accordance to the CNSC accepted schedule, (SF13-2 of Table 8); and
- Addressing increased expectations for an integrated accident management program (SF13-3 of Table 8).

As noted in the review of CSA N1600 documented in Appendix A.1, there are a number of detailed additional requirements in CSA N1600 that would need to be addressed for the implementation of the current version of the standard these have been captured as (SF13-4 of Table 8).

Thus, it is concluded that while the Bruce Power program and procedures meet the requirements of this review task, there is a gap in implementation.

5.3.6. Changes in Maintenance and Storage of Emergency Equipment

The only significant change in maintenance and storage of emergency equipment since the 2008 Bruce 3 and 4 ISR [10] relates to the use of portable emergency diesel generators that is provided by Emergency and Protective Services (EPS) for energizing Unit 0 Qualified Power Supply Loads in the event of loss of Class IV and Class III power [70] [71]. The emergency diesel generators are stored outside the protected area in a heated location and are under the ownership of the EPS organization. Standard Operating Guidelines have been created to provide direction on how to clear a designated path, and retrieve and set up the equipment. However, this did not require a change to the Nuclear Emergency Response Plan [17].

5.3.7. Effects of any Recent Residential and Industrial Developments Around the Site

There has been no recent significant residential and industrial development around the site.

6. Interfaces with Other Safety Factors

There is some degree of interrelationship among most of the 15 Safety Factors that comprise the Bruce A ISR. 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 5.8, addresses design provisions to facilitate accident management.
- “Safety Factor 5: Deterministic Safety Analysis” in Section 5.7, addresses the review of the existing Deterministic Safety Analysis for design basis accidents and beyond design basis accidents used in support of the emergency procedures and technical basis for Severe Accident Management Guidance.
- “Safety Factor 9: External OPEX and R&D” in Section 5.3.3.1, exemplifies the ongoing review of the scope of Bruce Power’s accident management approach and provisions in light of external OPEX.
- “Safety Factor 10: Organization and Administration” in Section 5.4.5, addresses effectiveness of the station condition record (SCR) process in resolving adverse conditions.

For the purposes of this assessment, the following scopes have been assumed for Safety Factors 13, 14 and 15:

- “Safety Factor 13 (this report): Emergency Planning” has been interpreted to include the preparations made for the protection of people and the environment from the adverse effects of exposure to ionizing radiation during abnormal operations;
- “Safety Factor 14: Radiological Impact on the Environment” has been interpreted to include the protection of people and the environment outside the Protected Area of the station from the adverse effects of exposure to ionizing radiation during normal operations which includes anticipated operational occurrences; and
- “Safety Factor 15: Radiation Protection” has been interpreted to include the protection of people inside the Protected Area of the station from the adverse effects of exposure to ionizing radiation during normal operations which includes anticipated operational occurrences (there are no natural areas of any significance inside the Protected Area of the station).

7. Program Assessments and Adequacy of Implementation

Section 7 supplements the assessments of the review tasks in Section 5, 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 provide a cross section, intended to 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 the assessment are compared with business needs, the Bruce Power management system, industry standards of excellence and regulatory/statutory or other legal requirements.

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.

Between 2011 and 2014, two Self-Assessments relevant to emergency planning were performed.

1) SA-TRDG-2012-06 "ERO Training Program" [72]

   In response to Action Notice #1 of TPED-BNGSAB-2009-T16678-T1, the training for six Emergency Response Organization "preparedness" groups (Duty Areas), consisting of 35 qualifications in total, was investigated:

   - Emergency Response Organization - Corporate Emergency Support Centre (CESC – 5 Qualifications)
   - Emergency Response Organization - Site Management Centre (SMC – 9 Qualifications)
   - Emergency Response Organization - Emergency Operations Centre (EOC – 7 Qualifications)
   - Emergency Response Organization - TEAM (8 Qualifications)
   - Emergency Response Organization - OTHER (5 Qualifications)
   - Emergency Response Organization - Transportation Emergency Response Plan (1 Qualification)

   Strengths were identified in that this training program has been analyzed, designed, developed and implemented to comply with the Bruce Power training standards and the requirements of the Systematic Approach to Training (SAT). Review of current supporting documentation indicates that the training program has a sound reference base and that training support materials have been recorded properly. No adverse conditions were identified.

   No gaps are identified from this self assessment.

2) SA-TRGD-2011-09 "Out of station ERO Complement Quals" [60]

   The objective of this self-assessment was to review the process to maintain minimum complement qualifications for the Bruce Emergency Services Team (BEST[5]) organization per DIV-OPA-00001 and DIV-OPB-00001. Results indicated that minimum qualification requirements are not understood, and therefore not checked to ensure BEST assigned minimum complement positions are fully qualified. Without this information, BEST members are being placed into minimum complement positions for which they are not fully qualified. The following issues were identified:

   - People are being assigned minimum complement positions for which they are not fully qualified.
   - BEST are calling BEST members to work overtime to replace someone who has been assigned a specific ERO minimum complement position without checking to see if the person they are calling actually has the qualification needed.

[5] "BEST" terminology is no longer used. Current reference in documentation is now either to Emergency and Protective Services (EPS) or to the Emergency Response Team (ERT), as appropriate.

- BEST are hiring (nuclear emergency response plan) Appendix A employees and assigned to minimum complement before they are qualified ESM1's (Emergency Services Maintainer 1).

This self-assessment was performed in 2011 on an organizational structure that is no longer in place. While the findings may not be directly relevant, when combined with audit findings from AU-2014-00005 (See Section 7.2), represent a recurring problem with staff selection for the ERO organization (See Section 5.1 and SF13-1 in Table 8).

3) Drills and Exercises

Note that the Bruce Power Nuclear Emergency Plan also considers the Drill and Exercise program a form of self-assessment, as the drill and exercise program will provide a list of findings for which the Emergency Management Department may initiate a causal factor evaluation as appropriate and initiate corrective actions.

Table 6 and Table 7 provide a summary of drill and exercises performed during the period 2010 to end of 2013.

Table 6: Summary of Emergency Drills

Date	Location of Drill	Findings
11Feb2010	Bruce A Simulator	None
17Feb2010	Bruce A	None
25Feb2010	Bruce A Simulator	None
14Jul2010	Bruce (Off-Site Warning Siren Full Volume Test)	None
29Sep2010	Kincardine (Off Site Centres)	None
10Nov2010	Bruce A	• ERO drill not suspended / terminated for medical emergency • Mutual Assist Response Team (MART) staffing and response problems • Unavailability of the required number of Assembly Area drill evaluators
17Feb2011	Bruce A Simulator	• In Plant Coordinator position not filled for drill • Emergency Shift Assistant (ESA) put in wrong ERO pager code

Date	Location of Drill	Findings
14Apr2011	Bruce A Simulator	None
29Jun2011	Bruce A	• Lack of Assembly Area Supervisor • Lack of the required Assembly area Drill Evaluators
14Sep2011	Bruce A	• Lack of the required Assembly Area Drill Evaluators
04Jan2012	Bruce A Simulator	None
11Jan2012	Bruce A Simulator	None
25Jan2012	Bruce A Simulator	None
14NOV2012	Bruce A	None
28NOV2012	Bruce A	• Lack of Radiation Instruments in Fuel Handling Maintenance Office Assembly Area
18SEP2013	Bruce A Simulator	None
08OCT2013	Bruce A Simulator	None
23OCT2013	Station Drill	None
06NOV2013	Station Drill	• Bruce A/Bruce B MART discrepancies

Table 7: Summary of Emergency Exercises

Date	Location of Exercise	Findings
16Nov2010	Bruce A	• Station Emergency Response delayed by REP selection
28Sep2011	Bruce A	• Lack of the required Assembly Area Drill Evaluators.
16-17OCT2013	Bruce A	None

No significant issues or trends are evident from the drill and exercise results.

7.2. Internal and External Audits and Reviews

The objective of the audit process as stated in BP-PROG-15.01 [73] 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 [20]).

7.2.1. Internal Audits

This section contains information arising from audits related to this Safety Factor. Internal audits are conducted by the Bruce Power Corporate Oversight and Audit Department. External audits are conducted as deemed appropriate by management by independent organizations (excluding regulators) from outside of Bruce Power.

The Bruce Power Nuclear Emergency Response Plan [17] Section 4.1.3.6 has the following requirement:

> "Bruce Power's NERP is audited by Bruce Power's internal audit organization over a period of three (3) years. The audit program will address the plan, preparedness, and response implementing procedures, equipment, facilities, training, personnel selection, and qualification. Reports of the ongoing audit program and special audits are directed to the owners of the Policy and Program responsible for the implementation of the NERP. Audit findings will be subject to root cause evaluations as appropriate, corrective actions will be identified, and, a schedule for corrective action will be developed. Important corrective actions will be tracked in the Corrective Action system."

During the period of 2009-2014, the following audits relating to emergency planning were performed:

1) AU-2014-00005 "Nuclear Emergency Response Plan" [59]

   The audit reviewed activities prescribed by BP-PLAN-00001 for the period from June 2011 to May 2014. A sample of the Plan's implementing procedures, drill reports, records, and training documentation were reviewed. Field observations of assembly areas, various emergency facilities on-site and in the local region, and one drill were performed.

   The overall conclusion of the audit was that the Bruce Power Nuclear Emergency Response Plan (NERP) was complete however it has not been fully implemented and it is not being fully complied with. The requirements of CNSC Regulatory Guide G-225 - "Emergency Planning at Class 1 Nuclear Facilities and Uranium Mines and Mills" [30] were met by performing the activities associated with BP-PLAN-00001 R004 and its implementing documents. There were four Adverse Conditions and one Opportunity for Improvement (OFI) as listed below (See Section 5.1 and SF13-1 in Table 8), each of which had a separate action request (AR) raised:

- There are non-adherences to some Nuclear Emergency Response procedures and forms in the areas of public information (no measurement of effectiveness, lack of a brochure in what to do in the event of an emergency, including evacuation routes), ad-hoc method for staff selection, facility and equipment maintenance, record retention and information management.
- Some Nuclear Emergency Response Plan documents have errors, inconsistencies, and omissions.
- Training for Emergency Plan personnel assigned to the Emergency Management Centre (EMC) does not adhere to the requirements of BP-PROG-02.02 R012, "Worker Learning and Qualification" for Systematic Approach to Training (SAT).
- Agreements with some external agencies have not been maintained.
- OFI - Some information on the Bruce Power intranet for the Emergency Response Organization is not being maintained or is inaccurate.

The audit also performed a performance improvement review, and noted the following:

OPEX

There is evidence that Bruce Power is seeking and sharing OPEX through the Fukushima Forums that were held in November 2011, October 2012 and September 2013. Bruce Power sent representatives to all 3 of these forums to participate.

SCRs from Previous Audits

There were six SCRs from surveillance AU-2011-00006 "Nuclear Emergency Plan" [74]that were reviewed for completion during audit AU-2013-00004 "Emergency Measures Program" [75]. This review determined that five of six SCRs were not effective at resolving the adverse conditions identified in the surveillance report. As a result SCR 28395294 "Corrective Action Process not Always Effectively Used" was initiated. The latest audit [59] also found that 5 of the 6 SCRs raised in the 2011 surveillance [74] were not effective in resolving the adverse conditions identified therein. Since SCR effectiveness is not addressed until the next audit cycle, 3 years later and repeat findings exist, and Focus Area Self-Assessment (FASAs) have not recently been performed in this area, this issue is assessed as gap (SF13-1).

Two other SCRs were initiated following AU-2013-00004. Previously those SCRs would receive a completion assurance review as scheduled by the corrective action process. The audit process has changed such that SCRs will only receive a completion assurance review during the next audit. Therefore the SCRs from this audit and AU-2013-00004 will be reviewed during the next Nuclear Emergency Response Plan audit in 2017.

Focus Area Self Assessments (FASAs)

The audit noted that no FASAs have been completed since AU-2013-00004.

2) AU-2013-00004 “Emergency Measures” [75]

The objective of this audit was to evaluate the completeness and implementation of BP-PROG-08.01 Emergency Measures Program [38], the parent program for the Bruce Power Nuclear Emergency Response Plan [17], and to evaluate the completeness of the Incident Management System and Emergency Management Centre Implementation Plan. The evaluation included the program document, all program implementing procedures and a sampling of lower tier procedures. The scope for the implementation plan review included the MS Project Incident Management System (IMS) and Emergency Management Centre (EMC) Implementation Plan (dated 17 June 2013).

The audit concluded [75] that BP-PROG-08.01 Emergency Measures Program and its implementing procedures were found not complete and not fully implemented. Specifically, the audit resulted in the following three adverse conditions and three opportunities for improvement, each of which had a separate SCR raised:

- BP-PROG-08.01, Emergency Measures Program [38] was not effectively managed to ensure that the program document is fully compliant with Bruce Power program requirements**.** This may increase the risk of not being able to demonstrate full compliance with the relevant requirements. CSA N286-05, Management System Requirements for Nuclear Power Plants section 5.1 requires that the business is defined, planned and controlled.
- The corrective action process has not always been effectively used by the Emergency Measure Functional Area to analyze and correct identified issues. This has resulted in rework and adverse conditions that are allowed to continue with the increased risk they present. This is a repeat condition.
- The implementing procedures for BP-PROG-08.01 Emergency Measures Program do not always meet prescribed document management requirements. This may increase the likelihood of human error and inconsistent results.
- OFI - Align Emergency Measure Processes with BP-PROC-00166 R023 [69].
- OFI - External Auditor Recommendations for IMS/EMC.
- OFI - Conduct a Focused Area Self-Assessment on Severe Accident Guidelines.

3) AU-2011-00006 “Nuclear Emergency Plan” [74]

This audit is considered superseded by the more recently performed AU-2014-00005 [59]. An audit of the Nuclear Emergency Response Plan is required to be conducted every 3 years, and the scope of the audit is the same, such that any significant repeat findings will have been captured in the later audit. In addition, this audit reflects an outdated emergency response organization.

4) AU-2010-00029 "Reporting of S-99 Emergency and Fire Events" [76]

   This audit was performed to address a concern that identification and reporting of declaration of emergency and fires may not be consistent with S-99. From the data reviewed, it was concluded that, reporting of events to the CNSC under S-99 Sections 6.3.1(36), declaration of an emergency, is consistent with the S-99 reporting requirements.

7.2.2. External Audits and Reviews

The Bruce Power Nuclear Emergency Response Plan [17] Section 4.1.3.6 has the following requirement for independent assessment:

> "Bruce Power management can initiate an external, independent assessment of the Emergency Management Program at any time. Such an assessment will be initiated when performance indicates a need for it. Such action is also warranted if it is determined that it will be a necessary enhancement to the self-assessment process and the audit programs."

One external audit during the 2011-2014 period was conducted as described in AU-2013-00004 [75] which stated the following:

> "A review was conducted of the Bruce Power IMS/EMC Plans (printed 12 July 2013) and the Bruce Power response letter NK21-CORR-00531-10560 / NK29-CORR-00531-10963 / NK37- CORR-00531-02077 Bruce Power Progress Report No. 3 on CNSC Action Plan – Fukushima Action Items (17 July 2013) against the INFO-0828 CNSC Fukushima Task Force Recommendations (December 2011) to determine the completeness of the plan. The review was conducted by external subject matter experts (SMEs) from VC Summer Station (South Carolina) and AECL (Chalk River, Ontario) and concluded that the actions taken and the plans meet the intent of the CNSC taskforce recommendations. Actions from the Fukushima Action Items (FAI) are continuing to be worked and the deliverables requested by CNSC have been provided."

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 operators 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.

Emergency Management and Fire Protection is one of the elements reviewed by Canadian Nuclear Safety Commission staff during their annual assessment of the safety performance of the Canadian nuclear power industry. In their 2013 annual review [77], the CNSC provided a rating of “SA”, or satisfactory, for Bruce A. In particular, with respect to nuclear emergency preparedness and response, the CNSC report that they “conducted an inspection of the planned (sic) emergency exercise at Bruce A and B in 2013. The inspection team concluded that overall, Bruce Power demonstrated its readiness to respond to a nuclear emergency.”

The CNSC performed a Type II Inspection of the Bruce Power Fall 2013 Emergency Exercise and communicated its findings to Bruce Power [61]. The inspection verified compliance by Bruce Power with regulatory requirements in the licence and with RD-353 [27]. In addition the criteria in BP-PLAN-00001, and related Bruce power procedures were used. The CNSC noted that the exercise that was held by Bruce Power was challenging in scope and fulfilled the stated objectives that the exercise was to cover, albeit the exercise was cut short and therefore players did not have a chance to complete all the tasks. The exercise also included some new response criteria such as dealing with loss of power and deployment of emergency mitigation equipment. The exercise also tested interfaces with the Emergency Management Centre (EMC) which Bruce Power plans to activate in the near future to replace the Site Management Centre located in B06. The CNSC also noted that the findings were mostly positive, with eight recommendations raised as a result of the exercise. Bruce Power’s responses to the recommendations are provided in [78] accepting the recommendations.

The CNSC also performed a Type II compliance inspection of Emergency Operating Procedures & Minimum Shift Complement Validation [68] during the same period as the Fall 2013 emergency exercise [61]. The following positive observations were made:

- There is a mechanism in place to ensure that the most recent version of an Abnormal Incidents Manual (AIM) procedure is used.
- Circumstances in which a procedural deviation is permitted are understood by certified staff and the associated station expectations are complied with.
- Certified staff was well trained on the execution of AIMs
- Field handouts were carried out as specified.
- The human performance tools were employed consistently by the field operators.
- Bruce Power used the exercise debriefs to identify procedural flaws, and demonstrated an initiative to incorporate this feedback in future procedure revisions.
- The exercise was as realistic as possible considering it was performed in a fully operational station.
- The controllers/evaluators were qualified.

There were some areas of concern which resulted in two action notices and six recommendations [68]. The action notices requested Bruce Power to:

- Review their process for validating the EME process, and ensure it is documented and auditable per station procedure for station operating procedure development and revision.
- Comply with BP-PLAN-00001 [17], to:
  - ensure key operator actions are performed within the time frame of the emergency exercise,
  - review the process for terminating an exercise (the CNSC viewed the exercise as being terminated early).
  - perform a more detailed analysis of the performance objectives to ensure key performance objectives are effectively maintained by the timely performance of operator actions.

Recommendations related to usability, availability, and timely training for ERO staff of the EME procedures.

Bruce Power's response accepting the action notices and responding to the recommendations were provided in Reference [79] (See Section 5.1 and SF13-1 in Table 8).

7.4. Performance Indicators

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

In accordance with S-99 [65], Bruce Power reports on three Performance indicators (PIs) related to Emergency Preparedness for radiological emergencies:

1. Radiological Emergencies Performance Index which provides an indication of the percentage of performance opportunities successfully demonstrated during drills, exercises or events for the past 8 quarters.
2. Emergency Response Organization (ERO) Drill Participation Index – which provides an indication of the participation rate of key ERO personnel in drills, exercises or events calculated for an 8-quarter rolling average.
3. Emergency Response Resources Completion Index which provides a measure of the completion rate of scheduled preventative maintenance.

Detailed definition of these indicators can be found in S-99 [65]. These indicators are at the Site level (i.e., both Bruce A and B) and reporting is done quarterly.

For the Radiological Emergencies Performance Index and the Emergency Response Organization (ERO) Drill Participation Index, Bruce Power has defined "Status Criteria" on whether the indicator results provide an indication of significant strength, satisfactory (performance), improvement needed, or significant weakness.

The quarterly performance indicator reports from 2010Q4 to 2014Q1 [80] were reviewed. Throughout this period, the Radiological Emergencies Performance Index was reported as a significant strength. The Emergency Response Resources Completion Index showed a 100% completion rate. The ERO Drill Participation Index fluctuates between "satisfactory" and "improvement needed", largely influenced by the exercise schedule. However, this index, post 2012Q4, is heavily influenced by the unusually high ERO participation rate for the 2012 Huron challenge exercise [63], which was a four day full exercise of a new Incident Management System (IMS) structure and a new Emergency Management Centre (EMC), amongst other changes. Taking this factor into account, performance for the past three quarters would show "improvement needed". ERO drill participation rate is thus identified as a gap (SF13-1).

In addition to the performance indicators monitored by Bruce Power, the CNSC produces an annual report on the safety performance of Canada's Nuclear Power Plants (NPPs). The report for 2013, "CNSC Staff Integrated Safety Assessment of Canadian Nuclear Power Plants for 2013", issued in September 2014 [77], summarizes the 2013 ratings for Canada's NPPs in each of the 14 CNSC Safety and Control Areas (SCA), including emergency management and fire protection, which covers emergency plans and emergency preparedness programs for dealing with radiological, nuclear and conventional emergencies. For 2013, the Bruce A rating for the emergency management and fire protection SCA was "satisfactory".

8. Summary and Conclusions

The overall objective of the Bruce A ISR is to conduct a review of Bruce A against modern codes and standards and international safety expectations and provide input to a practicable set of improvements to be conducted during the Major Component Replacement in Units 3 and 4, 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 whether the operating organization has adequate plans, staff, facilities and equipment for dealing with emergencies at the Bruce A plant and whether the operating organization's arrangements have been adequately coordinated with local and national systems and are regularly exercised. This specific objective has been met by the completion of the review tasks specific to emergency planning.

Table 8 summarizes the key issues arising from the Integrated Safety Review of Safety Factor 13.

Table 8: Key Issues

Issue Number	Gap Description	Source(s)
SF13-1	Improvements/revisions to the Emergency Measures Program, the BPNERP, and implementing documents are required, specifically: • ensuring audit findings and CNSC Action Notices are effectively addressed; • ERO Drill participation rate; • implementation of real-time off-site fixed radiological detection and monitoring; • ensuring security arrangements at off-site centres; • providing recommendations to off-site authorities; • Pre-distribution of Iodine Thyroid Blocking agents requires to be implemented (committed to CNSC by year end 2015).	Sections 5.1, 5.3.4, 7.1, 7.2.1, 7.3, 7.4 Micro-gaps against requirement clauses: REGDOC-2.10.1 – Clause 2.2.3 REGDOC-2.10.1 – Clause 2.2.4 REGDOC-2.10.1 – Clause 2.2.6 REGDOC-2.10.1 – Clause 2.3.4

Issue Number	Gap Description	Source(s)
SF13-2	Completion and/or resolution of Fukushima Action Items, which includes: • completion of SAMG updates to provide guidance for multi-unit severe accidents; • completion of required studies (e.g., instrumentation and equipment survivability, in-vessel retention, shield tank overpressure protection, plant habitability) in support of the first item in this list; • direct measurement combustible gas concentration or acceptable resolution of issue. (Note: resolution of FAIs is progressing according to a schedule acceptable to the CNSC).	Section 5.3.5 Micro-gaps against requirement clauses: REGDOC-2.10.1 – Clause 2.1 REGDOC-2.3.2 – Clause 3.3 REGDOC-2.3.2 – Clause 3.4 REGDOC-2.3.2 – Clause 3.5
SF13-3	Addressing the increased expectations for an integrated accident management program to comply with the expectation in CNSC REGDOC-2.3.2. This includes such issues as: • targeted stress tests; • effectiveness of the most suitable or preferable measures for each reactor damage state assessed and documentation in detail; • use of PRA to verify SAMG effectiveness, specification of time periods, and scenarios for training and drills; • control of contaminated run-off water to the environment.	Section 5.3.5 Micro-gaps against requirement clauses: REGDOC-2.3.2 – Clause 4.2 REGDOC-2.3.2 – Clause 4.3

Issue Number	Gap Description	Source(s)
SF13-4	Addressing the additional requirements in CSA N1600. There are a number of detailed additional requirements in CSA N1600 that would need to be addressed for the implementation of the current version of the standard. The more significant of these include: • an evaluation of losing critical functions, which might impact the ability to respond and recover from an emergency; • processes for deviating from emergency response plans or recovery plans; • detailed requirements for nuclear emergency recovery plans. Given that CSA N1600 is likely to be substantially revised in the short term, a phased approach should be considered for its detailed review for elements that need to be addressed by Bruce Power.	Section 5.3.5 Micro-gaps against requirement clauses: CSA N1600 – Clause 4.2.3 CSA N1600 – Clause 4.5.2 CSA N1600 – Clause 4.5.12 CSA N1600 – Clause 4.6.1 CSA N1600 – Clause 5.4

The overall conclusion is that, with the exceptions noted in Table 8, Bruce Power's programs meet the requirements of the Safety Factor related to Emergency Planning.

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

A.1. CSA N1600-14, General Requirements for Nuclear Emergency Management Programs

CSA N1600-14, 2014, "General requirements for nuclear emergency management programs" [34] is a new CSA Standard issued in May 2014. This Standard provides requirements for a comprehensive nuclear emergency management (EM) program embracing the EM components (prevention/mitigation, preparedness, response, and recovery) in keeping with international EM practice, with a predominant focus on preparedness, response, and recovery. It establishes the elements of a continuous improvement process to develop, implement, maintain, and evaluate the EM functions of nuclear facilities and their surrounding communities. A high level review of this standard against the requirements of the CNSC REGDOC-2.1.10 [29] and CNSC REGDOC-2.3.2 [25] was performed to first identify any additional/revised requirements on licensees, and then to make a high level assessment of the Bruce emergency management programs against CSA N1600. This is shown in Table A1 below. It should be noted that in general, CSA N1600 has much more specific requirements; however they remain largely aligned with the requirements in the CNSC REGDOCs as they apply to NPPs. In addition, it also contains extensive guidance. This has not been included in Table A1.

Additionally, the requirements in CSA N1600-14 are often applied to the "organization", which is defined as including, but not limited to, NPPs, all levels of government, first responders, and non-governmental organizations. Hence the application of CSA N1600 would require agreement amongst the various organizational entities as to the extent and scope that a specific requirement applies to whom. For example, the requirements on protective actions are more appropriate to the provincial ERO, but this is not specified in the standard. It is understood that this standard is to be revised.

Table A1: High Level Review of CSA N1600

CSA N1600 Clause	Nature of Additional or Revised Requirements with respect to CNSC REGDOC-2.10.1 and CNSC REGDOC-2.3.2	Significance to Bruce Power Nuclear Emergency Planning
4.1.3	CSA N1600 requires participation in inter-organizational emergency management coordinating committees. CNSC REGDOC-2.10.1 does not cover this area.	None. Plan is in place.

CSA N1600 Clause	Nature of Additional or Revised Requirements with respect to CNSC REGDOC-2.10.1 and CNSC REGDOC-2.3.2	Significance to Bruce Power Nuclear Emergency Planning
4.1.4	CSA N1600 requires alternative means, measures, procedures, processes, approaches, or technologies to be approved by the AHJ prior to implementation. CNSC REGDOC-2.10.1 requires that licensees seek CNSC approval for changes only if the (mandatory) validating analysis reduces ER effectiveness. It is expected that minor or administrative changes be reported to the CNSC.	None.
4.2.3	CSA N1600 requires an evaluation of losing critical functions which might impact the ability to respond and recover from an emergency with the goal being to ensure continuity of the critical functions (critical functions cover more than equipment). There is no equivalent requirement in CNSC REGDOC-2.10.1. The latter requires identification of essential emergency response equipment, and a description of how their operation and effectiveness in an emergency are assured. In addition, CNSC REGDOC-2.3.2 requires demonstration with reasonable assurance that equipment and instrumentation used in severe accident management will survive and perform their required function.	Additional requirement. This is considered a gap.
4.2.6	CSA N1600 requires a documented review of the planning basis every five years. CNSC REGDOC-2.3.2 requires periodic and continuous review, but does not specify a minimum frequency.	None.
4.3.1, 4.3.8, 4.5.10	CSA N1600 requires a communication needs analysis and processes for various internal and external groups. CNSC REGDOC-2.10.1 requires descriptions of communications, notifications, interface agreements, and coordination.	None. Indirect compliance.
4.4.1, 4.4.4	CSA N1600 requires the establishment of a planning cycle and NEMP review committee. No such specific requirement exists in the CNSC REGDOCs.	None.
4.4.5	CSA N1600 requires a records management process for the organizations NEMP. No such requirement is specified in CNSC REGDOC-2.10.1.	None.

CSA N1600 Clause	Nature of Additional or Revised Requirements with respect to CNSC REGDOC-2.10.1 and CNSC REGDOC-2.3.2	Significance to Bruce Power Nuclear Emergency Planning
4.5.2, 4.5.12	CSA N1600 requires that the emergency response plan includes a process for deviation from the plan and who can authorize this. No such requirement is specified in CNSC REGDOC-2.10.1.	Additional Requirement. The structure of the BP plan, accepted by the CNSC, allows for flexibility to define this. This is considered a gap against these clauses.
4.5.6.2, 4.5.6.4.3	CSA N1600 requires that the nuclear emergency response plan identify protective actions and injection control actions for the food chain as well as a process for rescinding such actions. Other than iodine thyroid blocking agents, no such requirement is specified in CNSC REGDOC-2.10.1.	Additional requirement. However, this appears to be provincial responsibility.
4.6.1	CSA N1600 has more detailed requirements for the development and content of nuclear emergency recovery plans in comparison to CNSC REGDOC-2.10.1.	Additional requirements. This is considered a gap.
4.10.8	CSA N1600 has detailed requirements for planning of exercise program evaluation in comparison to CNSC REGDOC-2.10.1.	None. Details are embedded in BP plan and implementing procedures.
5.4	CSA N1600 requires a process for deviating from a recovery plan, and who can authorize this. CNSC REGDOC-2.10.1 does not contain such requirements.	Additional requirement. This is considered a gap.

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 ISR Basis Document [1] 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 ISR 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 ISR Basis Document defines RNA as "the particular clause provides requirements that are less strenuous than clauses of another standard that has already been assessed". The definition has been broadened to include 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-2.10.1, Nuclear Emergency Preparedness and Response

In support of the review tasks listed in Section 5, a detailed assessment of REGDOC-2.10.1 has been performed in Table B1.

Table B1: CNSC REGDOC-2.10.1, Nuclear Emergency Preparedness and Response

Article No.	Clause Requirement	Assessment	Compliance Category
2	An effective EP program is based on the following four components: 1. Planning basis: an analysis of the risks and hazards that the EP program will address 2. Emergency response plan and procedures: a comprehensive description of how a response will be executed, with accompanying support material 3. Preparedness: the processes to ensure that people, equipment and infrastructure will be ready to execute a response according to the emergency response plan and procedures 4. Program management: the management system aspects that assure the effectiveness of the EP program Licensed organizations with an existing EP program that address other corporate needs are encouraged to use this infrastructure to meet the requirements in this document. Key components and overlapping provisions of an EP program and integrated accident management program are illustrated in Appendix A.	BP-PLAN-00001 (BPNERP) was issued in April of 2014 and takes into account the requirements in G-225, the latter having since been superseded by CNSC REGDOC-2.10.1 - Nuclear Emergency Preparedness and Response. The BPNERP addresses emergency preparedness, response and mitigation requirements. The BPNERP predominantly deals with releases of radioactive materials from fixed facilities. It describes the concepts, structures, roles, and processes needed to implement and maintain Bruce Power's capability to prepare for and to respond to a nuclear radiological emergency. The Plan outlines the command, control, and coordination structure and activities, activation, site integration, external agency coordination, deployment of emergency resources, and emergency facilities through the use Emergency Response Procedures developed to guide effectively trained emergency response staff in emergency response and mitigation techniques.	C
2.1	All licensees shall: 1. establish a planning basis for their EP program 2. ensure the planning basis considers the hazards that have, or could have, an adverse impact on the environment	Sub-clauses 1-3 are addressed as follows: The planning basis for the EP program is established though BP-PROG-08.01, taking an all hazards approach, and is based on a requirement to sustain response without external assistance	Gap

Article No.	Clause Requirement	Assessment	Compliance Category
	and the health and safety of onsite personnel or the public, and also consider: a. all accidents and internal or external events that have been analyzed as having an unacceptable impact on their facilities b. the inclusion of multi-unit accidents scenarios for multi-unit power reactor facilities c. extended loss of power 3. use the results from the planning basis to determine the scope and depth of EP program requirements Additional requirements for licensees of reactor facilities with a thermal capacity greater than 10 MW. These licensees shall: 4. provide regional and provincial offsite authorities with necessary information to allow for effective emergency planning policies and procedures to be established and modified, if needed, periodically Guidance Guidance for all licensees A nuclear emergency may be caused by, or involve, different types of hazards, including natural incidents (e.g., flooding, tornadoes, tsunami, ice or snowstorms, forest fires) and equipment malfunctions (identified within the design basis and beyond design basis). All hazards that cannot be practically eliminated with possible initiating and propagating pathways should be identified within the planning basis. Response to criminal and malicious activity may be dealt with under a separate program.	for a minimum of 72 hours in the event of loss of grid or prolonged ac power outage. Risks are constantly under review through a corporate risk log process. Hazard identification, risk assessment and impact analysis to determine planning requirements are conducted a minimum of every five years, or when deemed by the Emergency Management Oversight Committee or the CNSC. However, SAMG implementation to extend the planning basis to cater to a wider range of multi-unit severe accidents is in progress. This is considered to be a gap. With respect to sub-clause 4, the Bruce Power Nuclear Emergency Response Plan, BP-PLAN-00001, provides off-site authorities the necessary information for effective emergency planning policies and procedures to be established and modified, if needed, periodically.	

Article No.	Clause Requirement	Assessment	Compliance Category
	The planning basis should be based on a full range of postulated scenarios that may challenge the facility's emergency response capabilities. This should include scenarios that involve a nuclear or radiological emergency combined with a conventional emergency, such as an earthquake or forest fire. A detailed analysis may be used to determine scenarios that can be practically eliminated. Plans should be developed for those scenarios that cannot be practically eliminated. Inputs to be considered in the analysis should include: the licensee's safety analysis, probabilistic safety analysis, and operating experience. Additional guidance for licensees of reactor facilities with a thermal capacity greater than 10 MW. The information to be provided to regional and provincial offsite authorities should give all necessary details to make informed decisions on the size of emergency planning zones and the level of preparedness required. The necessary information should include: • possible accidents that cannot be practically eliminated • an estimate of the probability of such accidents occurring • an estimate of the associated radiological consequences, including isotopic release quantities, possible release start time and duration and the geographical area potentially affected Federal authorities would be provided emergency planning information through the CNSC.		
2.2	All licensees shall:	The Bruce Power Nuclear Emergency Response Plan, BP-	C

Article No.	Clause Requirement	Assessment	Compliance Category
	Develop and maintain emergency response (ER) plan(s) with supporting emergency response procedures. The ER plan shall be based on the planning basis as described in section 2.1 of this document. The ER plan shall identify and describe the methods that licensees use to respond to emergencies. This includes, but is not limited to, the following areas: 1. emergency response organization and staffing 2. emergency categorization, activation and notification 3. emergency assessment 4. offsite response organizations interface and support 5. emergency personnel protection 6. emergency response facilities and equipment 7. emergency information and public communications 8. recovery 9. validation of the ER plan and procedures Guidance Guidance for all licensees The ER plan, which may consist of one or several documents, incorporates pertinent information directly or by reference. Plan content can vary to accommodate facility-specific needs and circumstances based on risk. The ER plan may incorporate emergency preparedness and response procedures directly, or it may reference pertinent documents, such as the facility procedures manual(s). If referenced, the documents should be	PLAN-00001, and supporting Emergency Response Procedures, describe the methods Bruce Power uses to respond to an emergency and has the attributes described in the clause requirements.	

Article No.	Clause Requirement	Assessment	Compliance Category
	immediately accessible. Procedures are used to define the necessary steps and/or requirements for various emergency preparedness and response processes and activities. Licensees should also consult RD/GD-99.3, Public Information and Disclosure, concerning public disclosure protocols regarding events and developments at their facilities.		
2.2.1	All licensees shall: In accordance with the ER plan and procedures: 1. establish an emergency response organization (ERO) with a command structure that is clearly defined and integrated 2. define and document the minimum number of staff required to maintain the ERO and their qualifications 3. define the expected reporting times for the ERO to report to the emergency response facility or designated area (see section 2.2.6 of this document) after it has been alerted to respond 4. document the requirement to maintain and retain logs of all actions, orders, and track and update actions throughout the emergency Additional requirements for licensees of reactor facilities with a thermal capacity greater than 10 MW. These licensees shall: 5. define and document how the ERO staffing will be	1. The integrated emergency response organization is described in section 7 of the Bruce Power Nuclear Emergency Response Plan (BP-PLAN-00001) as consisting of two primary components - the duty Shift ERO, the on-call Emergency Management Centre (EMC), to address station and site support. 2. The minimum number of staff, their roles and responsibilities, and communication interfaces is also described in section 7 of the Bruce Power Nuclear Emergency Response Plan (BP-PLAN-00001) (Table 1). Qualifications are addressed in TQD-00005. 3. The shift emergency controller (SEC), the senior authorized person on shift, assumes command and control of the shift ERO on declaration of an emergency, until it is transferred to the Emergency Management Centre Commander (section 4.2.1). The on-call EMC key staff are targeted to assemble within 90 minutes of notification (section 7.2.1.3 of the Bruce Power Nuclear Emergency Response Plan). 4. The requirement to maintain and retain logs is identified in Bruce Power Nuclear Emergency Response Plan under the various organizational descriptions in section 7.2.1.1, and	C

Article No.	Clause Requirement	Assessment	Compliance Category
	maintained and monitored to ensure the minimum shift complement is available at the nuclear facility at all times 6. define and document how licensees will maintain the ERO extended response over multiple shifts Guidance Guidance for all licensees An indication of an effective ERO is the demonstration of clear command and control over the emergency response. It should be clearly understood who is in charge and with whom final decisions and authorities lie. The ERO should be adaptable and flexible, so as to be able to manage an incident as it evolves or as its circumstances change rapidly or abruptly. Procedures should be in place to ensure: • clear roles and responsibilities and authorities of each ERO position • timely and adequate onsite and offsite communication • periodic update and turnover briefings • decisions documented in event logs • effective and clear communication Appropriate arrangements should be identified for shift turnover and provision of food and other amenities for prolonged duty caused by beyond design basis initiating events. Additional guidance on the number of staff required to maintain the ERO and their qualifications can be found in CNSC regulatory document G-323, Ensuring the Presence	7.2.1.4. For the Shift ERO, the Emergency Shift Assistant maintains the SEC log. Within the EMC the Site Ops Logger has this responsibility. 5. BP-PROC-00011, Emergency Response Organization, Staffing, and Availability, provides the process to ensure on-call ERO staff is selected, trained and qualified. On-duty staff is managed through the minimum shift complement process. 6. The Logistics Section Chief is responsible for site logistics, including additional staffing call-ins and shift change coordination (section 7.2.1.4 of the BPNERP).	

Article No.	Clause Requirement	Assessment	Compliance Category
	of Sufficient Qualified Staff at Class I Nuclear Facilities – Minimum Staff Complement. Licensees should also consult G-274, Security Programs for Category I or II Nuclear Material or Certain Nuclear Facilities, for further information regarding security aspects of emergency preparedness and response. Additional guidance for licensees of reactor facilities with a thermal capacity greater than 10 MW. Members of mobile offsite survey teams need not be accounted for as part of the minimum complement for facilities equipped with real-time fixed radiological detection and monitoring capabilities, if the licensee makes provisions for immediate mobilization of offsite survey teams upon activation of the ERO. Licensees should also consult REGDOC-2.12.1, High-Security Sites: Nuclear Response Force.		
2.2.2	All licensees shall: Have an ER plan and procedures that: 1. describe the complete set of conditions that would require activation of the ERO 2. describe how unusual events, incidents and emergencies are to be determined and classified to initiate onsite response; the same notification categories and standard definitions used by offsite authorities shall be used and/or cross-referenced 3. describe the immediate notification process and secondary communication methods to alert all onsite	Each sub-clause is addressed as follows: 1. Conditions for definition of a station emergency and thus activation of the ERO are defined in the Bruce Power Nuclear Emergency Response Plan (BP-PLAN-00001) section 4.2.2.1. In addition, various AIMs (e.g., LOCA, steam line break, MCR uninhabitable), also require the declaration of a station emergency. 2. Section 4.2.2.1 of the Bruce Power Nuclear Emergency Response Plan (BP-PLAN-00001) outlines the use of an emergency tone to classify the station emergency, as well as the Provincial Notification Category (described in Appendix F of the BPNERP) which is based on the	AD

Article No.	Clause Requirement	Assessment	Compliance Category
	personnel, to initiate personnel assembly and accounting, and to activate the ERO and associated emergency response and support facilities 4. define organizational methods, processes, timelines and emergency levels to notify the appropriate personnel and authorities 5. describe all offsite notification requirements and any time requirements that apply, ensuring that: a. the description includes identification of the appropriate positions, by title and agency, of the provincial, territorial and local government agencies b. offsite authorities are notified within 15 minutes of categorizing the event Additional requirement for all Class I facilities: ensure the CNSC is notified within 15 minutes of activation of the ERO. Guidance Guidance for all licensees Criteria that define when the ERO should be activated should be clearly documented. Licensees should follow provincial requirements, or when none exist, use the following categories, listed in order of increasing significance, to categorize various events: • reportable event: an event affecting the nuclear facility that would be of concern to the offsite authorities responsible for public safety • abnormal incident: an abnormal occurrence at the nuclear facility that may have a significant cause and/or may lead to more serious consequences	Provincial Nuclear Emergency response Plan. 3.,4.,5. Section 4.2.2.2 of the BPNERP defines the initial and secondary notification processes. Offsite provincial authorities are notified within 15 minutes after categorization, on a "best effort" basis, followed by municipal agency notifications. The CNSC notification target time is within 30 minutes on a best effort basis, after provincial and municipal agencies. This is considered an acceptable deviation as the CNSC has accepted the BPNERP.	

Article No.	Clause Requirement	Assessment	Compliance Category
	• site area emergency: a serious malfunction that results or may result in an emission at a later time • general emergency: an ongoing atmospheric emission of radioactive material, or one likely within a short time frame, as a result of a more severe accident. While item 5b above requires licensees to notify the offsite authorities within 15 minutes of event categorization, ideally such notification should be done as soon as possible. It is critical that the CNSC and offsite authorities be advised within the identified timeframes. The only acceptable exception to the requirement would be when immediate action was required to prevent a catastrophic incident from occurring.		
2.2.3	All licensees shall: In accordance with ER plans and procedures: 1. describe the methods and procedures to continually assess the emergency and predict both onsite and offsite conditions and parameters 2. continuously take appropriate measures to protect onsite personnel 3. continually characterize the magnitude of the offsite risk to the public and the environment 4. continually provide updates on a regular basis to offsite authorities and the CNSC Additional requirements for licensees of reactor facilities with a thermal capacity greater than 10 MW. These licensees shall: 5. have real-time fixed radiological detection and	1,2,3,4. Section 4.2.2.6 of BP-PLAN-00001 refers to Appendix C implementing procedures (section 7B) which address assessing the emergency and predicting off-site consequences. Section 4.2.2.7 refers to the BERP (Bruce Emergency Response Projection) code (run in parallel by the province) to assess airborne release dose projection estimates. Hourly data is transmitted to off-site authorities by the SEC and the EMC when responsibility is transferred to it (Section 7.2.1 of BP-PLAN-00001). 5. There is no mention of the requirement for real time fixed radiological equipment in BP-PLAN-00001, or referenced documents, DIV-EM-00006, Emergency Off-site Radiological Monitoring Process for Airborne Releases of Radioactive Materials. The requirement for real time fixed radiological detection was identified as a Fukushima Action Item (AI 1307-3793) and has been implemented (see NK21-CORR-00531-11379, NK21-CORR-00531-11644).	Gap

Article No.	Clause Requirement	Assessment	Compliance Category
	monitoring capabilities around the nuclear facility perimeter with appropriate backup power, and shall communicate results to offsite authorities and the CNSC 6. have sufficient capacity and capability for offsite radiological monitoring, including mobile offsite survey teams, and report results to the offsite response authorities and the CNSC 7. promptly and continuously assess and determine source term estimate, plume dispersion and dose modeling, and report results to the offsite authorities and the CNSC 8. promptly and continuously estimate dose to the public based on source term estimation, plume dispersion and dose modeling, and provide the dose estimates to offsite response authorities and the CNSC Guidance Guidance for all licensees Emergency assessment, including categorization, is performed to determine: • the onsite response and staff mobilization required to protect onsite personnel and equipment • the notification category necessary for the provincial or territorial authorities to determine the required offsite response to protect the public and the environment Licensees should describe the methods and procedures for continual assessment of the following pertinent conditions and parameters:	However, processes would need to be revised to incorporate their use. This is considered a gap. 6, 7, 8, are adequately addressed by the shift ERO complement and as needed augmentation, use of survey teams and health physics lab analysis, periodic reporting to off-site agencies, and use of public dose prediction programs (BERP).	

Article No.	Clause Requirement	Assessment	Compliance Category
	• the status, integrity and stability of the affected facilities and their components • identification, quantities, concentrations, or release rates of radiation, contaminants or other hazardous substances • onsite and offsite impacts on or threats to health, safety and the environment • location and direction of radioactive plumes or other emissions • loss of instrumentation Additional guidance for licensees of reactor facilities with a thermal capacity greater than 10 MW. Source term sampling and estimation should be determined and reported to the CNSC on an hourly basis, upon determination and compilation of the data in a format approved by the provincial authority.		
2.2.4	All licensees shall: In accordance with ER plans and procedures: 1. establish plans and procedures to coordinate response activities with appropriate offsite organizations, in the event of an emergency with offsite implications 2. formally document any arrangements or agreements with other organizations or personnel 3. ensure that agreed-upon resources, and the quantity of these resources required to respond to offsite conditions, are available when needed 4. cooperate with and assist offsite organizations with their response activities to address offsite impacts; provide expertise and resources (personnel, emergency response equipment, and material) in support of offsite authorities	1., 2., 3., 4., section 4.1.2.5 of the BP-PLAN-00001 identifies agreement with external agencies. Off-site interfaces for organizations that Bruce Power must interact with are identified in section 4.2.6 of the BP-PLAN-00001. Formal agreements are identified with off-site agencies for firefighting, hospitalization, dose measuring devices installed off-site, specialized services, nuclear liability insurance claims, etc. (section 4.1.2.5). The minimum number of ERO positions and staff are identified in the BP-PLAN-00001. Mutual Aid agreements are identified in the Bruce Power Emergency Management Program (BP-PROG-08.01) 5. There is no mention of the requirement to provide recommendations to off-site authorities on required protective actions in the BPNERP. Note though that BERP is run in parallel with the PEOC by Bruce Power and would	Gap

Article No.	Clause Requirement	Assessment	Compliance Category
	during an emergency; and define the quantity of available resources within their ER plan 5. promptly and regularly provide recommendations to offsite authorities when protective action is required and inform the CNSC 6. establish what data is required and at what frequency, and make provisions to have nuclear facility data, and any other pertinent information that is determined as relevant to the emergency response, regularly transmitted to offsite authorities and the CNSC Additional requirements for licensees of reactor facilities with a thermal capacity greater than 10 MW. These licensees shall: 1. incorporate the provincial or territorial emergency planning zone that is being used for plume exposure and ingestion pathways; the provincial or territorial plans shall be directly referenced 2. collaborate with the municipal or regional authorities to develop and maintain public evacuation time estimates based on current census data, and future population growth projections on a per-decade estimation until end of life of the facility 3. have, at all times, a designated onsite person with the authority and responsibility to categorize a nuclear emergency and to perform the following promptly and without consultation, upon categorization of the emergency: a. initiate an appropriate onsite response b. notify the appropriate offsite authorities c. provide sufficient information for an effective offsite response	thus allow for the basis for recommendations to be made). This is considered a gap. As such, recommendations would need dedicated expertise for Bruce power. 6. Regular flow of information is required by the BP-PLAN-00001 (e.g., section 4.2.6) and implementing document DIV-EM-00006 required hourly reporting. Additional Requirements. 1. The PNEP is identified as a planning basis document and the primary and secondary zones are mentioned in the BP-PLAN-0001 in the context of PNEP responsibility on BP for public education, including brochures about what to do in the event of a nuclear emergency in the Primary Zone (section 4.1.2.4). 2. There is no programmatic requirement for this, however the BPNERP is reviewed by the Province (who has this responsibility), and interface agreement exists with municipal and regional authorities. This is thus considered indirect compliance. 3. At all times either the SEC, or the EMC Commander, fulfill the role of a designated person with the responsibility to declare an emergency and initiate appropriate on-site response, off-site notifications and information. 4. On-site staff are marshalled by the station emergency tone, various communications technologies and fan-outs notifications for ERO augmentation and off-site emergency notifications (section 4.2.2.5 of the BP-PLAN-00001). 5.,6.,7. Per BP-ERP-00001, the SEC has the authority (unless advised otherwise by the EMC commander), to operate EFADS using the nominal strategy to minimize the total activity prior to release. Prior to EFADS operation, notification is provided to PEOC and CNSC, and if	

Article No.	Clause Requirement	Assessment	Compliance Category
	4. provide the designated person with a suitable means of alerting onsite response personnel and notifying the offsite notification point 5. for NPPs, ensure there is a designated person onsite at all times with the authority for venting 6. for NPPs, ensure that offsite authorities and the CNSC are consulted before undertaking any venting activity, unless venting must be performed in an urgent manner to protect the structural integrity of containment; in such a case, every effort shall be made to inform the offsite authorities and the CNSC as early as possible 7. include, in each report to the CNSC and offsite authorities, estimates of when venting will be required 8. notify the province and the CNSC of all abnormal incidents as described in section 2.2.2 Guidance Guidance for all licensees Licensees should identify the jurisdictions, organizations or persons that could be formally involved in emergency preparedness and response activities pertaining to facility emergencies with offsite impacts, and then develop mutual aid and community agreements where appropriate. During an emergency it is critical to have an onsite person with the required authority to order emergency venting if required. However, this authority can be delegated if it is impractical to have a senior emergency officer onsite at all times.	immediate venting is not required, then discussion must take place between the EMC and PEOC. Including the proposed venting strategy and estimated time of venting. When directed by the Province of Ontario, the timing and rate of discharge may be altered. 8. see clause 2.2.2 assessment.	

Article No.	Clause Requirement	Assessment	Compliance Category
	The ER plan should also define a clear and concise strategy for communications between onsite and offsite organizations. All communications, including event data and the decisions made throughout the emergency response, should be documented and recorded. While the licensee is required to provide recommendations to offsite authorities, it is at the discretion of the authorities to accept, reject or modify recommendations. The nuclear emergency response plans for offsite response organizations (those of provinces and municipalities as well as firefighters, emergency medical services personnel and police) should be included with licence application documents for licence renewal and new applications.		
2.2.5	All licensees shall: In accordance with ER plans and procedures: 1. develop and document emergency radiation protection measures that align with their radiation protection program Additional requirements for licensees of reactor facilities with a thermal capacity greater than 10 MW. These licensees shall: 2. have sufficient personal protective equipment (PPE) and provisions to respond to emergencies and protect the emergency responders for the first 72 hours without offsite assistance 3. maintain sufficient PPE and response equipment, calibrated and poised for immediate use in an emergency; the type and amount of PPE and defined emergency response equipment shall be based on criteria for design-	1.,2., 3. Section 4.2.3.6 of the BPNERP identifies the radiation protection measures for emergency responders. This includes assignment of dose limits. In addition, section 4.2.6 identifies the establishment of the Emergency Worker Centre to monitor and control the exposure of external emergency workers who may be required to enter areas affected by radiation. Per BP-PROG-08.01, Bruce Power uses an all hazards approach to the planning that effectively sustains a response without external assistance for a minimum of 72 hours. DIV-EM-00002, Maintenance and Testing of Emergency Preparedness Faculties and equipment, referenced in BP-PLAN-00001 defines the process and frequencies, by which emergency facilities and equipment are periodically inspected, inventoried, operationally checked, and tested in order to support the BPNERP. This includes a list of all	C

Article No.	Clause Requirement	Assessment	Compliance Category
	basis accidents and beyond-design-basis accidents Guidance Additional guidance for licensees of reactor facilities with a thermal capacity greater than 10 MW Licensees should be able to manage the first 72 hours of an emergency response without offsite support, in case outside assistance is unavailable. Remotely located facilities (such as those on northern sites) may experience significant emergency response delays because of effects such as severe weather. In such cases, licensees should demonstrate how their ER plans have accounted for the possibility that offsite assistance may not be available for extended periods of time. Electronic dosimeters should be calibrated, poised and immediately available for designated emergency work. Systems used for maintaining, reading and charging these dosimeters should be in working condition at all times. For battery-operated equipment, sufficient numbers of batteries should be available. Backup facilities and emergency response equipment needed to maintain equipment for electronic dosimeters, radiation instrumentation and laboratory services should be referenced within the ER plan. Emergency protective provisions may include, but are not limited to: • establishing or designating areas for the emergency	location where emergency equipment and supplies are located, and includes off-site survey vehicles.	

Article No.	Clause Requirement	Assessment	Compliance Category
	assembly of site personnel • ensuring that assembly areas are located in areas that can be accessed safely during emergencies • ensuring that there are alternate safe access routes to radiation instrumentation and electronic dosimeters, in addition to assembly areas and PPE during emergencies • accounting for site personnel and all other persons on site (contractors, visitors, etc.); all onsite staff should be able to be accounted for within 30 minutes; accounting should be commensurate with the scale/categorization of the emergency • using dose records to assign specific emergency response tasks • ensuring offsite emergency responders have access to radiation protection assistance from onsite personnel • implementing special administrative measures, such as action levels to control radiation doses • conducting radiation surveys and radioactive contamination monitoring • monitoring and tracking of radiation doses • implementing back-out dose limits and protective actions when emergency action levels are exceeded through pre-set electronic personnel dosimeter alarms • providing search and rescue, decontamination and first aid services • providing dosimetry and any other emergency response equipment, instruments, materials, facilities and services necessary to ensure that onsite and offsite personnel are protected • ensuring appropriate radiological and hazardous substances protection and information are provided to all emergency responders, including those from external		

Article No.	Clause Requirement	Assessment	Compliance Category
	organizations providing onsite support • ensuring that PPE, electronic dosimeters and radiation survey meters / radiation instrumentation are appropriate for their intended use • interfacing with offsite responders (e.g., ambulance attendants and hospital staff) to ensure that pertinent hazardous material and radiological information is provided to medical staff • providing thyroid-blocking agents (potassium iodide pills) when applicable • briefing, tracking, and debriefing the dispatched teams on safety requirements, communication requirements, etc.; emergency response personnel's briefing should include personal safety requirements and a three-way communication strategy • continued verification of the habitability of all emergency response facilities, including monitoring for radiation fields and hazardous materials, where appropriate This document does not address shift turnover. Additional guidance on shift turnover can be found in CNSC Regulatory Document G-323, Ensuring the Presence of Sufficient Qualified Staff at Class I Nuclear Facilities – Minimum Staff Complement.		
2.2.6	All licensees shall In accordance with ER plans and procedures: 1. identify an onsite emergency response facility or designated area to be used as a response location 2. identify essential emergency response equipment, and describe how its operation and effectiveness during	1. Section 4.2.3.5 of the BPNERP requires staff to assemble at designated locations specified in station response procedures. These are defined, for example, in BP-ERP-0018. Accounting for staff is the responsibility of the Assembly Area Supervisor. A list of all station facilities and locations is provided in the Appendix C, section 8.1 of the BPNERP. 2. Emergency response equipment is addressed in DIV-EM-	Gap

Article No.	Clause Requirement	Assessment	Compliance Category
	emergencies are assured; essential emergency response equipment includes equipment required to detect and assess hazards, and communicate response activities 3. identify and have emergency response equipment and materials that are operational and available in sufficient quantities for an extended multi-shift response; they shall also be readily accessible during emergency conditions Additional requirements for licensees of reactor facilities with a thermal capacity greater than 10 MW. These licensees shall: 4. have an emergency response facility (ERF) located onsite, but outside of the protected area; if this cannot be achieved, describe security arrangements to prevent nuisance actors from interfering with emergency response, and provisions for alternate means of communication in the event of a total communications blackout 5. have an emergency response facility located offsite and outside of the plume exposure planning zone 6. ensure that the emergency response facilities will ensure the health and safety of workers in the ERF and ensure the continuity of operations for all emergency situations that cannot be practically eliminated (if this cannot be achieved, then have backup facility with similar capability for each of the onsite and offsite such that the backup facility is unlikely to be effected by an event that would disable the primary; in addition, activation or transfer of operations to the backup facility must be done without disruption to the response operations) 7. provide a workspace with computer, internet access	00002. The planning basis for the BPNERP is 72 hours without off-site assistance. 3. As per 2. above. 4. The EMC is located in the Bruce visitors centre. The back-up location for the EMC is the CESC in Kincardine, with an alternate back-up facility in the B-06 Technical Building. Security arrangements to prevent nuisance actors from interfering with emergency response is not addressed in the BPNERP. This is considered a gap. 5. The CESC is located outside the primary zone (plume exposure planning zone). 6. Assembly areas are surveyed for radiation levels. Evacuation levels for assembly areas are defined in procedures. Back-up locations are identified in the BPNERP for the EMC. In-plant locations are assessed for safety in BP-ERP-00018 and alternatives identified. 7. The BPNERP makes provision in the EMC facility to allow attendance and accommodation of CNSC regulatory staff as independent observers during activation of the ERO (section 7.2.1.4). CNSC staff will be responsible for their own procedures and communications requirements. 8. The BPNERP planning basis is for 72 hours without off-site support. 9. Any layout and design issues would have been identified during drills. 10. Facilities have provision for providing data, to require on-site and off-site facilities per DIV-EM-00002. 11. Bruce Power has no mutual aid and agreements in place solely for the purpose of supporting its Nuclear Emergency Response. 12. Sufficient primary and back-up communication methods	

Article No.	Clause Requirement	Assessment	Compliance Category
	and telephone for a CNSC representative in each ERF; in addition, the CNSC shall be granted access to install an antenna for a satellite phone at each ERF 8. ensure all emergency response facilities have the capacity and capability of sustaining emergency response for a minimum of 72 hours without offsite support 9. ensure the design and layout of emergency response facilities are able to support the emergency response 10. ensure emergency response facilities have provisions in place to provide nuclear facility data 11. pre-arrange memoranda of understanding and/or other priority services agreements required to keep ERFs functional over prolonged periods, and ensure such agreements are documented and either referenced or attached to the ER plan 12. determine and implement methods for communicating with onsite personnel and offsite authorities, including the implementation of at least two levels of backup communications systems; licensee communication links must be compatible with the licensee, province or territory, and the CNSC Guidance Guidance for all licensees Licensees should describe the emergency response services, equipment, supplies and facilities that would be available during emergencies, including, but not limited to the following: • administration facilities	are described in section 4.1.2.2 and 7.2.1.3 of the BPNERP. In addition, as a result of Fukushima Action Item completion [NK21-00531-11379], communications upgrades have been completed, including a radio communications infrastructure and satellite phone capability both at the new EMC and the CMLF. Further enhancements included the installation of a VSAT (Very Small Aperture Terminal) system at the EMC to provide multiple backup phone hubs and internet connectivity. These upgrades address connectivity issues between the EMC and station EOC as well as external agencies.	

Article No.	Clause Requirement	Assessment	Compliance Category
	• technical support centres • control facilities • personnel and public assembly areas • emergency operations coordination centre • centre to integrate onsite activities with offsite programs • first aid and/or medical facilities • laboratory services (fixed or mobile) • decontamination facility • backup power capable of sustaining emergency power to emergency response facilities for a minimum of 72 hours • reference materials, such as current and approved versions of charts, maps, plans, drawings, diagrams, specifications and procedures • essential safety equipment, PPE and other appropriate supplies, such as food and water for a minimum of 72 hours • administrative aids, such as status boards and reference materials • fixed or portable instruments or equipment, as required, to detect, measure, monitor, survey, analyze, record, process, treat, transport, warn, announce, communicate, or assess Additional guidance for licensees of reactor facilities with a thermal capacity greater than 10 MW The CNSC workspace should have appropriate resources (such as computers, information access, internet access and satellite phones) to enable CNSC representatives to perform their functions adequately. The preferred means of ensuring the protection of workers and the continuation of operation is to have hardened		

Article No.	Clause Requirement	Assessment	Compliance Category
	facilities within the primary zone that have: • radiological protection/shielding • adequate ventilation, • contamination control • the ability to withstand design-basis event hazards, such as wind, tornado, snow or ice		
2.2.7	All licensees shall: In accordance with the ER plans and procedures: 1. provide information about the emergency to offsite authorities during the emergency response and recovery phases 2. coordinate with offsite authorities when communicating emergency information to the public Guidance Guidance for all licensees In the emergency plan, licensees should describe the procedures to communicate information about the emergency to offsite authorities during emergencies. These procedures should ensure that emergency information is sent routinely – and as conditions change (either positively or negatively) – to offsite authorities so the information can be disseminated to the public. The information communicated to offsite authorities should include possible radiological and non-radiological hazard(s), including their short-term effects as well as their potential long-term effects on the public, for all emergency scenarios.	1. BPNERP requires a number of information linkages with off-site authorities. The Emergency Management Centre is the primary emergency response interface with the PEOC. Bruce Powers Corporate Emergency Support Centre (CESC) is the primary interface with the CNSC HQEOC (section 4.2.6). Official communication with the Municipal Emergency Operations Centre (MEOC) is through the Bruce power provided liaison officer and the EMC. 2. Bruce Power has representatives on the Municipal EOC and the PEOC to liaise and coordinate with these organizations. Per the BPNERP, until the PEOC and its public communication function, the provincial Emergency Information Centre (EIC) is operational, Bruce power will continue informing the public and media about the emergency. When the EIC is operational, Bruce power will make staff available for comment and media briefings at the EIC request. During recovery phase, communications with the public on the event, causes, impact will continue.	C

Article No.	Clause Requirement	Assessment	Compliance Category
	In the emergency plan, licensees should describe the protocols to ensure coordinated public communications during an emergency. For nuclear power plants, provisions should include consideration of communications strategies and describe the roles and responsibilities of organizations that are responsible for communicating key information to the public		
2.2.8	All licensees shall: In accordance with ER plans and procedures: 1. describe the process to transition from emergency response to recovery after the termination of an emergency, including the requirements to establish a recovery organization and to develop a recovery plan 2. identify, in the recovery plan, the positions/titles, authorities and responsibilities of the individuals who will fill key positions in the recovery organization; this organization shall also include technical personnel with responsibilities to develop, evaluate and direct recovery and reentry operations Guidance Guidance for all licensees A conceptual and strategic recovery plan should be prepared in advance. This can act as the basis for developing the recovery plan after the event has occurred and the emergency phase is complete.	1. As invoked by BP-PROC-00317, The Recovery Director is appointed by the Executive team to oversee a team in recovery operations. A number of additional positions as identified in BP-PROC-00317 support this role. 2. The BPNERP does not specify the process for developing recovery plans. However, per BP-PROG-08.01, recovery plans are identified through BP-PROC-00317, Crisis Management, and the use of business continuity procedures, with oversight provided by the Crisis Management Team. In accordance with this procedure, each business group is responsible for developing and maintaining their own recovery procedures. This is considered to be indirect compliance.	IC

Article No.	Clause Requirement	Assessment	Compliance Category
	The recovery plan should: • identify and describe the resources (personnel, facilities and emergency response equipment) that are to be available for recovery purposes • describe how personnel will be protected when assessing or implementing the recovery program (e.g., personnel protection measures for entry into hazardous areas) • provide for post-accident assessments of the causes, details, impacts and/or consequences of the events • ensure all recovery efforts operate in accordance with the licensee's operating licence requirements Once the emergency phase of an emergency response has ended, workers undertaking recovery operations (such as repairs to plant and buildings, waste disposal or decontamination of the site and surrounding area) are subject to the occupational dose limits listed in the CNSC's Radiation Protection Regulations.		
2.2.9	All licensees shall: 1. validate ER plans and procedures to demonstrate that systems as designed (equipment, procedures and personnel elements) meet performance requirements and support safe operation 2. validate any changes to ER plans or procedures before implementing them, to ensure continued effectiveness 3. unless otherwise specified in the licence conditions handbook, notify the CNSC of changes to ER plans and procedures, and submit the results of the validation to the CNSC as per the terms and conditions of the CNSC licence Guidance	1. ER plans are validated through drills and exercises that are conducted regularly, exercising parts or all of the BPNERP, for different scenarios so as to continually improve processes. 2.,3. DIV-EM-00003, Emergency Preparedness Requirements Management to review whether changes to emergency response procedures, ERO or facilities will require a revision to the NERP, and hence CNSC approval, and if so to ensure the rationale for the change is adequate. However, this document does not strictly address "validation" of the change. Given the context of and means of validation for bullet 1, this is considered indirect compliance.	IC

Article No.	Clause Requirement	Assessment	Compliance Category
	Guidance for all licensees For the purpose of this section, "change" means an action that results in modification to, addition to, or removal from a licensee's ER plan. All changes should be validated to demonstrate that performance requirements are met and to determine if there has been a reduction in effectiveness (i.e., decreased capability to respond to an emergency). A licensee may make changes to its ER plan(s) and procedures without CNSC approval, but only if it performs and retains an analysis that demonstrates that the changes have not reduced the ER plan's effectiveness. This analysis must also demonstrate that plans continue to meet operating licence requirements as well as regulatory requirements. A change to a licensee's ER plan and procedures that reduces the effectiveness of the plan is not to be implemented without prior acceptance by the CNSC. A licensee desiring to make such a change should submit an application for change approval to the CNSC; the request should include the revised ER plan and demonstration of validation. The CNSC will have 30 days to review a change request, after which it will inform the licensee if the change has been accepted. The CNSC is unlikely to permit changes that would decrease an ER plan's effectiveness; however, under special circumstances (e.g., construction or temporary facility modifications), such changes may be approved with specific conditions. Under no circumstances would the CNSC allow a licensee to implement changes		

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	that would compromise safety or lead to unreasonable risk. Minor or administrative modifications to programs or procedures can be reported to the CNSC through established channels such as the Quarterly Operations Report or through formal correspondence.		
2.3	Preparedness consists of activities to ensure that people, equipment and infrastructure will be ready to respond to an emergency, in accordance with the ER plan and procedures.		NA
2.3.1	All licensees shall: In accordance with training and qualification: 1. collaborate with responding offsite agencies to educate them on radiation protection Additional requirements for licensees of reactor facilities with a thermal capacity greater than 10 MW. These licensees shall: 2. develop and submit emergency drill and exercise schedules annually to the CNSC 3. train and qualify all emergency response organizations (EROs) in accordance with the positions to which they have been assigned; educational materials are required to be available for any person who would be responding to the emergency on behalf of an offsite authority, not just the first responders 4. establish requirements for frequency of re-qualification training for all ERO positions Guidance	1. Per the BNPEP, Procedures are in place to allow for the access and the radiation protection requirements of off-site support staff responding to the site. Bruce Power supplies call-in staff to fulfill some technical positions in the PEOC Technical Group and an official liaison position in the PEOC Operations Group. The Liaison Officer with the MEOC will also provide radiation level interpretation and technical background information for the municipal staff. 2. Per BP-PROC-00010, A comprehensive list of drill and exercise objectives is defined and a schedule for conducting drills and exercises is established so that all of the objectives are tested within a set period of time. The schedule is reviewed at least quarterly. The CNSC is included on the distribution list. 3. Per BPNERP, section 4.2.13, TQD-00005, ERO Training and Qualification, describes the program that is used to qualify and train personnel appointed to the ERO. This program was developed using the Systematic Approach to Training (SAT). 4. The Continuing Training frequency for ERO positions is 18 months as specified in TQD-00005, Emergency	C

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	Guidance for all licensees Licensees should provide necessary training to individuals and/or organizational units to assure and demonstrate they are qualified and able to completely fulfill their assigned emergency response roles. The training is intended for any person who would be responding to the emergency on behalf of an offsite authority and is not solely limited to first responders. ERO training may consist of both formal and informal instruction (including workplace and classroom instruction). Licensees can also develop and use online training materials. Emergency drills are an additional option. Typical attributes of an emergency drill include: • limited scope • limited number of personnel • specific equipment • timely feedback • realistic environment An emergency drill typically involves testing a procedural or physical component of the emergency response program. An emergency drill may be conducted as an initial or periodic test, as a supervised training session or as an evaluation of a remedial event. For example, after steps are taken to correct a weakness identified by an emergency exercise, a drill may be held to further evaluate the effectiveness of the remedial measures. Licensees should describe the following:	Response Organization Training and Qualification Description.	

Article No.	Clause Requirement	Assessment	Compliance Category
	• initial and continuing training programs for EROs • ERO staff qualifications • ERO positions for which incumbents will be required to undertake periodic or on-going training • training requirements for contractors and offsite organizations (e.g., firefighters, police personnel, ambulance drivers, hospital staff) that support or participate in onsite activities – insofar as these requirements relate to training that is outside their typical professional duties, but that is required for responding to onsite emergencies; such training could address subjects like access requirements or radiation protection • schedules, procedures and assessment criteria for the conduct of emergency drills and exercises • positions responsible for managing, planning, controlling and evaluating drills Personnel assigned to emergency response roles should demonstrate and maintain their capability to perform assigned tasks at all times. Drills should include the use of all procedures, PPE, response equipment and facilities that could be required during an actual emergency. Requirements and guidance for training systems can be found in REGDOC-2.2.2, Personnel Training.		
2.3.2	All licensees shall: Identify and implement requirements and provisions to assure that the necessary emergency response facilities, equipment, and materials are maintained and in working condition at all times. However, facilities and equipment may be taken out of service for required maintenance if alternate provisions are put in place during these periods.	DIV-EM-00002, Maintenance and Testing of Emergency Preparedness Faculties and equipment, referenced in BP-PLAN-00001 defines the process and frequencies, by which emergency facilities and equipment are periodically inspected, inventoried, operationally checked, and tested in order to support the BPNERP. This includes a list of all location where emergency equipment and supplies are	C

Article No.	Clause Requirement	Assessment	Compliance Category
	Guidance Guidance for all licensees Emergency response facilities, equipment and materials must be in a state of readiness at all times. Accordingly, licensees should implement provisions to ensure that such equipment, facilities and materials are always in working condition. These provisions are to include regular inspection, calibration, testing, and maintenance, or replacement as required, within formal systems of quality control and inventory control and accounting. This criterion includes all required PPE.	located, and includes off-site survey vehicles.	
2.3.3	All licensees shall: 1. test the implementation of their emergency measures Additional requirements for licensees of reactor facilities with a thermal capacity greater than 10 MW. These licensees shall: 1. perform exercises to test the effectiveness of their EP program 2. ensure emergency exercises are based on their planning basis; for multi-unit nuclear reactor facilities, licensees must ensure that multiple-unit emergency exercises are part of their exercise repertoire 3. establish specific objectives for each emergency exercise; the type and number of objectives will depend on the size of the facility and the scope of the exercise 4. design exercise objectives to sufficiently challenge their	1. Section 4.4. of the BPNERP identifies the scope and frequency of drills and exercises, including the planning and design process for scenarios, the process for conducting a drill or exercise and the evaluation process. BP-PROC-00010, Emergency Preparedness Drills and Exercises provide the detailed process. Additional requirements 1. Per BPNERP. 2. The planning basis for the BPNERP covers DBAs, and a multi-unit sustained loss of ac power. Its structure can also cater to the response to BDBAs addressed through SAMGs. Emergency exercises are based on this planning basis. The Huron Challenge IV represented a station loss of Class IV and Class III power exercise. Hence this is assessed as indirect compliance. 3. Per BPNERP. Per BP-PROC-00010, All Drill and Exercise Performance Objectives shall be assessed at	IC

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	capability and capacity to respond to emergencies 5. include provisions in emergency exercise objectives for: a. assessment b. protection of facility personnel c. protection of the public and the environment d. termination of an emergency e. adequacy and conduct of exercises 6. test all requirements listed in this document over a five-year period, with a full-scale integrated emergency testing exercise at least once every three years involving, at a minimum, regional and provincial offsite authorities 7. submit emergency exercise objectives, team organization and scenario development framework to the CNSC at least 20 business days before conducting full-scale emergency exercises (in case of operational requirements and factors beyond licensee control, changes can be made up to the day of the exercise) 8. execute exercises that will meet all stated objectives, demonstrate thorough planning, and identify weaknesses and deficiencies so they can be prioritized and corrected; and provide an overall accurate indication of their emergency response capabilities 9. demonstrate sound organizational and professional execution in the conduct of the exercises by: a. keeping exercise scenarios unknown to the emergency responders before exercises are conducted b. providing timely and realistic data, messages and materials c. having exercise participants demonstrate realistic and professional behavior for simulated actions 10. ensure persons perform their required tasks during exercises as though actual emergency conditions were	each site over a three-year period. A list of performance objectives is provided in Appendix A of BP-PROC-00010. 4. Per BPNERP. 5. Per BP-PROC-00010, termination of an emergency is built into exercise design, and frequency is to be tested once per year. 6. A matrix of performance objectives and their observables and test frequencies is included in Appendix B of BP-PROC-00010. BPNERP and BP-PROC-00010 defines the test frequency for each component or test group. Except for hospital radiological contaminated casualty and local off-site centres, which are per mutual agreement with local jurisdiction, the frequency is every three years or earlier. A full-scale corporate exercise (Shift ERO, EMC, CESC) is performed yearly. (Performance objectives in BP-PROC-00010 are from CNSC NFO-0667, “Recommended Criteria for Evaluation of On-Site Nuclear Power Plant Exercises”, 1997, which has not been updated. 7. The requirement specified in BP-PROC-00010 is for final package to be submitted top CNSC at T= -14 (calendar) days. The yearly schedule is negotiated with external groups per BP-PROC-00010 and the integrated drill schedule is distributed to external groups, including the CNSC. 8. Per BPNERP section 4.4.5, a schedule to address the corrective actions is developed and tracked in the corrective action tracking system. Per BP-PROC-00010, an Exercise Development Team is assembled to assist in developing scenarios, ensuring stated objectives are	

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	present 11. staff and train exercise controllers and evaluators to control and evaluate exercises, and provide them with exercise materials that include: a. instructions about how to conduct exercises b. exercise evaluation criteria 12. provide direction pertaining to existing requirements for safety and security measures adhere to applicable regulations and licence conditions during exercises, ensuring all participants are aware of the actions and interventions that are not permitted while exercises are in progress 13. provide feedback after exercises to improve their overall ability to respond effectively to emergencies 14. prepare self-assessment reports regarding the execution of full-scale emergency exercises; such reports must be submitted to the CNSC 40 days after exercises have been conducted (in exigent circumstances, reports could be delayed to no later than 90 days following the conclusion of exercises) Guidance Additional guidance for licensees of reactor facilities with a thermal capacity greater than 10 MW Emergency exercises test the adequacy of EP programs and the implementation of emergency measures. This includes an evaluation of the adequacy of the procedures and training of the ERO to respond to an emergency. Emergency exercises simulate emergency events and	met, and consider external stakeholder input. 9. BP-PROC-00010 ensures scenarios are validated or walked through by operations technical staff and emphasizes scenario for the exercise is considered confidential information and is not to be divulged to any players. Per BP-PROC-00010, ground rules are sent to all players at T=-7 days. 10. BP-PROC-00010 Appendix C Section 5.2 element 10: “Players are expected to respond as if the emergency event were real. Controllers and evaluators shall instruct players on the appropriate degree of simulation as necessary” 11. Pre-drill and exercise sessions are held with evaluators and controllers per BP-PROC-00010. 12. As part of Pre-drill and exercise sessions are held with evaluators and controllers, ground rules and clear instructions with respect to plant and personnel safety are provided. 13. Per BPNERP, and BP-PROC-00010 requirements. 14. Per BPNERP, and BP-PROC-00010 requirements, exercise reports are issued within 90 days.	

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	conditions over a minimum of several hours, in order to test the integrated performance of the EP program. Emergency exercises simultaneously measure and demonstrate: the preparedness and competence of participants in the specific emergency response roles, the quality of the associated procedures, and the effectiveness of the administrative framework. Exercises designed with a high degree of fidelity ensure that the performance observed could be reasonably expected during an actual event. Deficiencies that are identified during emergency exercises should be rectified as soon as possible, to provide assurance that the ER plan and procedures can and will be implemented successfully in the event of an emergency. Typical attributes of an emergency exercise include: • mobilization of emergency equipment and resources in a realistic environment over an extended period of time • demonstration of inter-agency and other government department cooperation • testing of communication systems and/or public information systems • testing of emergency response facilities and equipment readiness • conduct of the exercise with the minimum complement numbers of staff, in order to demonstrate adequacy of the response • criteria to terminate the exercise that are established ahead of time, in order to ensure that all of the required actions are completed • success criteria that are established during the planning phase, and a corresponding evaluation of performance during the exercise		

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	A full-scale integrated exercise tests the capacity of onsite and offsite agencies to respond to an emergency that results in a release of nuclear substances from the affected unit(s). Full-scale emergency exercises involve, at minimum, several onsite and provincial and regional offsite stakeholders. Larger full-scale exercises can include federal and – where appropriate – international authorities and agencies. Emergency exercises do not always need to be full-scale. For example, tabletop emergency exercises, such as those for notification and communications, may be sufficient to stimulate discussion of various issues regarding a hypothetical emergency. Emergency exercises should not be used as part of a participant's training development. Participation in an exercise is not meant to evaluate an individual's competency, but rather is intended to assess the adequacy of an EP program and its implementation. Coaching and training should not be provided to participants in exercises by controllers or evaluators. Exercises should be conducted in accordance with the minimum requirements of the ER plan. Self-assessment reports should contain the following information: • success and failures of exercise drills • lessons learned • areas for improvement • corrective action plans		
2.3.4	All licensees shall:	BNEP section 4.1.2.4 outlines public education requirements for both emergency preparedness and response.	Gap

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	Incorporate information on public emergency preparedness into their public information program (established as per RD/GD-99.3, Public Information and Disclosure) to ensure information on emergency preparedness and response is communicated to surrounding communities and stakeholders. Additional requirements for licensees of reactor facilities with a thermal capacity greater than 10 MW and with designated offsite emergency planning zones. These licensees shall provide the necessary resources and support to provincial and municipal authorities in implementing the provincial and municipal plans to do the following, or shall do the following: 1. ensure that a sufficient quantity of iodine thyroid-blocking (ITB) agents is pre-distributed, to all residences, businesses and institutions within the designated plume exposure planning zone, together with instructions on their proper administration 2. ensure that a sufficient quantity of ITB agent is pre-stocked and ready for prompt distribution within the designated ingestion control planning zone; this inventory of ITB agents shall be located so that it can be efficiently obtained by, or distributed to, members of the public when required 3. ensure that ITB agents can be obtained by residents of the designated ingestion control planning zone at any time 4. ensure that particular consideration is given to sensitive populations such as children and pregnant women within the designated ingestion control planning zone 5. ensure that the pre-distributed and pre-stocked ITB	1-8, Pre-distribution of ITB agents to the public is not currently a requirement of either Bruce governance or the BPNERP. However, this had been discussed at a Commission Meeting, and is planned to be done by December 31, 2015. This is considered a gap.	

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	agents are maintained within expiry date 6. ensure that the pre-distribution plans are supported by a robust, ongoing, and cyclical public education program 7. ensure that all residences, businesses and institutions within the designated plume exposure planning zone are provided with public emergency preparedness information detailing how they should prepare for a nuclear emergency and what they should do or expect during a nuclear emergency; this information will reinforce the public education program designed to support the pre-distribution of ITB agents 8. ensure that this public emergency preparedness information is readily available to the general public, including online Guidance Guidance for all licensees Licensees may, where possible, leverage existing communication channels (such as those used by local municipalities or those identified in their public information program as per RD/GD-99.3, Public Information and Disclosure). Licensees should periodically assess the adequacy of public emergency preparedness information. Additional guidance for licensees of reactor facilities with a thermal capacity greater than 10 MW		

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	For reactor facilities with a thermal capacity greater than 10 MW and with designated offsite emergency planning zones: The term ITB agent is used generically and includes potassium iodide (KI) tablets. The pre-distribution of ITB agents should be undertaken by representatives of the health and/or emergency management authorities of the province or region/municipality, with support from the licensee. The pre-distribution of ITB agents should be done in a carefully planned and coordinated manner, to ensure that the public receives the appropriate information and education related to the benefits, risks and usage instructions of ITB agents. Pre-stocked ITB agents for the designated ingestion control planning zone should be located to facilitate prompt and efficient distribution during an emergency. Recognizable locations with credible persons within the community (such as fire stations, police stations and pharmacies) should be considered in the selection of pre-stocking locations. Following the completion of pre-distribution activities, periodic reviews with the local populations to assess the adequacy of pre-distribution programs should be performed. The term “designated plume exposure planning zone” is sometimes referred to as “primary zone”, “urgent protective action zone” or “emergency planning zone”. The size of the plume exposure planning zone is determined by the appropriate offsite authorities based on information in the		

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	planning basis and is typically sized in the range of 8 to 16 km. The term “designated ingestion control planning zone” is sometimes referred to as “secondary zone”, “extended planning distance” or “ingestion planning zone”. Appropriate offsite authorities determine the size of the ingestion control planning zone (typically in the range of 50 to 80 km) based on information in the planning basis. To ensure the public have easy access to the required emergency preparedness information, licensees should collaborate with municipalities to provide residents with useful information on how they should prepare, what they should expect and how they should respond to an emergency at the nuclear facility. An emergency preparedness information product should be distributed in hard copy annually to every residence, business and institution within the plume exposure planning zone, and posted on a variety of websites, including those of the licensees, municipalities and provincial EMOs. This should include information on: • how they will be alerted • how they will be notified or informed on what to do • sheltering-in-place instructions • evacuation orders • how/when to take ITB agents, and where to get them if not pre-distributed • contact details for where to obtain additional information, such as websites and social media sites		

Article No.	Clause Requirement	Assessment	Compliance Category
	Licensees may, where possible, leverage existing communication channels (such as those used by local municipalities or those identified in the public information program). In discussion with local authorities, licensees should consider providing public preparedness information with ITB packages when distributing to local populations.		
2.4	All licensees shall: Include, at a minimum, the following elements in their management systems: 1. a written policy statement issued by licensee senior management, committing all units of the organization to the system and its effective implementation 2. a program owner identified with the authority to ensure that resources are given to all aspects of the EP program 3. procedures describing the planned and systematic actions necessary to provide adequate confidence that all specified requirements are satisfied 4. procedures that specify who (position or unit) is to review and update the program on an ongoing basis, and how this is to be done 5. review and update EP program and associated documentation (e.g., response plan, training material, procedures, etc.) at defined intervals to take into account relevant factors, such as operating experience, changing needs or circumstances, and lessons learned from real events Guidance	1. BP-MSM-1, Management System Manual, provides the following policy in regard to emergency preparedness: “Bruce Power shall ensure adequate planning and preparation is in place to deal with any emergency situations that could endanger the safety of site staff, impact on the protection of the environment, and/or impact on the safety of members of the public. Bruce Power shall manage emergencies using an “all hazards” approach, encompassing mitigation, preparedness, response and recovery.” 2. BP-PROG-08.01, Emergency Management Process, is approved by the Chief Legal Officer and Vice President Emergency, Management Division. The Department Manager, Emergency & Protective Services Programs and Integration is the accountable program owner as identified in BP-MSM-1 SHT0001. 3. At a high level, BP-MSM-1 identified the following high level components to managing the business: • Strategic Direction. • Plan - Policy, Program and Process Controls. • Do - Process Management. • Check - Monitoring for Results. • Act - Continuous Learning	C

Article No.	Clause Requirement	Assessment	Compliance Category
	Guidance for all licensees The EP program should be managed as part of a facility's overall management system. A management system is generally defined as a set of interrelated or interacting elements that establish policies and objectives, and that enables those objectives to be achieved safely, efficiently and effectively. The management system brings together the processes needed to satisfy EP program requirements in a planned and integrated manner. The management system's requirements primarily aim to ensure that safety is not compromised, by considering the implications of all actions with regard to safety as a whole. Safety should be the paramount consideration, guiding decisions and actions, in the establishment of a management system. As stated in their licences and licence conditions handbooks, licensees should: • manage their EP programs in accordance with management system requirements • detect and report deficiencies, and ensure all corrective actions are tracked and implemented as per management system requirements	• Leadership and Organizational Accountability BP-PROG-08.01 identifies the planned and systematic actions to ensure all specified requirements are satisfied. These are supported by various implementing processes and procedures. 4,5, The Department Manager, Emergency & Protective Services Programs and Integration is the accountable program owner as identified in BP-MSM-1 SHT0001. Per BP-PROG-08.01 Hazard Identification, risk assessment, impact analysis to determine planning requirements are all conducted at a minimum of every five years or when deemed necessary by the Emergency Management Oversight Committee or CNSC. Program performance assessment is performed per SEC-EPP-00007, Emergency Management Programs Assessment. BP-PROG-01.06, Operating Experience Program, provides methods for Focused Area Self-Assessments and BP-PROG-15.01 provides methods used for program Audits. B-ERP procedures are reviewed every three tears. In addition BP-MSM-1 identifies the VP Regulatory Affairs and nuclear Oversight with providing programmatic governance and oversight of a process that ensures periodic management review of the of the management system. The review will monitor and confirm its effectiveness, adherence to requirements and assess the need for changes to the management system, its principles and scope.	

B.2. CNSC REGDOC-2.3.2, Accident Management

In support of the review tasks listed in Section 5, a detailed assessment of REGDOC-2.3.2 has been performed in Table B2.

Table B2: CNSC REGDOC-2.3.2, Accident Management

Article No.	Clause Requirement	Assessment	Compliance Category
3	This section specifies the requirements for an IAMP. The first subsection sets the goals of accident management. The second subsection gives the general or high-level requirements. Then, specific requirements covering various elements for an IAMP are grouped under the requirements for equipment, procedures, and organizational and human aspects.		NA
3.1	In accordance with the NSCA and associated regulations, the overarching nuclear safety objective is to protect individuals, society, and the environment from harm by establishing and maintaining effective defences against radiological hazards and hazardous substances. When an accident occurs in a nuclear reactor facility, the above objective is achieved by fulfilling the following fundamental safety functions: • control of reactivity • removal of heat from the fuel • confinement of radioactive material • shielding against radiation • control of operational discharges and hazards substances, as well as limitation of accidental releases • monitoring of safety-critical parameters to guide operator actions The specific goals of a comprehensive and effective IAMP	This clause details the high level requirements of an integrated accident management program. The suite of design features, safety analyses, operating manual and AIMs, as well as SAMG and EME guidance and equipment, collectively meet these requirements in a general fashion.	C

Article No.	Clause Requirement	Assessment	Compliance Category
	are to: 1. terminate the progression of the accident as early as possible 2. prevent an accident from leading to severe consequences 3. maintain the integrity of fission product barriers including containment and spent fuel storage 4. minimize the release of radioactive materials into the environment 5. achieve a long-term safe stable state of the reactor core or spent fuel storage To fulfill these high-level requirements, the licensee shall meet all the requirements specified in this section and consider the guidance given in sections 4, 5, 6 and 7.		
3.2	In support of the development, implementation, and validation of an IAMP, licensees shall: 1. develop and implement a reactor-specific IAMP, to ensure that adequate capabilities are maintained to cope with scenarios ranging from AOOs to severe accidents 2. address, to the extent practicable, the initiating events that have the potential to cause extensive infrastructure damage such that offsite resources are not readily available 3. ensure that the IAMP covers all modes of reactor operation including the shutdown state; events that could cause damage to the fuel in a reactor core, in transport to storage, or stored in a spent fuel pool shall be considered 4. identify and document challenges to safety functions and physical barriers and perform safety analysis 5. identify and confirm reactor site capabilities to cope with the challenges to safety functions in performing accident management actions	1, Site specific OMs, AIMs, SAMG Emergency Response Procedures, and EMEG and associated provisions collectively represent a site specific IAMP. This is considered indirect compliance. 2,3, The Bruce Power Emergency Management Program is predicated on an all-hazards approach that does not rely on external resources for 72 hours. (BP-PROC-08.01). Specific OMs and AIMs cover shutdown states and accidents involving the spent fuel bay. 4,5, An on-going program of hazard identification, safety analysis and PRA identifies and analyzes challenges to safety functions and updates relevant documentation. 6. Also part of N286 compliance. AIMs are exercised as part of refresher training. For the nuclear emergency plan,	IC

Article No.	Clause Requirement	Assessment	Compliance Category
	6. conduct periodic reviews, drills and integrated exercises to confirm or improve the effectiveness of the established IAMP 7. ensure that the IAMP interfaces with the emergency preparedness program 8. make accident management provisions, including: a. developing criteria for use in determining what procedures to use b. demonstrating the capability to take actions to protect and inform personnel at the scene c. identifying the roles and responsibilities of the personnel responsible for accident management d. identifying and evaluating reactor systems and features suitable for use during accident management e. providing adequate training to personnel involved in managing an accident	objectives to be tested and minimum frequency of drills and exercise that support the program are specified in the BPNERP (section 4.4). 7. Conditions for definition of a station emergency and thus activation of the ERO are defined in the Bruce Power Nuclear Emergency Response Plan (BP-PLAN-00001) section 4.2.2.1. In addition, various AIMs (e.g., LOCA, steam line break, MCR uninhabitable), also require the declaration of a station emergency. 8. Criteria for which procedures to use are specified in various documentation. For general response to transients, DIV-OPA-00003, Response to Transients – Bruce A, outlines the general strategies, roles, and actions. In addition the BPNERP represents the overview document, supported by various implementing documents, for response to a station emergency. General SAMG strategies are provided by the DFC and the SCST, again supported by various implementing document, including required training.	
3.3	Licensees shall: 1. provide adequate capabilities to preserve the physical barriers for release of radioactivity and to ensure that means are available to: a. control challenges posed by DBAs within appropriate limits b. mitigate consequences of BDBAs c. reduce radiation risks from possible releases of radioactive materials by carrying out accident management actions 2. address the information needs for accident management, by providing adequate instrumentation that is capable of:	1. Capabilities for challenges posed by DBAs (and some BDBAs) are assessed and confirmed within appropriate limits through Safety Analysis documented in the Safety Report, and PRA analysis. EOP, SAMG, and EP actions reduce risks from possible releases of radioactivity. EME guide (NK21-EME-03504.1) addresses some BDBA (loss of Class IV, Class III, and EPS) which includes make-up to reactor units and IFBs. In addition some Fukushima Action Items remain open per NK21-CORR-00531-11379 (e.g., protection of containment integrity, shield tank overpressure protection). This is considered a gap.	Gap

Article No.	Clause Requirement	Assessment	Compliance Category
	a. diagnosing that an accident, including a severe accident, is occurring or has occurred b. obtaining information, as necessary, on key parameters (which may include neutron flux, temperatures, pressures, flows, combustible gas concentrations, and radiation levels) to assess accident conditions and progression c. addressing continuously the state of essential safety functions, including reactor core monitoring, reactivity control, fuel cooling, hydrogen control, and containment d. confirming the effectiveness of the accident management actions 3. demonstrate with reasonable assurance that the equipment and instruments used in severe accident management will survive and perform their intended functions in the ensuing harsh conditions	2., 3., For DBAs, the EQ program EQAs confirm instrumentation survivability to assess the need for and effectiveness of accident management actions. These also be credited for many BDBAs, including severe accidents. This is to be confirmed with site-specific assessments per NK21-CORR-00531-11379. However, a particular area that requires attention is the need for combustible gas concentration measurement during severe accidents. This is considered a gap.	
3.4	Licensees shall: 1. develop, verify and validate accident management procedures and guidelines, including EOPs and SAMGs 2. account for factors specific to the reactor design in the development of SAMGs for severe accidents 3. consider that information available to the operating staff or emergency groups may be incomplete and characterized by significant uncertainties 4. include the following in SAMGs: a. the parameters and their thresholds that define the transition from EOPs to SAMGs b. key parameters to diagnose the state of various reactor and reactor systems throughout the progression of the accident c. actions to be taken to counter the damage mechanisms that would potentially challenge the integrity of the containment, irrespective of predicted frequencies of	1. AIMs are validated by at least two methods during initial issue, and at least one method following significant revisions, per BP-PROC-00250, Abnormal incident Manual (AIM) Management. Validation of SAMG is performed during training and exercises. Large scale exercises, as well as more specific exercises and drills validate the nuclear emergency plan. 2. Generic SAMG are adapted to the reactor design. However, updates to account for multi-unit events, hydrogen management, in-vessel retention, and IFB are in progress (e.g., NK21-CORR-00531-11379).. 3. Instrumentation and equipment survivability assessment to be completed will provide insights into information available to staff (NK21-CORR-00531-11379). These are considered a gap. 4. EOPs include CSP monitoring and initiation of SACRG1 if not restored (i.e., entry into SAMG). SAMG include	Gap

Article No.	Clause Requirement	Assessment	Compliance Category
	occurrence for those damage mechanisms d. indicators that can be used to judge the success of the implemented actions e. the communication protocol to be followed during implementation of accident management f. guidance on dealing with multi-unit damage, uncovered fuel in spent fuel pools, releases of radioactive materials and hydrogen into buildings adjacent to the containment 5. ensure the EOPs and SAMGs consider sufficiently long time periods to initiate and complete required actions, taking into account the human and organizational performance and the possibility of prolonged time required to restore power due to multi-unit damage or large-scale external disturbances 6. include necessary steps into guidelines for events where supplementary equipment (also called emergency mitigating equipment (EME)) and where external supports are required to mitigate the accident consequences 7. provide for transition from the accident management activities to accident recovery	monitoring of parameters in DFCs and SCSTs, specifying need for additional strategies when “setpoints” are exceeded. Communications protocols are defined in the BPNERP when a station emergency is declared, and specific communications protocol for SAMG actions are identified in SACRG-1 and SACRG-2. As per 2, guidance for multi-unit damage, uncovery of spent fuel bay, and hydrogen management are in progress and thus considered a gap. 5. EOPs are subjected to validation which provides assurance they can be executed as written. SAMGs are executed in parallel with EP exercises. 6. Per 4. 7. EOPs include long term monitoring activities which facilitate transition into accident recovery activities. SAMG SAEG-1 addresses monitoring of long term concerns with the implemented SAGs/SCGs. SAEG-2 provides information for the TSG that is used to support plant recovery actions after the conditions for termination of SAMG are met.	
3.5	Licensees shall: 1. establish the organizational infrastructure necessary for implementing IAMPs, which covers aspects such as authority, organization, co-ordination of the response, plans and procedures, training, drills and exercises, human factors, and quality assurance programs. 2. ensure that personnel involved in managing an accident have the necessary information, procedures, and human and materiel resources to carry out effective accident management and mitigation actions 3. clearly define the roles, responsibilities and authorities for the personnel involved in accident management and	1. organization infrastructure consisting of the identified aspects is in place. Human factors issue would surface in drill and exercise results, thus indirect compliance. 2. Ongoing update of SAMG (e.g., per NK21-CORR-00531-11379), and thus considered a gap. 3. roles and responsibilities for responding to transients are defined in DIV-OPA-00003, and BPNERP and supporting documentation. 4. EOC and other assembly areas are established within the plant for station emergencies, see for example, BP-ERP-00018, Assembly Area Supervisor. EMC is established in the visitors centre with alternate areas identified.	Gap

Article No.	Clause Requirement	Assessment	Compliance Category
	ensure coordination among different organizations 4. ensure that the IAMP contains provisions for the setup of emergency response facilities 5. establish and implement initial and continuing training programs for all personnel who are required to respond to accidents in accordance with the principles of a systematic approach to training 6. make sufficient provisions to ensure habitability of facilities required to support human performance during the implementation of the IAMP or provide alternate habitable facilities	5.Training is SAT based, including for ERO staff, per TQD-00005 6. Habitability assessments for BDBA are in progress (e.g., NK21-CORR-00531-11379) and thus considered a gap.	
4	To satisfy the requirements specified in section 3 <u>pertinent to development of an IAMP</u>, the licensee should consider the following guidance.	Sections 4, 5, 6, and 7 provide guidance on how to meet the requirements of section 3. Potential areas for improvement have been highlighted in red.	
4.1	A structured top-down approach (as illustrated in Appendix A) should be used for developing an IAMP. At the top level, the objectives of accident management should be defined according to the level of defence and associated goals that are given in section 3. Challenges to safety functions and physical barriers, together with the associated damage mechanisms and conditions, should be identified, which is referred to as identification of challenges. For each of the identified challenges, suitable and effective measures or provisions should be derived, described, and referenced or documented in procedures or guidelines, and used for training the personnel responsible for executing the measures for managing such an accident, should it occur. The staff responsible for developing the IAMP should have a sufficient level of training and experience regarding accident management in a nuclear facility.	Bruce Power's various programs and measures collectively meet the intent of an IAMP. However, there is no overarching program titled "Integrated Accident management Program." Given the historical basis of the current programs, this is considered an acceptable deviation.	AD
4.2	For setting out an IAMP, the following steps should be	(All of 4.2 clauses) Bruce Power various programs and	Gap

Article No.	Clause Requirement	Assessment	Compliance Category
	taken: • identification of challenges to the reactor safety functions • identification of reactor capabilities • development of strategies and measures to cope with the identified challenges • performance of supporting analyses to evaluate and confirm the adequacy of the strategies and measures developed • development of procedures and guidelines • consideration of other elements such as equipment and instrumentation provisions, organizational responsibilities, and communication interfaces While following the above major steps for establishing an IAMP, the licensee should also consider the following important elements as described in section 4.3: • equipment provisions • role of instrumentation • organizational responsibilities • on-site communication interfaces and external interfaces, if necessary Licensees should also consult REGDOC-2.12.1, High-Security Sites: Nuclear Response Force, and G-274, Security Programs for Category I or II Nuclear Material or Certain Nuclear Facilities for further information regarding security aspects of accident management.	measures, while historically developed, meet the intent of the identified steps for an IAMP. Safety Report analyses, PRA, and hazard analyses identify events and sequences that could be caused by credible failures or malfunctions of SSCs, human errors, common-cause internal and external hazards, and combinations thereof, and are thus considered in the accident management program. This is an on-going assessment, e.g., insights and lessons from Fukushima, and the consideration and practical elimination of BDBA challenges to containment is under constant review. As part of PRA, severe accident analysis is performed for representative sequences, which includes a realistic assessment of mitigating provision capability. As part of SAMG strategy development and FAI follow-up, understanding of severe accident phenomena and reactor-specific physical processes, such as core degradation, in-vessel core debris retention, ex-vessel corium spreading and coolability, molten fuel coolant interaction, molten core concrete interaction, and all known containment challenge mechanisms is included in Technical Basis Documents. Implementation of SAMG improvements identified in COG JP-4426 addresses multi-unit events, in-vessel retention, hydrogen management and IFB. SAMG strategies address multiple approaches to accident management, including preventative and mitigative strategies. In addition EME guidance has been provided to prolong and restore power and heat sinks. However, the guidance identifies various additional considerations: Targeted stress tests; taking into account the effects of accident conditions on equipment, instrumentation, and the personnel who perform the actions; effectiveness of the most suitable or preferable measures for each reactor damage state assessed and documentation	

Article No.	Clause Requirement	Assessment	Compliance Category
		in detail; use of PRA to verify SAMG effectiveness, specification of time periods, and scenarios for training and drills; control of contaminated run-off water to the environment. This is considered as gap-guidance.	
4.2.1	The development of an IAMP should consider postulated initiating events and accident sequences that could be caused by credible failures or malfunctions of SSCs, human errors, common-cause internal and external hazards, and combinations thereof. Challenges that are not considered in the reactor design envelope, but could potentially threaten the integrity of the containment should be practically eliminated; that is, the existing process systems, safety and control systems, complementary design features, available SSCs, and procedural provisions should make the occurrence of these challenges practically impossible. For example, the installed rupture disks or relief valves that provide reliable and sufficient depressurization capability for a reactor core or vessel can eliminate the high-pressure corium ejection phenomenon and thus the possibility of direct containment heating by corium. Among credible events, a selected set of accident sequences that can be used to represent the consequences of each group of accident sequences should be used to obtain insights into the behaviour of the accident and to identify challenges to reactor safety functions. This requires investigating how specific accidents will challenge safety functions and – if safety functions are lost and not restored in due time – how the accident progresses, how the fission product barriers are breached, how long it will take to reach	Covered in clause 4.2	

Article No.	Clause Requirement	Assessment	Compliance Category
	each stage of the accident, and how severe each accident stage will be. In the domain of beyond-design-basis accidents (BDBA), insights into the response of the reactor to BDBAs, including severe accidents, should be obtained. A technical basis for SAM should document the understanding of severe accident phenomena and reactor-specific physical processes, such as core degradation, in-vessel core debris retention, ex-vessel corium spreading and coolability, molten fuel coolant interaction, molten core concrete interaction, and all known containment challenge mechanisms. The technical basis should also include severe accident phenomena in spent fuel bays and multi-unit distress. The technical basis should be updated as necessary to reflect the state-of-the- art knowledge and experimental data obtained from applicable severe accident research programs and lessons learned from the reactors that have experienced severe core damage. The updated knowledge and data should be used to evaluate the reactor ability to cope with accidents and to deduce suitable accident management strategies, provisions, procedures, and guidelines. Reactor-specific beyond-design-basis initiating events, such as events triggered by extreme external hazards (e.g., earthquakes, flooding, and extreme weather conditions), should also be considered to increase the reactor coping capability. The aim is to ensure that a set of sufficient, supplementary onsite equipment and consumables (e.g., fuel and water inventories) are identified, obtained, protected and stored onsite or offsite. These can be used to		

Article No.	Clause Requirement	Assessment	Compliance Category
	maintain or restore the cooling of the core, the containment, and the spent fuel pool following a beyond-design-basis initiating event. After the consumables are used up, offsite resources should be obtained to sustain those cooling functions indefinitely. Accident management should consider that some beyond-design-basis initiating events may result in similar challenges to all units on the site. Challenges for severe accidents and beyond-design-basis initiating events may be identified using a targeted assessment of safety margins against a set of postulated extreme conditions that cause a consequential loss of safety functions leading to severe core damage. Such a reactor-specific “stress test” can be used to determine the time of autonomy of reactor-critical safety functions, any potential weak points, and any cliff-edge effects for a given set of the considered extreme situations. This type of exercise may be used to identify the potential for safety improvements and to provide input to the development of an IAMP.		
4.2.2	Similar to identification of challenges, all reactor capabilities to fulfill the safety functions and to preserve fission product barriers during DBAs or BDBAs should be investigated in terms of capabilities of both SSCs and personnel. Reactor capabilities to cope with BDBAs by the available SSCs including the complementary design features should be identified, including the use of non- dedicated systems, external water sources, temporary connections (hoses, mobile or portable equipment), and offsite hardware and personnel resources. Considerations should also be given to whether failed systems can be restored to service. In	Covered in clause 4.2	

Article No.	Clause Requirement	Assessment	Compliance Category
	addition, an assessment should be made of how operator actions are carried out to mitigate accident consequences. Multiple diverse SAM measures should be provided for significant challenges to containment integrity. Consideration should be given to both the benefit and potential negative impact of using portable or supplementary equipment to cope with beyond–design-basis initiating events. Relevant information including lessons learned from past nuclear accidents as well as data from experimental activities should be considered during the identification of reactor capabilities.		
4.2.3	To ensure that the accident management objectives are achieved, a set of strategies for severe accident prevention and accident mitigation should be developed on the basis of the understanding of accident phenomena and reactor-specific accidents, as well as the considerations of the identified reactor challenges and capabilities. Preventive strategies are needed to preserve safety functions that are important to prevent core damage such as maintaining core cooling and containment integrity. Mitigative strategies are needed to terminate the progression of core damage once it has started, minimize the radiological consequences, and achieve a long-term safe stable state. Reactor damage states, such as damaged fuel, core uncovered and damaged, core debris uncovered leading to failure of the reactor vessel, and movement of the core	Covered in clause 4.2	

Article No.	Clause Requirement	Assessment	Compliance Category
	debris outside the reactor vessel, should be identified based on the reactor parameters monitored and considered in the development of accident management strategies. Suitable strategies that cover each reactor damage state should be developed and prioritized, taking into consideration the evolution of the accident (i.e., the time window for each reactor-specific damage state) and both positive and negative effects. The possibly large uncertainties in identifying such a time window should be taken into account. For each of the strategies developed, all suitable measures or actions should be identified and evaluated, taking into account the effects of accident conditions on equipment, instrumentation, and the personnel who perform the actions. Effectiveness of the most suitable or preferable measures for each reactor damage state should be assessed and documented in detail. The licensee should identify practical preventive and mitigation actions to achieve the accident management objectives. Generally, accident management actions should include: • establishment and maintenance of reactivity control • assurance of availability of heat sink for heat generated in the reactor core • depressurization of the reactor coolant system and steam generators • maintenance of coolant inventory in the primary heat transport system • control of pressure and water inventory in steam		

Article No.	Clause Requirement	Assessment	Compliance Category
	generators • control of pressure and water inventory inside the calandria or reactor vessel • control of pressure and water inventory outside the calandria or reactor vessel • assurance of containment isolation • control of the containment pressure and temperature • control of the concentration of hydrogen and other flammable gases • prevention of unfiltered releases of radioactive products To increase the reactor coping capability against beyond-design-basis initiating events, suitable strategies should be established; for example, use of the installed SSCs for the initial accident management phase, dedicated systems or supplementary equipment stored onsite or offsite for the transition phase during which the installed SSCs are incapacitated, and offsite equipment and resources to maintain or restore fuel and containment cooling functions indefinitely.		
4.2.4	Safety analysis to support an IAMP can be largely based on the existing analysis (e.g., documented in safety reports or probabilistic safety assessment [PSA] documents). Additional analysis, if required, should be performed specifically to address accident management issues. Safety analysis should be used to assist in developing an IAMP by: • formulating the technical basis for identification of reactor challenges and capabilities and development of strategies, measures, procedures and guidelines • demonstrating the acceptability of the identified solutions	Covered in clause 4.2	

Article No.	Clause Requirement	Assessment	Compliance Category
	to support the selected strategies, measures, procedures and guidelines against the established criteria • determining the reference source terms and accident conditions for environmental qualification of equipment for DBAs and survivability/operability assessments of equipment for BDBAs, including severe accidents Safety analysis performed to support SAM should use the best-estimate approach. Uncertainties in the analytical prediction of challenges to fission product barriers should be taken into account if the level of knowledge of important severe accident phenomena and physical processes is low and if the associated supporting experimental data are insufficient. Necessary computational aids should be identified and developed to assist in the overall success of accident management activities performed by the response organization prior to an actual event. These computational aids are typically obtained using simplified assumptions and are often presented graphically. The results of deterministic severe accident analysis should assist the licensee to: • specify the criteria that would indicate the onset of severe core damage • identify the symptoms (i.e., parameters and their values) by which reactor personnel may determine the reactor core condition and state of protective barriers • identify the challenges to fission product boundaries in different reactor states, including shutdown states • evaluate the timing of such challenges to improve the		

Article No.	Clause Requirement	Assessment	Compliance Category
	potential for successful human intervention • identify the reactor systems and materiel resources that may be used for SAM purposes • assess that SAM actions would be effective to counter challenges to protective barriers • evaluate performance of equipment and instrumentation under accident conditions • develop and validate computational aids for SAM For severe accidents, the results of PSA should assist the licensee to: • verify that SAM would be effective for representative severe accident sequences, including multi-unit events, events triggered by natural and human-induced external hazards, and events involving an extended loss of all AC power • provide a basis for assessing safety benefits of potential design enhancement options • identify accident scenarios for personnel training and drill purposes The credited human actions in preparation of the IAMP should be supported with adequate analyses. Considerations should be given to: • the instrumentation to provide clear and unambiguous indication of the need to take action • allowing sufficient time for the operator to detect and diagnose the event, and carry out the required actions • environmental conditions that do not prevent safe completion of the operator action • the required training		
4.2.5	Procedures and guidelines to implement the strategies and	Covered in clause 4.2	

Article No.	Clause Requirement	Assessment	Compliance Category
	measures for accident management should be developed and described in documents such as EOPs and SAMGs, or equivalent documents (see the requirements specified in section 3.4). If EOPs and SAMGs already exist, the IAMP can be built using these existing elements. Any new information on reactor site configuration, changes in hazards, and knowledge gained should be considered, and if appropriate procedures and guidelines should be updated accordingly. The EOPs should contain a set of information, instructions and actions designed to prevent the escalation of an accident, mitigate its consequences and bring the reactor to a safe and stable state. The SAMGs should contain a set of information, instructions and actions designed to mitigate the consequences of a severe accident according to the chosen strategies. Uncertainties may exist both in the reactor status and in the outcome of a selected action. Therefore, SAMGs should propose a range of possible actions and allow for additional evaluation and alternative actions. SAMGs should also address various positive and negative consequences of proposed actions, including the use of equipment, limitations of the equipment, cautions and benefits. The procedures and guidelines should be verified and validated. This should include the usability of the procedures and guidelines (see section 5.2). Clear criteria for EOP to SAMG transition should be defined.		

Article No.	Clause Requirement	Assessment	Compliance Category
	Adequate guidance should be provided in the design of the IAMP to ensure that its event and symptom-based EOP components, or equivalent, are appropriately coordinated among the responsible personnel and that the symptom-based approach is invoked when it is required. Measures, including providing guidelines and training, should be defined to support staff decision- making for situations where an event has progressed to a stage for which procedures have not been defined. EOPs and SAMGs should cover events with multi-unit damage, potential damage to the fuel in spent fuel pools, releases of radioactive materials and hydrogen into buildings adjacent to the containment, and run-off of contaminated water to the environment. The time period that EOPs or SAMGs assume to initiate and complete required actions should reflect potential damage to the reactor. For example, a SAMG may specify a time period required to hook up alternative power and water sources. For external events, the extent of reactor damage and disturbances from outside or at the grid should be taken into account to prolong this time period. Having a diesel back on line may take a whole day or even longer, much more than the time that is assumed sufficient for an intact site area without large disturbances from outside. For beyond-design-basis initiating events, the reactor may require supplementary equipment stored onsite or offsite and external support to mitigate the accident consequences.		

Article No.	Clause Requirement	Assessment	Compliance Category
	These necessary measures should be specified in guidelines for coping with these events.		
4.3	Additional important elements that should be considered in the development of an IAMP include equipment and instrumentation, organizational responsibilities, and communication interfaces.	(All of 4.3 clauses) For non-emergency situation, operating procedure and AIMs effectively meet this guidance. The SAMG, EMEG, and BPNERP and supporting documentation addresses it for severe accident situations and station emergencies. (Note: Assessments for Instrumentation and equipment survivability, and plant habitability are ongoing (e.g., NK21-CORR-00531-11379). This is considered a gap-guidance).	Gap
4.3.1	Reactors should be equipped with hardware provisions (which may include supplementary onsite and offsite equipment) to fulfill the fundamental safety functions (i.e., control of reactivity, removal of heat from the fuel, confinement of radioactive material) as far as reasonable for all accidents considered in the IAMP, including severe accidents. Dedicated systems and complementary design features should be provided to practically eliminate some severe accident phenomena such as core melt at high pressures and hydrogen detonation. All complementary design features and available water sources for removal of decay heat from damaged reactor fuel should be identified in advance and put in place for managing severe accidents, particularly for maintaining the cooling of the core debris and the integrity of the containment. Suitable analysis tools and methods should be used, in conjunction with the existing risk (e.g., based on the identified reactor challenges and capabilities), to aid in decision-making regarding equipment and instrumentation provisions or upgrades for accident management.	Covered in clause 4.3	

Article No.	Clause Requirement	Assessment	Compliance Category
	For the most serious BDBA challenges, such as an extended loss of heat sinks, buildup of a diverse and flexible mitigation capability should be considered. For example, portable or supplementary equipment can provide multiple means of obtaining power and water to support key safety functions for all reactors at a site. BDBAs and severe accidents potentially create harsh environments with high temperature, high pressure, high radiation level, and high concentration of combustible gases. These environmental conditions, which could well exceed those of DBAs used for equipment qualification, present additional challenges to the equipment. The licensee should perform equipment survivability assessments to provide reasonable assurance that equipment used in SAM is available at the time it is called upon to perform. Survivability of the equipment that could be used in SAM should be evaluated through a systematic review and assessment of equipment functions and conditions based on the available knowledge and data, such as from equipment environmental qualification for DBA, severe accident testing and analysis, and engineering judgment. The following steps should be taken: • identification of accident management actions used to mitigate severe accidents • definition of fuel and core damage stage and time period for each accident management action • identification of equipment used to perform each of the actions • determination of the bounding environmental conditions to		

Article No.	Clause Requirement	Assessment	Compliance Category
	the equipment within each time period • demonstration that the equipment will survive to perform its function The habitability of the facilities used in accident management (such as the main control room, the secondary control room, and the emergency response facilities, including a technical support centre) should be assessed and assured, taking into account the environmental conditions (e.g., radiological conditions and other conditions related to lighting, ventilation, temperature and communication) within and surrounding the facilities during an accident. Where necessary, alternate habitable facilities should be provided.		
4.3.2	Adequate instrumentation should be available at each stage of an accident for the monitoring and diagnosis of reactor conditions and for assisting in accident evaluation, accident management decision-making, and action execution. The reactor parameters used in each stage of accident management should be checked and evaluated for their reliability. The preferred method to obtain the necessary information is to use the instrumentation that is qualified for the expected environmental conditions. The effect of environmental conditions on the instrument reading should be estimated and taken into account to produce the procedures and guidelines. Any key instrumentation reading from a non-qualified instrument that is used to diagnose reactor conditions for SAM should have an alternate method, (possibly including computational aids) to compare the reading. Where the risks associated with faulty readings are high under local environmental conditions, consideration	Covered in clause 4.3	

Article No.	Clause Requirement	Assessment	Compliance Category
	should be given to upgrading or replacing the instruments. For scenarios where the required parameters are missing or their measurements are unreliable, the need for development of computational aids to obtain information should be identified, and appropriate computational aids developed in advance. The guidelines for equipment survivability specified in section 4.3.1 for severe accident conditions also apply to reactor instrumentation. A list of instrumentation for each stage of the severe accident should be established. Reasonable assurance should be provided that the instrumentation used to monitor severe accident progression and facilitate accident management actions is available. Harsh environmental conditions, including the effects of hydrogen burn within the containment on cables and electrical containment penetrations, should be also taken into account. Given that during a severe accident the total information flow may be overwhelming and that some of the indications may be contradictory due to failed equipment and instrumentation, the licensee should consider using diagnostic and support tools to help with decision-making for accident management (e.g., computational aids as discussed in section 4.2.4).		
4.3.3	An IAMP should clearly define and document the roles and responsibilities at each stage of an accident, including: • evaluation and recommendation (“evaluators”) • lines of authority (“decision makers”) • implementation of the actions (“implementers”) • transfer of responsibilities and decision-making authority	Covered in clause 4.3	

Article No.	Clause Requirement	Assessment	Compliance Category
	• interfaces with other organizations and authorities The duties of the “evaluators” are to assess the reactor conditions, identify potential actions, evaluate the potential impacts of these actions, and recommend actions to be taken. During the execution of EOPs, both the evaluators and implementers who carry out the approved actions may come from the main control room and field personnel. For SAM, the technical advisory team at the technical support centre should perform evaluations and recommend recovery actions to the decision-making authority. The control room staff should provide input to the evaluations of the technical support centre on the basis of their knowledge of reactor equipment and instrumentation, and their other special skills from their training. The technical support centre personnel should have a good understanding of the underlying severe accident phenomena and reactor-specific accident progression stages. They should have a detailed knowledge of the EOPs and the SAMGs. The team of the technical support centre should communicate extensively with the control room staff. Lines of authority should be clearly defined at each stage of the accident. Where evaluation responsibilities and decision-making authority are transferred from the control room staff to the technical support centre and a higher level of authority, the transition should be made at some specific point in time that poses no additional risk to accident management.		

Article No.	Clause Requirement	Assessment	Compliance Category
	Specifically, the licensee should establish clear roles and responsibilities of the following participants for each stage of an accident. The list includes, but is not limited to: • plant shift supervisors • control room shift supervisors • reactor unit operators • common service operators • field personnel • senior health physicist • emergency response manager • nuclear safety manager • plant manager • technical advisory team The above-listed roles and positions may vary by station; however, if titles vary, the functions should be equivalent. In consideration of beyond-design-basis initiating events, the minimum number of qualified personnel needed for managing the situation should be identified. The effects of extreme weather conditions, seismic events or events that are disruptive to society on the availability of skilled personnel should be considered. Contingency plans should be developed to identify substitutes that could perform the same tasks in case these skilled workers are unavailable. Suitable backups should be pre-defined for key roles in the accident management organization, including potentially the possibility to transfer authority in whole or in part.		
4.3.4	During a severe accident, no single group is likely to have the complete information, knowledge, and skills required to manage the accident. It is therefore important to establish	Covered in clause 4.3	

Article No.	Clause Requirement	Assessment	Compliance Category
	effective onsite communication interfaces among groups including the emergency response teams as specified in REGDOC-2.10.1, Nuclear Emergency Preparedness and Response. These interfaces will enable efficient integration of the information and expertise available within the operating and supporting organizations or from other involved authorities. The impact of beyond-design-basis initiating events on communication should be considered. It may be prudent in some DBA conditions to inform offsite authorities; provisions should be made for reliable communication among different accident management and emergency response organizations. Conditions include extreme situations such as widespread onsite and offsite damage caused by severe weather conditions, flooding or earthquake. Measures should be taken to ensure the effectiveness of the emergency communication systems, including regular practice in their use. Licensees should also consult RD/GD-99.3, Public Information and Disclosure concerning public disclosure protocols regarding events and developments at their facilities.		
5	To satisfy the requirements specified in section 3 pertinent to the implementation of an IAMP, the licensee should consider the guidance given in this section. Implementation of an IAMP should consider, but not be limited to: • integration of procedures, guidelines, and arrangements to ensure that interfacing issues are addressed and that all	(All of section 5) The elements of an integrated accident management program are integrated in the sense that it is clear which procedure or guide is to be used under a give situation, with appropriate interfaces. These are verified through various approaches, depending on their use. Organizational authorities are defined for all categories of events. The required number of staff are defined based on the need to execute the accident management program	C

Article No.	Clause Requirement	Assessment	Compliance Category
	IAMP components are put in place to meet the goals of accident management • verification of the procedures and guidelines to ensure that they work as intended • consideration of human factors and human-machine interface issues to ensure that the required accident management actions can be implemented as intended and in a timely manner • organizational aspects to ensure that the defined responsibility matrix is consistent with the qualifications and expertise of the staff and with other authorities and supporting organizations • personnel training to ensure that a suitable training plan is executed to implement the IAMP	elements. Training for all staff involved in accident management follows a SAT approach. Exercises and drills are defined and evaluated and used to improve the program. Simulators are used according to the event being trained. Evaluators are used to assess performance and obtain feedback.	
5.1	Licensees should integrate the established procedures, guidelines, and arrangements including equipment and personnel resources to implement the reactor-specific IAMP. EOP to SAMG transition and the associated issues including roles and responsibilities, equipment performance, and potential instrument errors under accident conditions should be identified and addressed. The implementation stage may identify necessary changes in certain aspects of the IAMP. The onsite and offsite emergency response plans and procedures should be reviewed with respect to the accident management actions, to ensure that conflicts do not exist. Hardware arrangements, including temporary and supplementary equipment, should be checked for their operability and usability under accident conditions.	Covered in clause 5	

Article No.	Clause Requirement	Assessment	Compliance Category
5.2	The overall process of verification and validation should be formally documented. The level of documentation required will depend upon the complexity of issues addressed and the potential impact on safety. The objectives of the verification and validation of accident management procedures and guidelines are to: • demonstrate that procedures and guidelines achieve the goals for which they were developed • confirm their usability (in terms of being easily understood and followed by their users) • verify technical accuracy (meaning identification of the correct equipment and line-ups) • assure completeness of scope (that is, to provide adequate guidance for all expected activities) • confirm that all specified actions are reasonable (i.e., consider possible challenges and threats to the personnel) and identify alternatives, where appropriate.	Covered in clause 5	
5.3	Safe and reliable human and organizational performance is an essential part of IAMP. Such performance under emergency situations should be taken into account during the implementation of the IAMP to meet the expectations specified in regulatory guides G-276, Human Factors Engineering Program Plans [12], and G-323, Ensuring the Presence of Sufficient Qualified Staff at Class I Nuclear Facilities – Minimum Staff Complement [13]. Field operator performance and human-machine interface issues under hazardous environments and conditions should be identified and considered during the execution of SAMG actions. SAM may require sufficient qualified personnel that are not part of the normal minimum staff complement.	Covered in clause 5	

Article No.	Clause Requirement	Assessment	Compliance Category
	Sufficient verification and validation of all aspects of human and organizational performance, including EOPs and SAMGs, to execute all the identified accident management actions should be conducted to clearly demonstrate that they can be carried out by reactor personnel under all types of conditions covered by the IAMP. The IAMP should incorporate measures to ensure that the personnel are ready to carry out the appropriate roles and responsibilities. For example, certain accident events may cause damage to the facilities (e.g., the technical support centre) and provisions should be made to ensure the habitability of the facilities or an alternative is available. Improvement of the IAMP should be achieved through the consideration and incorporation of relevant results from well-supported research in human performance, including decision-making. EOP implementation primarily involves the operations organization, with support from other organizations as needed. SAMG implementation has wider organizational implications, which require careful considerations in terms of roles and responsibilities, personnel qualification, and interfaces with the technical support centre and the emergency response centre (see section 4.3.3). Appropriate arrangements should be identified for shift turnover and provision of food and other amenities for prolonged duty caused by beyond-design-basis initiating events.		

Article No.	Clause Requirement	Assessment	Compliance Category
	Consideration should be given to the fact that reactor staff may be concerned about family and friends following a beyond-design-basis initiating event and may be under extremely high stress while executing accident management actions. For certain situations, it may be impossible to increase or replace staff for a given time. Measures should be taken to address all of these situations.		
5.4	Appropriate levels of training should be provided to the operating personnel and responsible organizations to ensure their competency in using all instructions and actions specified in EOPs, and their knowledge of the information required to identify events and accidents that are beyond the design basis and of the guidelines specified in SAMGs. Training should be commensurate with every personnel's respective roles in the case of an accident, enabling them to: • understand their roles and responsibilities within the IAMP • learn about accident phenomena and processes • become familiar with the activities to be carried out • enhance their ability to perform in stressful conditions • verify the effectiveness and improve the clarity of procedures and guidelines The licensee should establish qualification, training, deployment, and staffing numbers for the various organizational groups involved in accident management. Training programs should address the roles to be performed by the different groups, and include drills and exercises to enable assessment of the interactions between the various groups involved in IAMP. A set of drills should be developed	Covered in clause 5	

Article No.	Clause Requirement	Assessment	Compliance Category
	to cover multi-unit events and external events. The purpose of conducting regular drills and integrated exercises is to confirm and maintain that each of the essential elements related to procedures, equipment and personnel of the IAMP has a high degree of assurance of effectiveness, should an accident occur. While there are potential limitations to the use of simulators for BDBA, the licensee should use simulator training, as appropriate, because it provides a realistic and interactive environment, and is an efficient method for enhancing human response in complex situations. Where simulator training is not used, other means to address the human response/ human and organizational performance aspects should be implemented. Licensees should also consult REGDOC-2.2.2, Personnel Training for information concerning requirements and guidance for training systems.		
6	To satisfy the requirements specified in section 3 pertinent to validation of an IAMP, the licensee should consider the guidance given in this section. The first step of validating an IAMP is to review the program to assess its completeness and adequacy. The review also gives an opportunity to identify specific areas in the IAMP that need improvement to enhance reactor capabilities to cope with an accident. The adequacy of the SSCs and human/materiel resources that are required to complete IAMP actions should be assessed.	(All of 6) Review mechanisms are provided from OPEX, audits and assessments, including self-assessments and independents audits. In addition periodic reviews of safety analysis, and risks are performed. The recent COG JP4426 provided an opportunity to review the SAMG program in light of experience and recent developments. As a result further studies (e.g., instrument and equipment survivability assessments, in-vessel retention and containment protection strategies, plant habitability assessments, and EMEG are being implemented).	C

Article No.	Clause Requirement	Assessment	Compliance Category
	To ensure the continued effectiveness of the IAMP, the licensee should have a procedural mechanism (see requirement 6 in section 3.2) by which its components are continuously reviewed to ensure that the technical basis remains sound and current, and that station staff can carry them out effectively. Where the review indicates that improvements are required, the IAMP should be revised promptly to incorporate those improvements.		
6.1	Review of an IAMP before its implementation is intended to check its quality, consistency and completeness. Review of IAMP after its implementation is to evaluate its adequacy, effectiveness, and any needs for updating and strengthening. The review includes self-assessments and independent reviews. It is necessary to review and evaluate the effectiveness of the IAMP periodically to ensure it reflects modern requirements, reflects lessons from drills and exercises, incorporates knowledge gained from any new information and experimental data, and includes any changes in personnel, reactor equipment and instrumentation conditions, and training needs. The review should cover all the aspects of the preparation, development, implementation, and documentation of the IAMP, including: • review that the selection and scope of the IAMP meet requirements • review of the technical basis on the understanding of reactor-specific accident progression (reactor damage states), phenomena, and challenges, and on the state-of-the-art knowledge and data to tackle those challenges	Covered in clause 6	

Article No.	Clause Requirement	Assessment	Compliance Category
	• assessment of whether the identified reactor challenges and capabilities realistically address reactor design and conditions • assessment of whether the identified supplementary equipment for coping with beyond- design- basis initiating events is sufficient and properly protected, proceduralized, and maintained • evaluation of whether the identified strategies and measures are adequate for achieving the established IAMP objectives • review of the supporting accident analysis including computational aids for IAMP • evaluation of reactor equipment performance • evaluation of reactor instrumentation performance for accident management monitoring • verification and validation of the procedures and guidelines to ensure their overall quality and usability • check of the interface between the IAMP and the emergency preparedness program • review of responsibility allocation, staffing, personnel qualification, training needs, and performance • review of IAMP documentation and revisions In addition, completeness of the provisions important for implementing an IAMP should be reviewed in relation to the basic safety principles and IAMP requirements specified in section 3. All the identified provisions should be reviewed to evaluate whether they exist and can be successfully implemented. The review should also identify if additional provisions are required to strengthen the ability of the reactor staff to manage an accident, including a severe accident, or evaluate if an absence of a provision leads to		

Article No.	Clause Requirement	Assessment	Compliance Category
	the weakness in defence in depth.		
6.2	Reactor design capabilities for accident management, such as containment venting, hydrogen mitigation, and coolant make-up provisions should be identified and their effectiveness should be evaluated. For all systems and equipment that are expected to perform in a way or under conditions that were not considered in their original design, the licensee should conduct an assessment of their potential availability, effectiveness, and limitations for use in support of an IAMP. Existing systems may warrant design enhancement if the assessment reveals that the potential consequences of severe accidents are such that the existing systems may not provide the desired preventive and mitigating capabilities. Essential reactor monitoring features and instrumentation for diagnosing reactor state should be identified and assessed for severe accident conditions, and reasonable assurance should be provided that they will function reliably and provide meaningful data. The validation of an IAMP should also include an assessment of the adequacy and sufficiency of supplementary equipment and consumables (fuel and water inventories) used to maintain or restore nuclear fuel and containment cooling for coping with beyond-design-basis initiating events.	Covered in clause 6	
6.3	The licensee should perform an assessment to determine the availability of coolant, energy, and other materiel resources that may be required for the effective completion of accident management actions.	Covered in clause 6	

Article No.	Clause Requirement	Assessment	Compliance Category
	For procurement of external resources (e.g., equipment, power, water and personnel), the licensee should assess the adequacy of arrangements with other organizations to ensure availability, timing and access to these resources during accidents, with consideration of potential challenges posed by common cause and/or external events. These arrangements should be formalized and documented.		
7	To satisfy the requirements specified in section 3 pertinent to documentation of an IAMP, the licensee should consider the following guidance. All aspects of an IAMP should be described, typically by a suite of IAMP documents consisting of manuals, procedures, guidelines together with their technical basis and supporting safety analysis reports for justifications, explanations, verification and validation. There are also many other related documents such as description of the reactor physical protection, PSA studies, equipment and instrumentation survivability assessments, and reactor "stress test" reports as appropriate. At a minimum, the licensee should provide the following documented information about an IAMP: • sample bullet list item • goals and principles used for development and implementation of the IAMP • technical basis and results of probabilistic and deterministic analyses conducted in support of the IAMP • EOPs and SAMGs • performance capabilities for the systems and equipment that are used in support of accident management	The documentation attributes of an IAMP are met for individual elements. However, an overarching "IAMP" document does not exist. Given the historical basis of the current programs, this is considered an acceptable deviation.	AD

Article No.	Clause Requirement	Assessment	Compliance Category
	procedures and actions • responsibilities of persons and organizations involved in the IAMP, including requirements and plans for personnel training • results of the IAMP validation and reviews The technical basis documents provide technical information important to an IAMP. They can build on or provide a cross-reference to the existing technical descriptions. They should include, but not be limited to: • justification of accident selection and coverage of the IAMP, including a general description of reactor response to accidents • distinct stages of an accident progression if no accident management actions are credited • understanding of the relevant phenomena and the associated physical processes, including challenges to fission product barriers and the associated mechanisms and conditions • state of the current knowledge of the phenomena, including current predictive capabilities for modeling the phenomena and physical processes and relevant analytical and experimental supports • any other aspects or special topics important to EOP and SAMG development and verification Reviews and revisions of the IAMP documents should be tracked and controlled.		